Final Report TLQIS Project

An Evaluation of a Pilot Programme involving Innovative Teaching Methods in Engineering Programmes

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Summary

This report summarises the work done on a TLQIS project for which funds were allocated in 2003 for work which was completed in 2004. However as the project has underpinned a number of further developments which have since been implemented across a number of engineering modules these are also included in this report. The chronology of these developments (some of which are referred to in more detail in this report) is as follows:

1 TLQIS award 2003-4. Work done on developing materials for Fluid Mechanics and the project evaluation undertaken described in Appendix 2. Work completed 2004
2 2005- Introduction of on-line assessments in Blackboard for level 1 modules with marks contributing to module assessment.
3 2006- Extension of assessments to level 2 module

In parallel with the developments listed the teaching materials used, for each module, have been enhanced and improved and all made available to students through Blackboard. These materials include the lectures with a sound commentary recorded in Speechi.

An interactive teaching style has evolved in which learning technologies have been deployed. This has included significant use of the Interwrite **P**ersonal **R**esponse **S**ystem (PRS) which enables students to answer questions in-class with the lecturer getting instant feedback on their performance and also the use of Interactive Whiteboard technology which gives back spontaneity to lectures delivered through PowerPoint.

1 Introduction

1.1 The Initial Bid for TLQIS Funding

The wide mathematical ability range of the intake to Engineering programmes presents a particular problem for those teaching engineering topics for which mathematics is the key. Whilst some students can take in concepts readily others need more time to absorb principles and need to go over material more than once. In our intense 12 week modular teaching periods this need is not easily satisfied against the requirements of covering the whole syllabus on schedule.

A number of teaching innovations have been implemented during Semester 1 of the academic 2003-4 year designed to meet this need and to engage student learning and this bid to the TLQIS fund is principally focused on an evaluation of the feedback from the pilot programme which has been used in two modules. These modules are

1 Engineering Thermodynamics E1.1 taught to level 1 students
2 Aerofluid Mechanics E2.1 taught to level 2 students.

For each of these modules the students cohorts involved are those students registered on the BEng and MEng programmes in Aeronautical Engineering and Mechanical Engineering (Aerospace).

1.2 Teaching Innovation(s)

The main changes that have been adopted are:

1 All lectures have been presented using MS PowerPoint rather than using an overhead projector with black and white transparencies. This change has allowed the full use of colour in presentations and permitted the use of animation and transition effects. This enables complicated theory and equations to be built up systematically and initial findings suggest that the students find this approach beneficial.

2 Again harnessing the facilities of MS PowerPoint each lecture has been produced as a self running presentation with recorded sound; it has been possible to do this whilst combining manageable file sizes with good quality sound since in Office XP it is possible to embed sound files in .MP3 format (compressed sound). Thus typically for each lecture a self-running presentation of about 20 minutes in length underpins the basic theory and concepts. In this form any student who wishes to go over the material again can do so in their own time. These lectures have been made available on CD but work is in hand to allow students to access them on the Web through a VLE.

3 In parallel with this the PRS (Personal Response System) produced by Educue has been employed here students answer multiple choice questions 'live' using personal hand-held units (similar to TV remotes). Their responses are then fired directly into a transmitter connected to the lap-top being used to run the PowerPoint presentations. At the end of a preset time period it is possible to get the instantaneous feedback of knowing who answered, who got it right or wrong and to go over those topics in which there was clearly a misunderstanding. Initial findings suggest that students have engaged well with this technology and enjoy the challenges presented with enhanced learning as a result.

4 For each module a Blackboard site has been generated through which it is possible to maintain easy contact between lecturer and student. The layout of the Blackboard sites is illustrated in Appendix 6 with each containing all teaching materials, the lectures in silent and voice-over form, tutorials (with solutions provided later) and examination questions with solutions provided near to revision time. An analysis of student usage of Blackboard has been systematically done.

5 On a number of occasions throughout the semester students have been asked to fill in evaluation sheets and been able to make suggestions for further improvements.

The original bid is included in its entirety as appendix 1 of this report.

1.3 Purpose of the Bid

The bid to the TLQIS fund would be for support in analysing the body of feedback so far obtained and to provide some assistance in continuing the pilot programme into Semester 2 on two further modules.

1.4 Estimate of Costs

Temporary assistance in evaluating student feedback and learning styles data	£2500
Temporary assistance in the conversion of material from MS Word to PowerPoint	£2500

2 Undertaking the Project

As explained in the bid proposal (see appendix 1) work had already started on conversion of lecture material to PowerPoint for two modules taught in Semester 1. The funding requested as part of the TLQIS bid was to partly support conversion of a semester 2 module Fluid Mechanics E1.2 and to fund an evaluation of the effectiveness of the approach adopted.

The project evaluation was undertaken by Catherine McGlynn from ESPACH and the support for conversion of materials from Sword to PowerPoint came from Mr Fawei Geng a contract researcher working within the then School of Acoustics and Electronic Engineering. The final cost breakdown between the two elements was £1500 for development of materials and £3000 for the evaluation study, with a total TLQIS funding of £4500.

3 The Evaluation

As part of the evaluation of the project undertaken by Ms Glynn analysed the entry qualifications, attendance pattern and the results of Learning Styles Questionnaires completed by the students. She also analysed a number of regular short questionnaires which were handed out to students at the end of lectures. She also observed a number of lectures and had the opportunity to interview the students when she attended the lecture sessions. She produced her own final report of the project and this is appended here in its entirety as Appendix 2.

The short questionnaires asked the following questions:

1. Please write down one important point you have learned from this lecture.
2. Please indicate those points you found unclear.
3. (a) Please give your view of the presentation given.
   (b) What might have made it better?
4. Do you think that you would benefit from going over the material again?

Sample Responses from Level 2 Aerofluid Students to the Short Questionnaire (28/10/2002) for Lecture 5

Question 1	Question 2	Question 3	Question 4
Flow direction and vortices	Derivation of formulae	Very good	Yes
Where aerofoil data has come from	Maths	Clear, good	Yes will look on Blackboard
Kutta Joukowski Theorem	Maths		Yes
	Maths	Very Good	Yes
Stagnation points on a cylinder, lift.	Kelvin's Circulation Theorem		Yes
The Spinning Cylinder	Formulae	Good, clear	No
Kutta-Joukowski Theorem	Locating stagnation points	Clear, easy to follow	Yes
Kutta Joukowski Theorem		Very Good	Yes
Flow past a circular cylinder link to aerofoil sections	None	Very Good	Yes
Spinning Cylinder		O.K	Yes
Kutta-Joukowski Theorem	Derivations	Very Good	No
Mathematical reasoning behind lift on a cylinder		Good but could'nt see all the screen	
Lots of useful things about rotating cylinders	Some of the diagrams		Yes would benefit but will manage without.
Vortex flows and stagnation points on a cylinder	Most of it	Clear easy to follow	Yes- nearer to the exam
Vortex flows	Most things	Easy to follow	Yes
Vortex Kelvin's Circulation theorem			Yes
Kutta Joukowski Theorem		Good	Yes
Circular cylinder with rotation	The Maths	Good	No

Sample Responses from Engineering Thermodynamics E1.1 Lecture 1

Question 1	Question 2	Question 3	Question 4
Meanings and examples of open/closed systems	None	Very good, colour and graphics indicate points clearly.	No
Importance of using and the difference between closed and open systems	None	Sometimes difficult to read.	
Pressure	None	Visual effects keep the eyes open	Yes but through the notes
Recapping material		o.k	
How to find the pressure	None	Excellent	Bullet points for revision
	Equations relating to manometers	Very clear, PowerPoint made it more interesting and lecture flowed more readily	Yes –my understand more when I've looked at it again
	Found the questions at the end hard	Presentation good, colour and graphics kept up the interest	Possibly
Definition of systems	None	Good	Yes
Absolute pressure		Presentation easy to understand	Yes
Absolute and gauge pressure	Nothing	Nice change looks more interesting so helps you concentrate	Yes
Absolute pressure		Easy to read and understand	Possibly
Pascal's Principle	Specific gravity	More interesting than your average presentation, Good use of Powerpoint.	Yes
Atmospheric pressure	As a new subject a lot was unclear but am willing to learn	Very good	Yes
		Presentation is better and I like the question system	Yes
Pascal's Principle	Gauge/absolute pressure	Good	Yes
Open/closed systems	None	Presentation very clear. Lesson well planned, graphics useful	No
Difference between closed and open systems	None	Clear, easy to understand	Read the notes

The PowerPoint handouts for these lectures are included in 3 a,b. When delivered the presentations included colour and animation effects and for the Engineering Thermodynamics lectures each lecture had a set of questions which students answered using the Educue (now Interwrite) PRS system. (Over the time this project has been running the PRS system has been developed so that the hand held units used by students connect through a radio frequency receiver which connects to a USB port on the lecturer's computer. This development widens scope for the use of this technology considerably as nothing needs installation in the lecture room at all).

In general the move to PowerPoint did seem to engage the interest of the students but as is clear from Appendix 3b the students have a lot to absorb in what is only a 50 minute lecture slot.

Throughout semester 1 of the 2003-4 academic years the PowerPoint lectures were in place and some of the lectures were supported by recorded sound versions as well. During the course of semester 1 a means of packaging the presentations so that they could be accessed by students

through Blackboard was identified. This consisted of first recording the sound files to support individual PowerPoint slides, timing the slide transitions and animations to fit in with the commentary and then using Ms Producer packaging the files so that they could be placed on the World Wide Web. Once this had been achieved it was possible to link to the presentation in Blackboard and students accessing Blackboard could pick up the presentations with sound as well as a Silent version of the presentations.

Packaging the presentations in this way had the advantage that the student did not need to listen to an entire lecture. As long as the PowerPoint slides had a slide title on them the titles appeared as list on the LHS of the Producer screen and a student could just hop to the part of the lecture they wished to go over rather than listen to the entire thing. The ability to do this enabled the students to go over areas of particular difficulty as many times as they needed. An example of this is shown in Appendix 4 alb.

By the end of semester 1 all of the sound files for Engineering Thermodynamics E1.1 and Aero fluids E2.1 were in place and the recorded lectures were available for students as a revision aid. However there was insufficient time to prepare the sound files for Fluid Mechanics E1.2 as it took semester 1 for the PowerPoint lectures to be produced as part of the TLQIS project. The sound files for this module were produced over the summer vacation of 2004-5 ready for use by the start of the next academic year.

The results of the University's Evaluative Questionnaire Summary for the Two Level 1 Modules are summed up here. The questions posed are:

Question 1 Overall, how satisfied are you with this module?
Question 2 I would recommend this module to a friend who was interested in the course

Summary Results for Engineering Thermodynamics E1.1
Students on programme 35 questionnaires returned 26

	Extremely Satisfied	Very Satisfied	Satisfied	Neither Satisfied or Dissatisfied	Dissatisfied	Very Dissatisfied	Extremely Dissatisfied
Question 1		5	8	5	5	1	0
Question 2		2	12	6	3	0	1

Students are also asked to list their likes and dislikes about the module:

Likes	Dislikes
PowerPoint presentations (10) The PRS system (8) Good notes (7) Use of Blackboard(4) Range of teaching methods Tutorials (5) Laboratory Classes(6) Feedback forms (2) Good examples	PowerPoint (3) PRS System (4) The Notes (2) Hard topic(2) Too many formulae (2) Occasional computer problems Lack of spontaneity (2)

Summary Results for Aerofluid Dynamics E2.1
Students on programme 38 questionnaires returned 27.

	Extremely Satisfied	Very Satisfied	Satisfied	Neither Satisfied or Dissatisfied	Dissatisfied	Very Dissatisfied	Extremely Dissatisfied
Question 1		4	14	8	1	0	0
Question 2	1	4	8	8	2	1	3

Students are also asked to list their likes and dislikes about the module:

Likes	Dislikes
PowerPoint presentations (12) PRS System (2) Clear presentations (2) Good notes (4) Use of Blackboard(2) Tutorials (2) Laboratory Classes(6) Feedback forms (2) Good examples	Topic hard (7) Volume of material (4) Maths content 4) Lab scheduling (2)

Given the radical shift in teaching methods used and that this was the first year this had been operated the results of both sets of questionnaires were seen to be encouraging. It was however clear that particularly for the PRS system some students did not like to be identified or asked to answer questions. The problem was sorted in semester 2 since the Fluid Mechanics E1.2 module was taught to a cohort of 70 students and only 50 units were available instead of identifying individual students I encouraged the students to work in numbered pairs so that when they answered only a group number came up rather than an individual name. The comfort of working together and the lack of exposure for any single individual sorted out the adverse comments on the system.

4 Work Conducted form 2004 Onwards

As it took all of the time of the TLQIS project to get the materials in place it has only been possible to truly evaluate the response of the students over a period of time following the completion of the TLQIS project.

4.1 The Initial View

At the end of the 2003-2004 academic year it was clear that the majority of students engaged very positively with the material on Blackboard but a small cohort (about 25% of the total) did not engage at all. In correlating the usage of Blackboard with examination results it was found, perhaps not surprisingly, that there was a strong correlation between examination performance and Blackboard usage with those students who had not used Blackboard largely falling into the

group of students that did not obtain credits in the module. A means therefore of encouraging all students to use Blackboard was sought.

4.2 On-Line Assessments and further developments

During the academic year 2004-5 changes to the module specifications for Engineering Thermodynamics E1.1 and Fluid Mechanics E1.2 were made so that the assessment pattern was changed from 90% exam and 10% laboratory work to 70% exam, 10% laboratory work and 20% coming from four on-line Blackboard assessments staged throughout the semester. No change at that time was made to aero fluids E2.1 which remained as 90% exam and 10% laboratory work. In both modules the students responded positively to the Blackboard assessments and a healthy competition for 'good marks' was evident.

In addition, despite the large time investment made in recording lectures and packaging in Blackboard I came across a piece of software called Speechi which actually would do the same thing with very little effort. Not only could I produce recorded lectures more easily the finished product responded more readily than the presentations produced by Ms Producer and ran more robustly in Blackboard, Thus during the academic year 2004-5 some of the lectures were repackaged in Speechi format and replaced the Producer versions previously located there. Over the summer vacation 2005-6 it all of the recorded lectures were converted to Speech format.

5 Feedback from the 2004-5 Academic Years

As explained above the assessment for the level 1 modules (Engineering Thermodynamics E1.1 and Fluid Mechanics E1.2) was changed to 70% examination, 20% from4 Blackboard tests and 10% laboratory work. The assessment for aero fluids E2.1 remained as 90% examination and 10% laboratory work though for 2005-6 this has been changed in line with the level 1 module.

Coincidentally there was the same number of students in the level 1 Engineering Thermodynamics cohort as in the level 2 Aerofluid Dynamics cohort. However it was found that the level 1 cohort used Blackboard on average 3 times more than the level 2 students and of the level 2 students 25% did not use Blackboard at all. This increase in Blackboard usage at level 1 was thought to be directly linked to the on-line assessments.

Conducting the Assessments in Blackboard

For the two modules for which assessments were to be used initially Engineering Thermodynamics E1.1 and Fluid Mechanics E1.2 a number of multiple choice questions were set spanning the curriculum. The questions for each module were categorised and placed in Blackboard question pools from which a number of tests were generated. When the tests were taken by the students a random mix of questions from the pool was given to each student.

To ensure that the tests were conducted properly and fairly all students were required to take the test at a preset time and in a fixed location. An opportunity was offered to students who had received less than a 40% mark in each individual assessment to retake the assessment after further work, (given the random mix of questions the likelihood of anyone receiving the same questions was slim), and however the mark was then capped at 40%.

6.1 Feedback from Aero fluids E2.1

The Aero fluids students were issued with the survey included in Appendix 4a. The results of this survey were as follows:

1 I would prefer to have had this module delivered through OHP or chalk and have not gained anything from the PowerPoint delivery method used

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1	1	8	4	3

2 I have used the Blackboard site and found it

Very Useful	Useful	Neutral	Little Use	No use
	12	4	1	

3 I have not used Blackboard as I consider it an unnecessary waste of my time

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
	1	3	11	2

4 I have found the pre-recorded lectures useful and have used them outside the class

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
4	8	4	1	

5 I do not think that I should have to know where equations come from I would prefer just to be given them. The maths just confuses me.

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1	4	8	2	2

6 I can see the relevance of the material covered to aspects of Aeronautical Engineering

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
4	13			

Summarise Results of University's Module Questionnaire
39 Students 18 responses

	Extremely Satisfied	Very Satisfied	Satisfied	Neither Satisfied or Dissatisfied	Dissatisfied	Very Dissatisfied	Extremely Dissatisfied
Question 1	1		13	2	2		
Question 2	1	7	9	1			

Likes	**Dislikes**
Shock waves(2) Mach number, Reynolds's number Flow in nozzles Good notes(2) Interactive Whiteboard (3) Interesting course Course materials CD with lectures on PowerPoint Well presented Friendly lecturer, teaching methods	Need more examples(4) Difficult equations(3) Monday mornings Interactive whiteboard Volume of material Fast pace(2) Derivations(3) PowerPoint Interactive whiteboard

The examination marks were encouraging with an overall average mark of 50.5% and only 7 students failing the module.

6.2 Feedback from Engineering Thermodynamics E1.1

The Engineering Thermodynamics students were given the additional questionnaire shown in Appendix 4b and the results of this survey are shown here:

Engineering Thermodynamics 1.1 2004-5
Please tick the box you most agree with

1 In comparison to other modules you have studied this semester would you describe the Engineering Thermodynamics module as

Very demanding	Demanding	About the same	Less demanding	Easy
15	12	1	1	

2 In terms of the delivery of the module do you find the PowerPoint delivery has helped over conventional delivery (e.g. overhead transparencies or chalk)

Very definitely	definitely	Neutral	Negatively	Disastrously
8	14	5	2	

3 In terms of the material provided through Blackboard to support this modules have you found it

Very useful	Useful	Neutral	Not very useful	No use
9	15	3	2	

4 In terms of the Blackboard assessments staged throughout the module which account for 20% of the module mark have you found that they have encouraged you to study this material on a regular basis

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
8	13	7		1

5 If you have re-taken any of the Blackboard assessments do you feel that his has helped you to understand the material more?

Strongly Agree	Agree	Neutral	Disagree	Not applicable
1	6	8	1	14

6 As we come to the end of this module do you feel that the time you have allocated to study of the material has been

More than adequate	Adequate	Marginally on the low side	Inadequate	Far too little
	10	13	6	

7 How do you think that the interactive whiteboard has contributed to the delivery of the module

Very useful	Useful	Neutral	Not very useful	No use
9	10	5		2

If there are any further comments (positive or negative you would like to add) please add them here.

Comment 1

Very difficult subject delivered well. The Blackboard test is a good idea however the structure needs changing – why multiple choices give a 'lottery' feel to them being able to guess the answer! Get rid of the multiple choices and let us use formula sheets so we can either calculate and answer or deduce it logically. I do not see the point of being able to guess correctly making your success luck based

Comment 2

I think that the blackboard assessments should be checked for errors and relevance before they are given to us. Although they are sometimes irrelevant they are a very good idea and once the initial problems are ironed out they will work well

Comment 3

Allow time to explain things more clearly.

Comment 4

The interactive whiteboard is ok but chalk or a dry marker would have been the same and we would have slowed down too (a good thing).

Comment 5

For the handouts, Blackboard information, tutorials and test this module has been very good. You have very good notes so it's alright to understand.
Negative issues- not free to express oneself and it's not a free class so it's quite hard to understand but easy to understand when note is read at home

Comment 6

Seems to be an awful lot crammed in a short space especially as never been studied before at A-level. Liked the handout lecture slides

Comment 7

Very well run module

Summarise Results of University's Module Questionnaire

39 Students 28 responses

	Extremely Satisfied	Very Satisfied	Satisfied	Neither Satisfied or Dissatisfied	Dissatisfied	Very Dissatisfied	Extremely Dissatisfied
Question 1	2	7	14	4	1	0	0
Question 2	1	4	8	8	2	1	3

Likes	**Dislikes**
IT Support made it very clear(3)	Fast delivery (3)
Tutorial sessions	Challenging equations
Book of Notes (9)	Difficult subject
Blackboard (5)	Too many equations(2)
Regular Blackboard assessments(9)	Blackboard assessment(4)
Teaching Methods and style (6)	Complicated applications(2)
Well explained lectures and tutorials	A lot of work
Interesting course content(2)	Timing of tests
Very well run module	
Use of PowerPoint(6)	
Lecture Slides and questions (5)	
Interactive Whiteboard	

The end of semester examination results were encouraging with an average of 51.5% and a standard deviation of 14% and with only five students who sat the exam achieving an exam mark of less than 30%. Given that the exam mark was only 70% of the examination mark in the event only 3 students failed to achieve an overall mark over 40% for this module. The examination scripts showed considerable evidence that the majority of students had absorbed the key concepts of this fundamental subject.

6.3 Feedback from Fluid Mechanics E1.2

The cohort of students taking this module is larger than that taking Engineering Thermodynamics E1.2 since the Fluids module is also taken by students of Civil Engineering. The lectures were delivered to the entire cohort but because of the large class size the tutorial groups were split into two with Aeronautical and Mechanical students forming one group and Civil Engineering students another.

The Fluid Mechanics module is demanding both in terms of volume and mathematical basis, though it was clear that students were finding the module hard the majority worked steadily and engaged positively with the Blackboard Assessments.

Summarise Results of University's Module Questionnaire Fluid Mechanics E1.2
65 Students 28 responses

	Extremely Satisfied	Very Satisfied	Satisfied	Neither Satisfied or Dissatisfied	Dissatisfied	Very Dissatisfied	Extremely Dissatisfied
Question 1	2	5	20	4	1	0	0
Question 2	2	31	16	6	4	1	2

Likes	**Dislikes**
Tutorial sheets (4)	Not enough time (2)
Book of Notes (8)	Too much stuff (4)
Blackboard (8)	Too much PowerPoint
Regular Blackboard assessments(16)	Blackboard Assessments
Teaching Methods and style (2)	Dry material
Interesting course content(2)	Difficult subject
Use of PowerPoint(6)	Too many equations(2)
Lecture Slides and questions (5)	Boring subject
Interactive Whiteboard (4)	Need more feedback on assessments
Friendly and enthusiastic lecturer (4)	Fast delivery

The end of semester results was pleasing with an exam average of 53.16% with a standard deviation of 14.68% and only 4 marks below 30%. Of the 65 students only 11 of those who sat the examination failed to achieve an overall mark above 40% more significantly the exam scripts showed considerable evidence of understanding.

7 Does the Method of Teaching Transfer to Other Subjects?

A problem arose with the teaching of Mathematics at level 0 during the academic year 2004/5 partly brought on by the ill health of the module deliverer who completed semester 1 but was unable to teach semester 2 of the Engineering Methodology S0.2 module. At very short notice I agreed to pick up this module as long as I could use the teaching methods and IT medium I had been piloting. The course materials were revamped from handwritten sheets which previously had been drip fed to the students to a complete lecture book of notes which students received at the start of the module. The lectures were delivered using PowerPoint and an Interactive Whiteboard was utilised for delivery and tutorial work. A Blackboard site was set up to support the module and the PowerPoint lectures were added to the site to enable lectures to be revisited by students at a later date.

The particular cohort of students had complained about the semester 1 delivery of the subject in which the cohort had been split in two with one half taught by one individual and the other taught by a.n.other. This arrangement came about because the lecturer concerned considered it inappropriate to lecture to a group of more than 20. For the semester 2 teaching the class was maintained in one group for both lectures and tutorials. I delivered the lectures and the tutorials were covered by Dr Gordon Laws. Both the semester 1 and semester 2 Engineering Methodology Modules are 20 credit modules with 4 hours of lectures and 2 hours of tutorials in each of the 12 teaching weeks. In semester 2 the module was scheduled to 2x2hour lecture slots and 1x2hr tutorial slot. Delivering the lecture material using PowerPoint a pattern developed where in each of the two 2 hour lecture slots one hour would typically be used to cover new material and the remainder of the time allocated to students working on set problems relating to the new material. The additional tutorial time gave more time for students to sort out areas of difficulty and also in these slots the Phase tests were conducted.

Overall the module was well received by students and the results of the University's Summative Questionnaire are included here: Clearly the method has translated to mathematics but, as suggested also by Ms McGlynn, it would be necessary to establish whether it also of benefit to those subjects of a less mathematical nature.

7.1 Summative Results of University's Module Questionnaire Engineering Methodology S0.2

40 Students 18 responses

	Extremely Satisfied	Very Satisfied	Satisfied	Neither Satisfied or Dissatisfied	Dissatisfied	Very Dissatisfied	Extremely Dissatisfied
Question 1	3	10	4	-	1	0	0
Question 2	3	4	9	2			

Likes	**Dislikes**
Help provided (4) Notes and Handouts (5) Enjoyment(2) Lecturer's efforts (5) Blackboard (2) Phase tests (5) Lecture Style PowerPoint (3) Interactive Whiteboard Tutorials	Volume Difficulty Speed of delivery PowerPoint when rushed

More significantly the examination average of semester 2 Engineering Methodology was 54.9% compared with 42.4% from semester 1.

8 Conclusions

The award of the TLQIS bid has been the catalyst which has enabled a number of teaching methods to be trialled and evaluated. Whilst it is clear from the evaluation(s) that one style does not always meet the needs of every student the majority of students seem to respond positively to the methods used and this has been translated into improved student performance and ultimately student retention. As the report included in Appendix 2 indicates crucial to student attainment is attendance at timetabled events. Whereas it is clearly desirable that students attend timetabled events it cannot always be ensured and there are a number of valid reasons which mitigate against full attendance. The teaching materials developed as part of this work enable those students who either missed a lecture or those who attended but simply could not follow the entire lecture content to recover at their own pace and in their own time.

The project has demonstrated that students are motivated by assessment and will devote time and effort to module elements which contribute to their overall module mark. A longer term goal (harnessing the use of the PRS system) will be to give some portion of the module marks to questions which are answered in class. It is anticipated that such a step will encourage student attendance.

The work on on-line assessments has been developed further and a method is now in place by which multiple choice questions and solutions can be generated easily by harnessing more advanced features of Word and Excel (see publication 10).

9 Publications

1	An Evaluation of the Use of Blackboard to Support the Teaching of Engineering Students. Education for Capability University of Salford, September 2003.
2	Innovation in Engineering Education. International conference in Engineering Education, Olomouc Czech Republic, June 2004
3	Harnessing Learning Technologies to deliver the 3-Rs, Recruitment, Retention and Respectability, Education in a Changing Environment, Salford 2004. (Conference presentation only)
4	Media Enriched Content with Blackboard-Creating Content with Nuggets, Education in a Changing Environment, Salford 2004
5	Promoting Understanding using a Virtual Learning Environment International Conference on Engineering Education, Gliwice Poland, July 2005
6	Stimulating and Motivating Students using a Virtual Learning Environment Linked to Assessment, 3rd Education Conference, University of Salford, January, 2006.
7	Using Learning Technology to Deliver Re-Usable Engineering Education To be included in the Special Bound Volume of INEE 2006
8	Motivating Students using In-class Questions. ICEE 2007 (Coimbra, Portugal)
9	Handling Large Classes using Computer Aided Assessment in Blackboard, (To be presented at ECE 2008, November 2008)

Appendix 1 The Original Bid

An Evaluation of a Pilot Programme involving Innovative Teaching Methods in Engineering Programmes

Dr Elizabeth M Laws
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Abstract

The proposed TLQIS project covers the extension of an initial pilot study already undertaken to other modules being delivered in semester 2 of the academic year 2002-3. The project is designed to meet the needs of those students who are stimulated by the visual impact of the lecture material they are exposed to and also those who require the opportunity to go over material more than once before they can absorb new concepts. As part of the project an evaluation of both the pilot project undertaken in semester 1 and the delivery of the new material in semester 2 is included.

Rationale

The wide mathematics ability range of the intake to Engineering programmes presents a particular problem for those teaching engineering topics for which mathematics is the key. Whilst some students can take in concepts readily others need more time to absorb principles and need to go over material more than once. In our intense 12 week modular teaching periods this need is not easily satisfied against the requirements of covering the whole syllabus on schedule.

From an evaluation of the learning styles of individual students it is clear that there are differing needs to be met. The Honey and Mumford[1] learning styles questionnaire has been used for the last few years as part of our induction week programme however this year for the first time students were also issued the learning styles questionnaire produced by Felder[2]. A distinction between the two questionnaires is that the Felder scheme highlights one particular category as being of importance. ‘visual and verbal learners’. Felder suggests that:

VISUAL AND VERBAL LEARNERS

Visual learners remember best what they see--pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of words--written and spoken explanations. ***Everyone learns more when information is presented both visually and verbally.***

In most college classes very little visual information is presented: students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts. Unfortunately, most people are visual learners, which means that most students do not get nearly as much as

they would if more visual presentation were used in class. Good learners are capable of processing information presented either visually or verbally.

From an analysis of the Felder questionnaire it was noted that the majority of students scored highly in this category indicating that they are motivated by visual impact of material presented to them.

The project proposed is designed specifically to meet the needs of visual learners producing lecture material with visual impact (through colour and animation effects) which it is believed will enhance the learning experience. Whilst the material content is specific to the modules selected the approach adopted is transferable across all Schools and modules.

Pilot Study.

In Semester 1 of the academic year 2002-3 two modules have already been delivered in a manner which has focussed on the needs of visual learners.

1 Engineering Thermodynamics E1.1
2 AeroFluid Dynamics E2.1

The simple change made was to convert from lectures delivered using black and white transparencies to lectures delivered using lap-top and Data projector with the lectures delivered using MS PowerPoint. Whilst the approach relies on the availability of these resources. It is worth pointing out that though this is initially expensive (lap-top+projector outlay approximately £2500 though the price of data projectors now appears to be reducing significantly) this initial outlay immediately leads to a reduction in recurrent expenditure (for example a box of 100 photocopiable OHPs is estimated at £30) with each module requiring typically 3-4 boxes).

Both modules in the pilot are taught to BEng/MEng students on Aeronautical and Mechanical Engineering in the School and both modules have a mathematical basis. Increasingly it has been found that some students find problems in absorbing concepts readily and the short teaching time available within our semesterised course structure places severe strain on both students and lecturer. As part of this project using the facilities of MS PowerPoint I have endeavoured to provide those students who feel that they need to go over material again in their own time the opportunity to do so by producing a self-running version of each lecture with an embedded sound commentary which students can listen to if they wish.

As illustrations of the differences achieved a sample set of OHP's for lecture 1 of the Engineering Thermodynamics E1.1 and the corresponding material produced in MS PowerPoint is included as Appendix 1. Also included are some evaluation sheets completed by students following the delivery of the lecture which clearly indicate that they found the use of colour and animation an aid in the learning process and that many felt that they would like to go over the material again.

As the delivery of the modules proceeded it seemed easier to develop complicated equations harnessing the animation effects offered by PowerPoint since individual terms could be

introduced at appropriate stages or cancelled and surprisingly students, (particularly those on AeroFluids E2.1) responded positively in questionnaires even when the mathematics was quite difficult to understand.

Outline of the Proposal

The proposal is based on two distinct elements:

1 An extension of the teaching approach to a further module in semester 2.
2 A detailed analysis of the results obtained from the initial pilot and further feedback obtained throughout semester 2.

Item 1 Extension of Teaching Approach to Semester 2

It is proposed to extend the use of PowerPoint in lecture delivery to a module in Semester 2. Fluid Mechanics E1.2. This is a level 1 module which dovetails with Engineering Thermodynamics E1.1 and which is taught to both students on Aeronautical and Mechanical Engineering courses and also Civil Engineering students. Civil Engineering students have not taken Engineering Thermodynamics E1.1 and have not as yet been exposed to the mode of delivery proposed whilst students on Aeronautical and Mechanical Engineering will have experienced it through the earlier Engineering Thermodynamics module.

Item 2 Evaluation

The feedback obtained from the pilot programme will be rigorously analysed as will the module evaluation sheets completed by the two different cohorts of students. The Learning Styles questionnaires will, (with the co-operation of the students), be re-run and the results of the evaluation will be analysed with reference to the initial qualifications of the student group. From the School attendance system data about the attendance pattern of these students will also be obtained.

By the time the evaluation is conducted the examination results for these modules should be available and the performance of individual students in these modules will be correlated with their learning style and personal views on the delivery of the modules.

Given the mathematical flavour of the modules in the pilot study in parallel to the review of the two modules in the initial pilot corresponding information about the performance of these same students in the Engineering Methodology (Mathematics) modules will be collected.

In addition regular feedback will be obtained in semester 2 and it is anticipated that by the end of the academic year a significant body of data should be generated as a result of this project.

The questionnaire given to students will be re-drafted and sharpened and varied throughout the semester to encourage students to give as much detail as possible on what they have learned, how they have learned and what they still do not understand.

The data collected should be relevant to the widening access agenda – for example do the examination results correlate well with intake standards or are they more affected by an individual students' commitment, motivation and attendance in a particular module?. Has the teaching approach adopted affected student performance (and hence retention rates)? Have students achieved better, (or worse results), in these modules than in others? How do the results of this years student cohort compare with those in the previous years?. Does 'enjoyment' have a part in student motivation and hence success?

Feedback from module questionnaires in Semester 1 on the use of the Personal Response System, (leaflet enclosed for information), has shown that whilst the majority of students enjoyed the use of the system some reacted negatively not wishing to be encouraged to answer questions posed. In evaluating the use of the system in semester 2 it will be the intention to relate student reaction to the system to their individual learning styles.

Resources Required

These are based on the requirement of assistance in both the conversion of material to MS PowerPoint and also a detailed analysis of the evaluation conducted.

The amounts requested are:

£1500 for IT support in the conversion process of lectures, tutorials and solutions to Ms PowerPoint and the production of questions and solutions to be used with the PRS system. This is estimated as 150hrs at £10:00 per hour.

£3000 for staffing costs associated with the evaluation. In co-operation with Dr Elaine Baldwin in ESPACH it is anticipated that a PhD student nearing completion could be identified to conduct this work the costs are estimated at £200 per week for 15 weeks. The 15 weeks covers the 12 weeks of semester 2 during which data from the pilot scheme will be analysed and evaluation data will be collected and partially analysed with the additional weeks allowing the body of data obtained to be brought together and a report on the findings to be produced. In this regard it would be extremely useful if it were possible to have some input from Professors Heywood and Cowan towards the end of the project when the complete data set has been gathered.

Without the support of the TLQIS fund it would be impossible for this analysis to take place. As it would be the intention to start this analysis at the beginning of Semester 2 (i.e. before any firm decision by the TLDSC has been taken) an early intimation of the outcome of this bid would be appreciated.

Dissemination

External

Following discussions it has been suggested that appropriate Journals to target publications would be the Journal of Engineering Education and also some of the respected International Conferences on Engineering Education. These would include the Frontiers of Education Conference run jointly by the ASEE and ISEE..

Internal

It is intended that a seminar for colleagues within the School would be hosted towards the end of Semester 2.

References

1 Honey and Mumford Learning Styles
2 Felder Learning Styles Questionnaire
3. The Nature of Student Learning in Engineering, D Fordyce, International Journal of Technology and Design Education, Vo122, No 3,1992.
4. Using Kolb's Learning Cycle to Improve Student Learning, J.Stice, Engineering Education, February, 1987, pp 291-296
5. The Kolb model Modified for Classroom Activities, M.Svinicki and N.M.Dixon, college Teaching, Vo135, No 4, pp 141-146
6 The Effects of Personality Type on Engineering Student Performance and Attitudes R.M.Felder, G.N.Felder, and E.J.Diez, J Engr Education Vol 91, pp3-17 (2002)
7 Development of Engineering Thermodynamics Concept Inventory Instruments, Clark Midkiff,K, Litzinger,T.A, and Evans, D.L. Fromtiers in Education Conference, 2001.

Appendices

1 Sample Honey and Mumford Learning Styles Questionnaire and Descriptors
2 Sample Felder Questionnaire and Descriptors
3 Sample Engineering Thermodynamics Lecture 1 OHPs
4 Sample Engineering Thermodynamics Lecture 1 Ms PowerPoint
5 Evaluation by students of item 4
6 Personal Response Leaflet

Appendix 2 Final Report on the Project Evaluation (Ms C McGlynn, ESPACH)

Evaluation of a Pilot Programme Involving Innovative Teaching Methods in Engineering Programmes

PART ONE: RATIONALE AND BACKGROUND

This evaluation project marks the extension of an original study undertaken by Dr. Laws in semester one of the academic year 2002/2003. The purpose of the study is to assess the efficacy of enhancing the visual component of teaching taking place within the module Fluid Mechanics (E1.2). The hypothesis governing this work is that the use of software to promote a visual dimension to lectures given to engineering students will enhance the teaching style used within the module. This will make the dissemination of information more compatible with the varied learning styles of students.

For the last few years, induction week programmes have included the use of the Honey and Mumford learning styles questionnaire. This exercise has demonstrated that students vary in their preferred style and speed of absorbing and comprehending the information they are being taught. However, this is not the only difference between individual students.

The annual intake of students on engineering degrees varies in the qualifications they have gained before attending the University of Salford. In particular the wide mathematics ability range presents a particular problem for those teaching engineering topics for which mathematics is the key. In addition to this there is the issue of individual student motivation which affects attendance and the submission of coursework.

During semester two, Dr. Laws invited students in the school to complete a short electronic questionnaire. The questions allowed students to reflect on their motivation and performance. Those who responded tended to have regular attendance patterns. Eighty-three per-cent of them had good attendance (that is they attended fifty-five per-cent of classes or more over the course of the semester). Of the overall figure sixty-seven per-cent had very good attendance (seventy per-cent of classes or more). However, these students expressed some concern about engagement with the course. Fifty-eight per-cent of them felt that although the course met their expectations, they were sometimes overwhelmed by the volume of material. Sixty-four per-cent felt they were motivated enough to rise to the challenge of the course but could find these occasionally daunting. Also, only forty-seven per-cent felt they were sustaining a reasonable amount of regular study outside of the classroom.

Given this information, it is apparent that there are a number of variables that affect student performance. The introduction of a more varied teaching style cannot hope to deal with all the issues of motivation and work-rate. However, the validity of this investigation into visual teaching aids will be augmented by the discussion of available data on attendance and previous educational attainment.

Dr. Laws has been piloting the use of innovative teaching methods through the medium of software that allows for a visual representation of the information she is delivering verbally. This supplements the printed course notes that students receive. The software has two other advantages. Firstly, students can organise themselves into teams in order to answer set problems. Their answers are transmitted to the front of the class. This gives students the opportunities to work through formulas and to receive intervention from their tutor in order to correct mistakes and misunderstanding. Secondly, the Power Point information can be accessed by the students after lectures, which enables them to review the data at their own pace.

Given the emphasis on visually innovative techniques the evaluation of the module rests in part on models of teaching which address the different modes of learning preferred by students. The questionnaires that provide this information are discussed below.

Project Objectives

There were two objectives for this project . The first objective was to utilise learning styles questionnaires as a means of considering the impact of the use of Power Point visual representations of the information covered in the lectures delivered in the Fluid Mechanics module. The questionnaires were supplemented by short questionnaires circulated after teaching, which asked the students to consider what they had learned from the session and what they found unclear. The second objective was to build up a profile of the students using data such as attendance records, entry qualifications and exam results.

Two learning style questionnaires were completed by the students for the purpose of achieving the first objective. The first questionnaire was developed by Linda Silverman and Richard Felder . It has been drawn from their research on learning and teaching styles in engineering. Felder argues

> students whose learning styles are compatible with the teaching style of a course instructor tend to retain information longer, apply it more effectively, and have more positive post-course attitudes toward the subject than do their counterparts who experience learning/teaching style mismatches.

A key aim of Felder's questionnaire is to establish a preference for receiving information visually or verbally. Felder and Silverman assert that the usual preference is for the visual over the verbal but that generally teaching styles cater for the verbal:

> Most people of college age and older are visual while most college teaching is verbal the information presented is predominantly auditory (lecturing) or visual representation of auditory information (words and mathematical symbols written in texts and handouts, on transparencies, or on a chalkboard.)

Felder and Silverman argue that this mismatch can be rectified with the addition of visual material such as pictures, graphs and flowcharts. As the Felder learning styles questionnaire

presents a means of testing for this visual preference, it accorded with the objectives of the project.

The second learning styles questionnaire used was the V.A.R.K. model designed by Neil D Fleming. The acronym refers to the four modes of learning that Fleming identifies; visual, aural, read/write and kinesthetic. Fleming recommends that teaching methods should be varied to accommodate those who learn more effectively from techniques other than listening to lectures. In particular Fleming asserts that students with a visual preference "are not well served by present day methods of teaching in a university." The VARK model identifies preferences and suggests that many students benefit from a multi-modal style of teaching that allows them to absorb information through a number of media and to do 'hands on' working through of problems. The model also identifies voids, modes of learning that individual students do not gain the most benefit from.

The emphasis on visual modes of learning in both questionnaires provides a means of identifying such preferences amongst the students and assists in the first objective of ascertaining the possibility of a match in learning and teaching styles through the use of Power Point. The main difference between the questionnaires is that the binary nature of Felder's work asks students to prioritise one mode over another. The VARK model suggests that students can benefit from both visual and aural information, in addition to written texts and 'hands on' experience.

Data Collection

The Felder model was distributed in week one and the VARK questionnaire in week six. The initial pilot utilised the Honey and Mumford model and it was envisaged that this questionnaire would be employed again. However, problems with copyright meant that use of that model had to be discontinued and the VARK model was utilised instead. This accounts for the gap between the two questionnaires being completed.

In addition to learning and teaching style models other data has been collected to build up a profile of the group. Data concerning the attitude of students to the teaching methods has been collated. This has been done using the module evaluation sheets completed in semester one and by circulating short questionnaires at the end of sessions in order to gauge the immediate response of students to the information disseminated by the lecturer, Dr. Laws. Data has also been collated pertaining to academic achievement and indicators of commitment, such as attendance.

There are fifty-seven students enrolled in both BEng and MEng degrees taking this module. Of these, thirty-eight completed the Felder questionnaire. All but one student marked at least a mild preference for processing information through visual rather than verbal means. Forty of the fifty-seven completed VARK questionnaires. Of these only five of these registered a void, or weakness, in the visual mode of learning. Nineteen of the forty were designated as having a marked preference for utilising techniques.

The students who completed both questionnaires have been used as the basis of analysis relating to the match of teaching style to learning style. This group comprises twenty-seven of the fifty-

seven students enrolled. This equals a satisfactory response rate of forty-seven per cent. The learning questionnaires suggested that the introduction of a visual component to a lecture would be positively received by twenty-two (eighty-one per-cent) of these students, and that eleven out of the twenty-seven had strongly marked visual preferences (forty per-cent).

These results suggested that the group would benefit from the use of visually stimulating material, as provided by the software. In conjunction with the verbally delivered lecture and the opportunity to work in groups on practical questions related to the lecture, the Power Point display promotes a multi-modal style of learning. The fact that students can access the display in their own times means that different speeds of learning can be catered for, as well as different modes.

PART TWO: THE EVALUATION OF THE QUALITATIVE DATA

Background

Dr Laws developed the use of software during her teaching in Semester One. At the end of this teaching period she distributed the standard Salford module evaluation forms. Twenty-seven students out of forty-two were completed (sixty-four per-cent).

Only one respondent said that they were dissatisfied with the module. Eighteen out of the twenty-seven described themselves as satisfied or very satisfied (sixty-seven per-cent). Most pertinently for this study, eleven out of the twenty-seven (forty-one per-cent) specifically noted presentation as one of the good things about the module. Sample comments include:

"Futuristic and innovative use of I.T."
"Power Point brings the notes to life"
"Power Point makes it clearer and slightly easier to understand"

This data suggested that this group of students would be receptive to the continued use of this teaching method.

During the evaluated teaching period, questionnaires were distributed at the end of a number of classes to gauge the attitudes of students to the lecture they had just received. The following discussion relates to the fifth lecture in the semester, which took place on 13th March 2003.

Lecture Five – Bernouilli's Equation

The lecture focused on one particular equation. In her opening discussion, Dr. Laws stressed the importance of learning and understanding Bernouilli's Equation. The software aided this objective in a number of ways. The students were shown visual examples of flow regions. The elements of the formula were introduced separately onto the screen so that the students were not 'bombarded' with data, but taken through the equation step by step. To impress the importance of the equation upon the class, Dr. Laws based one part of her discussion around a slide that

clearly stated what students should know about the equation, which reinforced the importance of the information being disseminated. The software data was supplemented by handouts and reference to semester coursebook notes. Dr. Laws reminded the students that this lecture, like all the lectures on the course, could be accessed later using Blackboard.

The remainder of the class was taken up with the students working in small groups on questions relating to the equation. They were able to use the software to post their answers at the front of the class, which allowed Dr. Laws to assess their answers and give individual attention to students who had not grasped the concepts involved.

After the class, thirty-six questionnaires were collected from the students. The focus of the questions was the presentation and absorption of the information. Twenty-five respondents commented positively on the presentation (sixty-nine per-cent). Seven papers made no comment or rated the presentation as "OK" (nineteen per-cent). Four made negative comments about the presentation (eleven per-cent). Three of these four were listed, according to their VARK questionnaires as lacking a strong preference for visual modes of learning.

Students were asked "What would help you to learn this topic more easily?" Three made no comment (eight per-cent). Twelve students made reference to increasing home study (thirty-three per-cent). Answers offered included:

"More time reading up on it"
"Read it again at home"
"A recommended book (to look up any unclear points)"

The other twenty-one students (fifty-eight per-cent) made reference to increased teaching input. In particular there was a marked demand for more working out of equations on the blackboard.

PART THREE: A QUANTITATIVE PROFILE OF THE STUDENTS

During the pilot study information was collected on student performance. Their entry qualifications to Salford were recorded, along with their level of attendance and exam performance. This data showed quite clearly that the effects of new teaching styles could not be considered in isolation from factors such as educational attainment and individual motivation. This is shown in the tables below.

Table one: The relation between attendance and Fluid Mechanics exam results

The following categories were used

Very good attendance -	70% +
Good attendance -	55-69%
Poor attendance -	40-54%
Very poor attendance -	0-39%

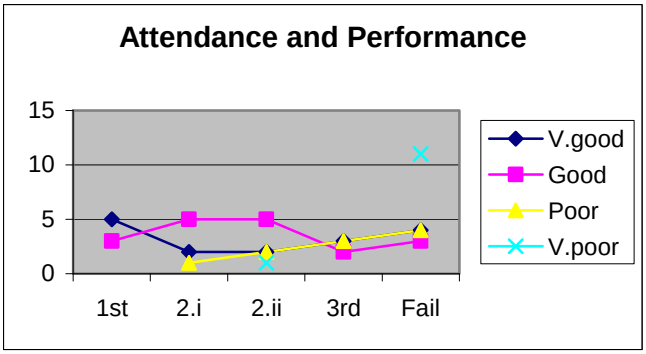
The rationale for these categories stems from the school's regulations. Students who attend less than fifty per-cent of required teaching receive letters to warn them that they must improve their record. The poor attendance category reflects students who are grouped around this danger mark and the very poor category signifies those who have slipped well below it. Good attendance denotes those who are not in danger of receiving a departmental reprimand. Those in the very good category attend seven out of ten classes or more.

The exam marks for the Fluid Mechanics module break down as follows:

First:	70% +
2:1	60-69%
2:2	50-59%
Third	40-49%
Fail	0-39%

	First	2:1	2:2	Third	Fail
V.Good	5	2	2	3	4
Good	3	5	5	2	3
Poor		1	2	3	4
V.Poor			1		11

As can be seen from the table, it is not enough to turn up to classes. Good attendance does not guarantee a good mark. However, what is apparent is that there is a strong link between poor attendance and poor attainment, with all but one of the worst attendees failing the module. This is shown clearly when the data is represented in graph form as seen below. The line for very poor attendance veers sharply above the others into the fail category, with only one candidate in this grouping securing a passing grade in fluid mechanics.



Tables 2 and 3 – the relationship between entry qualifications and exam performance.

Students are accepted to Salford with a range of qualifications. To ensure that valid comparisons between students were made a sample was drawn of A level students only. The categories below relate to the stipulated entry criteria for the MEng programme (300 UCAS points), the BEng programme (240) and the Bsc programme (160) points. Twenty seven of the fifty-five registered students who sat the fluid mechanics exam had A level examinations as their highest qualification on entry (forty-nine per-cent). Of these, twenty-four had Mathematics A level within their qualifications. Their exam results are shown below

	First	2:1	2:2	3rd	Fail
300	3	3			
240-299	1	1		2	1
160-239	1	2	2	2	2
0-159			2	2	3

	First	2:1	2:2	3rd	Fail
A	3				
B	1				
C	1			2	2
D	1	2	2	2	2
E		1	1	1	2

What is evident from these results is a correlation between very good performance at A level and very good performance in the fluid mechanics module. Most of the first class grades in the exam went to those with higher A level entry points, including grade A or B in Mathematics.

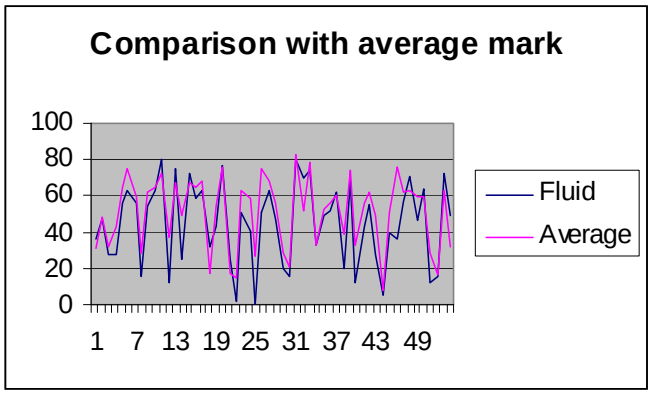
Tables 4 and 5: the relationship between learning styles and performance

Whilst attendance and previous attainment can be cited as indicators of good performance, it is not possible to make the same claims of causation when it comes to learning modes. This can be demonstrated using the table below. When the VARK questionnaires were completed nineteen out of the forty students were noted as having a strong orientation towards visual modes of learning (forty-eight per-cent). When compared to those without marked visual preference no clearly discernable pattern emerges

	First	2:1	2:2	3rd	Fail
Visual	3	4	6		6
Non-Visual	3	1	3	5	8

Given that the class is almost split in half by the VARK indicators it seems that there is no clear correlation between passing and failing or being notably excellent or notably poor.

What is also clear from the graph below is that introducing visual media cannot be linked to improved performance in an unproblematic way. Most students performed below their average mark in Fluid Mechanics. The implications of this quantitative data suggests that the effects of visually stimulating teaching materials cannot be considered out of the context with other variables as will now be discussed in the conclusion.



PART FOUR: CONCLUSIONS

Results of the evaluation

The pilot study of innovative teaching methods in the module fluid mechanics has shown some interesting results. On the whole the reception from the students has been very positive. There have been few critical comments of the style of teaching and the software has been specifically praised as one of the best elements of the module. However, direct causal links between stimulating visual modes of learning and increasing student performance are hard to detect.

The reason for this can be discerned by examination of other variables, in particular attendance and past attainment. One can provide a multi-media style of learning within the lecture theatre but if the students are not bringing themselves to that lecture theatre often enough, they will not benefit from it. As was discussed in the introduction the style of teaching Dr. Laws has piloted in this module provides other benefits than supplementing the verbal with the visual. The fact that students can access the lecture notes at any time by connecting to Blackboard means that they can learn at their own pace and go over problematic areas. However, if we infer a general lack of engagement with the course from poor attendance, the likelihood that the students who need to take advantage of this most are not doing so is strong. This inference is justified both by the increased failure rates of poor attendees and by the admission by the students in questionnaires that they are often not doing the amount of work they feel would allow them to perform well.

The second variable to be considered is entry-level qualifications. Fluid Mechanics is a subject that requires confidence in the area of mathematical equations and it is notable that those with grade A and B in Mathematics have done particularly well at it. Whilst providing an engaging

and stimulating teaching environment may encourage students to they are getting something out of lectures it cannot address weaknesses in previous teaching and performance by itself.

It is the conclusion of this report that the pilot has been successful in gaining the approval of the students for this method of teaching. It has also provided a potential means for improving understanding and performance. However, it is up to the students themselves to engage with these varied modes of learning and in particular to maintain a decent standard of attendance.

Recommendations

Overall the pilot has shown that students are appreciative on the whole of the software used to vary the teaching styles in this module. However, the extension of this teaching to another module, perhaps one that did not focus so heavily on equations, would provide a greater picture of the possibilities offered by Power point.

In addition this pilot study could be used as the focus of discussion on the subject of student engagement and alienation. Increased motivation and attendance would create a student body that could fully take advantage of the opportunities offered by this style of teaching.

Appendix 3a

Sample Lecture Slides for Engineering ThermodynamicsE1.1

THE UNIVERSITY OF SALFORD

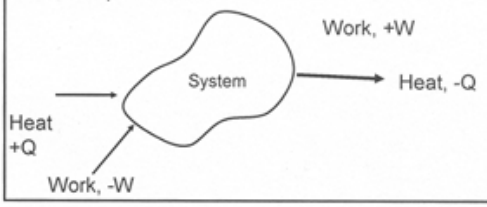
Lecture 3

Introduction 3
Heat, Property, State
The Two Property Rule

Heat Q,q

When two systems initially at different temperatures are in thermal contact an energy transfer occurs, without transfer of mass, this transitory energy is referred to as heat.

Like work heat cannot be stored, it exists only by virtue of the thermal in equilibrium.

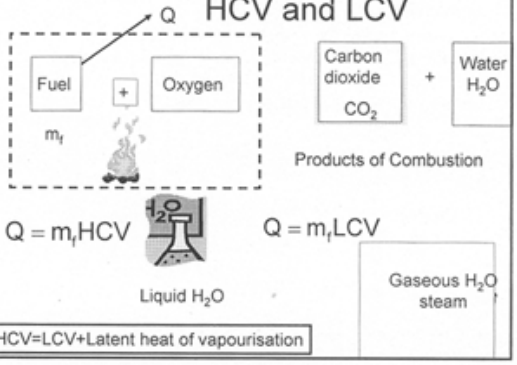


Heat does not necessarily cause a temperature rise, and in exceptional circumstances can induce a temperature decrease.

Heat is not "that which is always present when a temperature rise occurs" since work can also produce a temperature rise.

Heat can be likened to speech between two people, though the effects may remain forever, the conversation ends at the end of the last word.

HCV and LCV



Calorific Values for Gases

Calorific values of gases are normally quoted in J/m^3 at **standard atmospheric conditions**, (a pressure of **1 atmosphere and temperature 15°C**)

Fuel	HCV MJ/m^3	LCV MJ/m^3
Natural Gas	36.2	32.6
Hydrogen	11.8	10.0
Carbon Monoxide	11.7	11.7

Thus if a property of a system, P, is considered during a change of state from 1 - 2

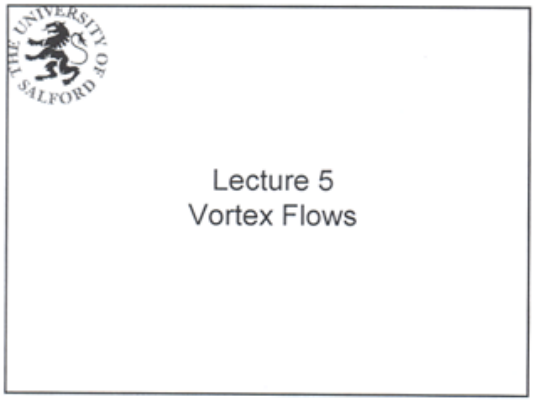
$$\int_1^2 dP = P_2 - P_1$$

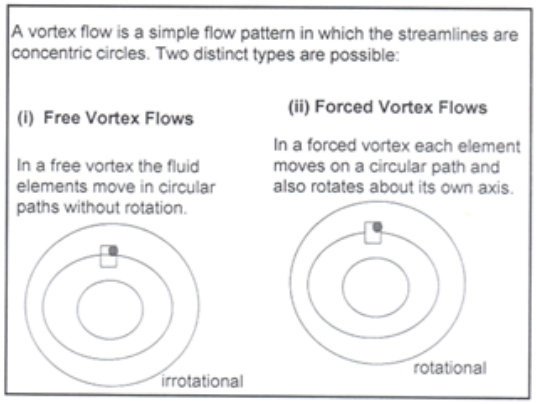
The path of a change of state is the locus of all states through which the system has passed during a change of state.

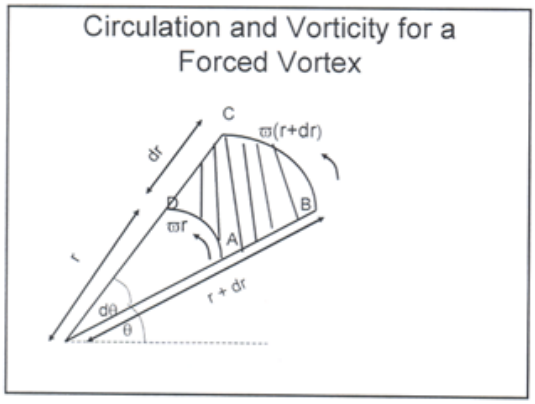
Thus for example the latitude and longitude of fixed points would be properties but not the distance between the points.

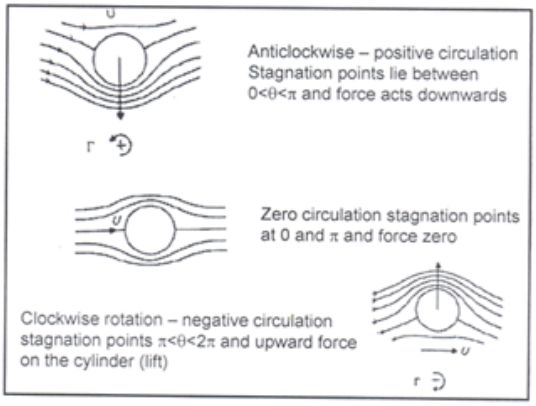
Extensive properties depend upon the quantity of matter e.g. V
Intensive properties are independent of the quantity of matter. E.g. v, p, T

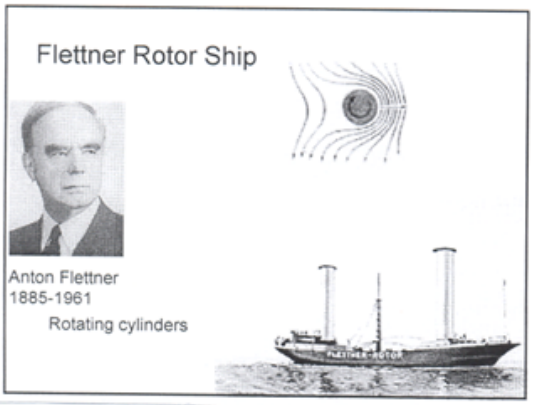
Appendix 3b Sample Lecture Slides for Aerofluids E2.1

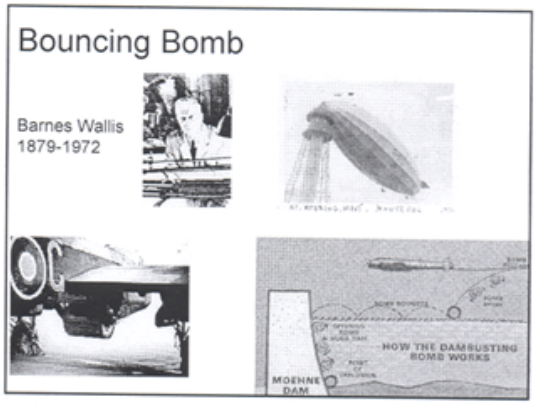






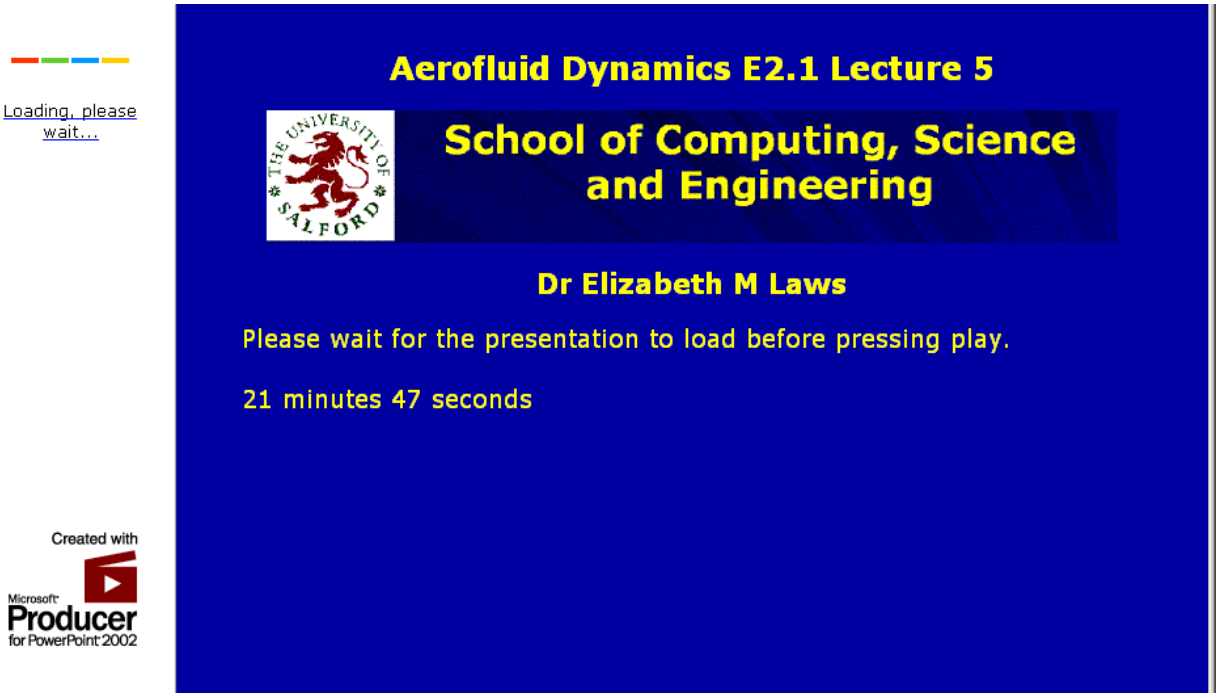






Appendix 4a Sample Screen Shots Showing Output from Ms Producer Fluid Mechanics E1.2

Appendix 4b Sample Screen Shots from Ms Producer Aerofluids E2.1



Appendix 5a Survey Given to Aerofluids E2.1 at the End of the Module

Aerofluids E 2.1 2004-5

Dear Student

I am aware that the Aerofluids module is fairly intensive because of both the volume of material covered and also because it is very mathematical in nature. I have endeavoured to compensate for this by producing good quality teaching materials with some colour and impact (delivered in PowerPoint) and providing you with the opportunity to go over things outside the lectures at your own pace with the pre-recorded lecture CD and also with the Blackboard site.

This year for the first time I have used the interactive whiteboard which I personally feel allows the spontaneity lost in using PowerPoint to be retrieved since annotations can be added as we go, though clearly in room G9 where all our classes have been based the facilities are a bit cramped.

As you know from discussions we have had throughout the delivery of the module I consider it important that you see where the equations we are using have come from though you will handle the compressible flow equations through the tables and in the examination the ideal flow and boundary layer equations will be given to you in the formula sheet provided.

The content and depth of this module has not been diluted and I trust that together with the two level 1 modules (Thermodynamics and Fluid Mechanics) we have studied together you have a firm basis for your further studies in Aerodynamics.

I would now be grateful of you would answer the following questions in addition to the University Evaluative questionnaire. Your comments will be important in helping me to decide how to deliver this module next year.

Dr Elizabeth M Laws

1 I would prefer to have had this module delivered through OHP or chalk and have not gained anything from the PowerPoint delivery method used..

Please tick the box you most agree with

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree

2 I have used the Blackboard site and found it

Very Useful	Useful	Neutral	Little Use	No use

3 I have not used Blackboard as I consider it an unnecessary waste of my time

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree

4 I have found the pre-recorded lectures useful and have used them outside the class

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree

5 I do not think that I should have to know where equations come from I would prefer just to be given them. The maths just confuses me.

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree

6 I can see the relevance of the material covered to aspects of Aeronautical Engineering

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree

Appendix 5b Survey Given to Engineering Thermodynamics E1.1 Students

Engineering Thermodynamics 1.1 2004-5

Please tick the box you most agree with

1 In comparison to other modules you have studied this semester would you describe the Engineering Thermodynamics module as

Very demanding	Demanding	About the same	Less demanding	Easy

2 In terms of the delivery of the module do you find the PowerPoint delivery has helped over conventional delivery (e.g overhead transparencies or chalk)

Very definitely	Definitely	Neutral	Negatively	Disastrously

3 In terms of the material provided through Blackboard to support this modules have you found it

Very useful	Useful	Neutral	Not very useful	No use

4 In terms of the Blackboard assessments staged throughout the module which account for 20% of the module mark have you found that they have encouraged you to study this material on a regular basis

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree

5 If you have re-taken any of the Blackboard assessments do you feel that his has helped you to understand the material more?

Strongly Agree	Agree	Neutral	Disagree	Not applicable

6 As we come to the end of this module do you feel that the time you have allocated to study of the material has been

More than adequate	Adequate	Marginally on the low side	Inadequate	Far too little

7 How do you think that the interactive whiteboard has contributed to the delivery of the module

Very useful	Useful	Neutral	Not very useful	No use

If there are any further comments (positive or negative you would like to add) please add them here.