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An investigation into the influence of cultural background on the mathematics achievements of international Engineering students.

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Abstract: *This exploratory research aimed to identify significant differences of approach to mathematics by engineering students which correlate with their country of previous study. Comparisons were made between students from the UK and those from the Middle East. The research used a written questionnaire in which students were asked about their mathematical influences, tuition, revision, assessment, feelings and beliefs about mathematics. The questionnaire was given to 120 first year undergraduates in engineering at the University of Derby, including 38 from the Middle East and 72 from the UK. Follow up interviews with students determined the structure of mathematics education common in the Middle East. Discussions with teaching colleagues and the University international student advisor further informed the conclusions. The data indicated observable differences in most areas. The most significant were influences and methods of tuition, where self study, closed question solving and the completion of similar exercises were considered more important by Middle Eastern students than by UK students. The research concludes that these data show that differences of approaches to mathematics between Middle East and UK students are not large and are only one factor determining differential performance. Recommendations are made that more subject specific research is carried out across a wider range of cultural backgrounds to help determine the relative importance of academic, cultural and material effects on student performance whilst noting the significant practical advice already published.*

Introduction

The cultural background of students may be a factor in determining the ways in which students have been taught, have learnt and been assessed in mathematics.

Students from different international backgrounds will have had different mathematical experiences prior to starting their undergraduate studies. They will have formed preferences based on their experiences and success and the mismatch between their expectations and preferences and the type of teaching, learning and assessment experienced in the UK may be a factor in their mathematical performance.

Context

Students from the Middle East form a significant group of Engineering undergraduates at Derby and staff feel that they sometimes have different approaches to mathematics learning when compared to UK students. Staff perceptions were that Middle Eastern students found open ended tasks and coursework unfamiliar and demanded very clear direction as to what was required in coursework and in examinations. Operational skills were usually very good but unfamiliar applications seem to cause problems with some Middle Eastern students responding to poor grades by claiming "…you didn't tell me to do that…". The overall grade performance of an identifiable group of students from the Middle East was perceived to be lower than UK educated students.

Research Questions

This research aimed to find if differences existed between the approaches to mathematics preferred by groups of students from different national backgrounds, to see if these differences could be a factor in mathematical achievement, and make recommendations for future tuition and support to improve the performance of students from the Middle East. It is impossible to state that, as groups, UK and Middle Eastern students have an exact parity of mathematical ability on entry. All students are subject to the same entry criteria although this will be through different qualifications. (It is true however that Middle Eastern students obtained an average 8% below their UK educated peers in the grading of their mathematical module at the end of the first semester).

Theoretical Framework

Much has been written and published about the Internationalisation of the Curriculum and the experience of International Students in UK higher education. A major literature review (Caruana, V. and Spurling, N., 2007) identified published work since 1995 citing 116 references in the section headed "The Experience of International Students". Of these sources 55 described International Students as a single cohort, 11 related to Chinese students and 10 to Asian students. There were no references to "Middle Eastern" students as the subject of study. One of the themes of the literature review was the highlighting of the dangers of classifying students as "international" who all have similar characteristics:

> "Many sources cite the prevalence within the wider literature of lecturers' stereotypical views of international students as passive, obedient learners, lacking in autonomy who memorise and are unfamiliar with UK academic culture and are therefore academically 'deficient' (De Vita, 2004; Hills and Thom, 2005; Kingston and Forland, 2004; Morrison et al, 2005; Smith, 2006)". (Caruana, V. and Spurling, N., 2007)

Others point out the variations amongst international students

> "(Morrison et al., 2005) focussed on the academic achievement of international students in the UK and sought to identify factors affecting ability to achieve potential (e.g. region and gender). They found that overall international students achieved fewer 'good degrees'. There was regional variation. Students domiciled in EU, Asia, Africa & Middle East performed less well than UK domiciled students. Those from North & South America, non EU Europe, Australasia did not vary". (Caruana, V. and Spurling, N., 2007)

It should be noted however that academic adjustment is only one of several commonly identified elements of international student performance. Social and material issues can play an important part in their success. Undergraduates may experience a difficult period of adjustment as they begin their studies. International students have to cope with major cultural differences. Changes in climate, diet, social status, economic viability and language, are likely to affect their academic performance. The issue of language changing from Arabic to English has been noted even when students are studying in their own country as students enter Higher Education in Saudi Arabia, "Students usually experience severe problems when the medium of instruction changes from their native language to another one". (Yushau, B. and Bokhari, M.A., 2005)

The literature review concludes with some general comments and recommendations suggesting that further work should be carried out to determine student views: "Studies that consider the student perspective and context should be encouraged across all the themes of the review" (Caruana, V. and Spurling, N., 2007). The significance of issues faced by students unfamiliar with the UK education culture is also stressed. "The research indicates that when studying in the UK, students' focus on adjusting to UK academic culture and learning about 'British style'. This can detract from deeper subject learning". (Caruana, V. and Spurling, N., 2007)

More recently, the "Teaching International Students Project (TIS)", sponsored jointly by the Higher Education Academy Engineering Subject centre (HEA) and the United Kingdom Council for International Student Affairs (UKCISA) and funded by the UK government, produced a large range of information and recommendations specifically related to engineering students. The key resource is "Working with International Students: a Guide for Staff in Engineering", which links to a range of topics including Intercultural Competencies, Academic Writing, Induction, Lecturing, Language, Seminars

and Group work. The evidence for the report comes from contributions from colleagues in UK Higher Education, however the report itself points out that “Very little of the research into culture is based on studies of the educational experience”. (Bond, K. and Scudamore, R., 2010)

The basis for this current study is an understanding that cultural differences exist, that the effect of these varies according to subject and origin of students and that the student perspective and context is worthy of further investigation. This study compares the formative mathematical experiences of engineering students from the Middle East with engineering students from the UK prior to the start of their undergraduate studies.

Methodology

The research was based primarily on data collected from a written questionnaire, supported by performance data, student interviews and colleague discussions.

Questionnaire

Data were collected from 120 written questionnaires, completed collectively in tutor groups, by first year undergraduate students across Civil, Mechanical and Motorsport Engineering programmes. The questionnaire was trialled with a small group of 9 second year, mainly international, students to check that the language was understandable, the only amendment being required was to change the term “mock exam” to “practice examination”, an early indication of language difficulties experienced by international students. Their responses were included making a total of 129 in the data set.

The questionnaire collected data about the student, their mathematical influences, learning preferences and views. Final questions were included to see if students were able to use English effectively when talking about mathematics. The types of questions posed presented a list of optional answers which the students were asked to place in order of importance to them.

Data were subsequently collected about their achievement at the end of the mathematics module taken during their first semester.

Informal semi-structured interviews with students from the Middle East and discussions with colleagues both from engineering and the student international office were used to clarify the formal structure of mathematical education in the Middle East.

Data were analysed to give results for UK students, Internationally educated students and the significant group of Middle Eastern (Iraq, Oman, Qatar, Saudi Arabia and United Arab Emirates) students, to give comparisons between students originating from the UK and those from the Middle East.

The questionnaire is attached in Appendix A. The first set of questions (questions 1-4) aimed to obtain factual information about student ID, country of education, age and entry qualifications.

Question 5 was typical of the types of questions used and related to the *importance* of a range of mathematical influences.

> Qu. 5 “There are many sources that have been used in your mathematics education. Please rank them in order of importance to you giving 1 for most important to for 7 least important”.

Seven options were given: class notes, text book, other students, teacher, self study, family and other e.g. on line

Question 6 asked about ways in which mathematics had been taught and asked for *preferences*.

> Qu. 6 “There are various ways in which students are taught mathematics. Please rank them in order giving 1 for your most preferred to 7 for your least preferred”.

Again seven options were given. The options were not intended to be mutually exclusive but rather to cover a range of open and closed study, pure and applicable study and top down (“Overall objective is described and then the individual elements are taught”) and bottom up study (Mathematics is taught step by step until the overall objective is revealed”). This question showed the most significant differences between students from the Middle East and the UK.

Questions 7 and 8 were about assessment. Question 7 was specific to examinations and ways in which students prepared for them and asked for students’ opinions about *usefulness* of different revision strategies.

> Qu.7 “Which methods of revision have you found most useful when revising for an examination? Please rank them in order from 1 for most useful to 8 for least useful”.

Eight options were given covering a range of strategies adopted by students and facilitated by tutors.

Questions 8 gave students the opportunity to give their feelings about the *reliability* of different assessment strategies

> Qu. 8 “Which methods of mathematical assessment do you feel gives the most reliable indication of your mathematical ability? Please rank in order from 1 most reliable to 6 least reliable”.

Six options were given and covering a range of examination and coursework types.

Questions 9 and 10 were designed to find out students’ views about mathematics in general as opposed to their experiences of mathematics education.

> Qu. 9 “Underline three words that most accurately describe your *feelings* about mathematics”.

Eight words were given which represent feelings about 4 themes. These were facility (easy and difficult), significance (important and irrelevant), student reaction (enjoyable and boring) and utility (useful and fascinating). It is acknowledged that the last pair were both positive giving a slight positive bias to the possible selections.

> Qu. 10 “Do you *believe* that all mathematics already exists and can be discovered or do you think that it is invented by mathematicians. Please underline discovered or invented”.

This question may have required a deeper depth of understanding and thought than others in the questionnaire, but was included as the answer has been suggested to be culturally based and is a much discussed question in academic studies of the philosophy of mathematics education. “The controversy between those who think mathematics is discovered and those who think it is invented may run and run, like many perennial problems of philosophy”. (Ernest, P., 1998)

Question 11 invited students to write about differences between their current and previous mathematical education experiences.

> Qu. 11 “Have you noticed any significant differences between the ways in which you are being taught, are learning and being assessed in mathematics, compared to your previous experience”?

Question 12 was included to allow students to demonstrate their facility in the use English to write about a familiar mathematical concept.

> Qu. 12 “Many people would describe a straight line as the shortest distance between two points. How else would you define a straight line?

This question was using mathematics as a vehicle for the use of English. The placing of the question at the end of the questionnaire, and the particular topic given to be described, may have been a factor in the poor quality of the responses however.

Overall the questionnaire was designed to reveal students approaches to mathematics by basing questions around the use of a variety of descriptors such as importance, preference, usefulness, reliability, feeling and belief.

The questionnaires were given separately to four groups of students between November 2011 and February 2012 after a very brief introduction to explain its purpose. There was no time limit although all groups completed the questionnaire in around 20 minutes.

Supporting Information

Student performance data were collated using final grades achieved in semester 1 mathematics modules. This produced a smaller sample (90) as some students had dropped out or had not yet taken a final grading in a mathematics module.

Follow up semi structured interviews were held with selected Middle Eastern students to determine in more detail their previous educational experience. Students were selected on the basis of their country of education. The questions related to language of instruction, methods of instruction, structure of qualification, duration and frequency of tuition and method of assessment. It was clear that most

students had similar experiences and so the interviews were limited to 8 students from across the Middle East.

Once preliminary analysis of the results was made, the findings were shared with participating engineering colleagues and their reflections used to inform the discussion of the results.

A separate discussion was held with the University international student advisor to place the findings in the context of the whole University experience to determine if the results were similar or different on a subject and country of origin basis.

Findings

The country of study of the 129 student participants is shown below (figure 1).

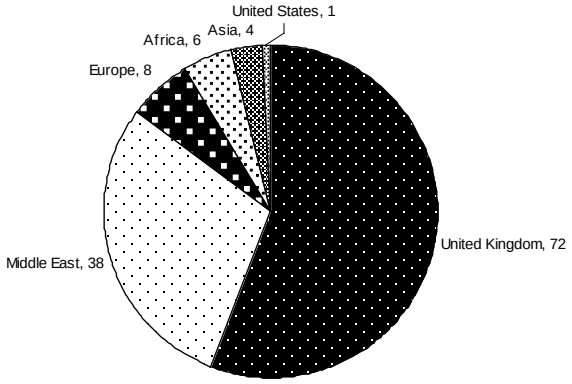

Figure 1: Country of Study of student participants

The main analysis of results is based on a comparison of two groups of students. The first is the group of 72 UK educated students and the second is a group of 38 Middle Eastern educated students. The remaining 19 international students did not form a single common group suitable for comparative analysis.

The mean age for groups was similar (UK 22.0 and Middle East 22.6) although the spread was slightly wider for the Middle East group.

The analysis and findings for each of questions 5 to 9 are presented in the same way.

The tabulation presents the orders of preference for both groups of students. The charts show preferences in UK order as this represents the majority of students against which Middle Eastern student responses are compared and indicate the relative importance given to each option within each group.

Instances where Middle Eastern students have ranked an item in their top three that does not appear in the UK students' top three are highlighted and discussed.

The rankings given to options outside the top three are generally disregarded in the analysis as they probably represent "just completing the task" although the least favoured may be significant.

The analysis of the data is concerned with the order in which students have placed options. In some cases students chose to give equal rankings to different options in which case the options were ranked as1,2,2,4,4,6 giving ranking scores of 6,5,5,3,3,1. This procedure does not affect the overall order of preferences but does have the effect of slightly inflating the individual ranking scores.

Generally the responses are fairly similar between the two groups although there are some interesting differences.

The analysis of the results of question 5. (Figure 3)

Q5 Sources of mathematics education: ↓ most important / least important	
UK students	Middle East students
Teacher	**Teacher**
Class notes	**Class notes**
Text book	**Self study**
Other students	Text book
Self study	Other students
Others sources e.g. on line	Family
Family	Other sources e.g. on line

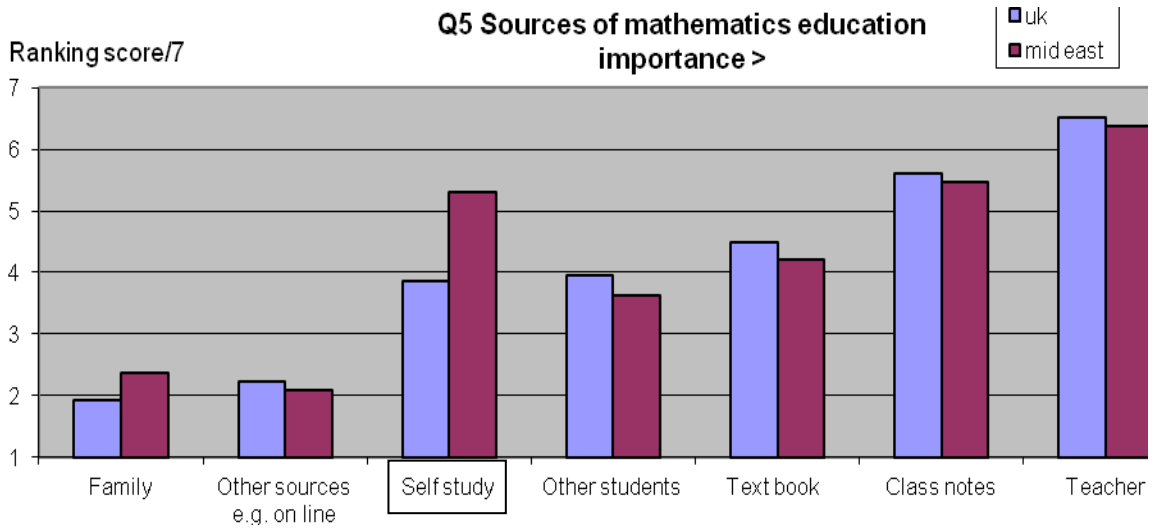

Figure 2: Qu.5 Sources of Mathematics Education

It is comforting to note that the teacher is seen as the most significant source of education for nearly all students! The main significant difference is in the importance given to self study by Middle Eastern students. Possible interpretations of this suggested by colleagues and supported by evidence from student interviews is that a significant part of the method of instruction experienced by Middle East students is the expectation that a large amount of drill and practice is demanded.

Analysis of the results of Question 6 (Figure 3)

Q6 Teaching/learning techniques: ↓	most important least important
UK students	Middle East students
Taught step by step then objective revealed	**Taught step by step then objective revealed**
Objective described then elements taught	**Solving maths questions with definite solutions**
Topics referenced to practical applications	**Doing similar written exercises after tuition**
Solving maths questions with definite solutions	Objective described then elements taught
Doing similar written exercises after tuition	Topics referenced to practical applications
Physical task e.g. laboratory investigation	Open investigation with no specified outcome
Open investigation with no specified outcome	Physical task e.g. laboratory investigation

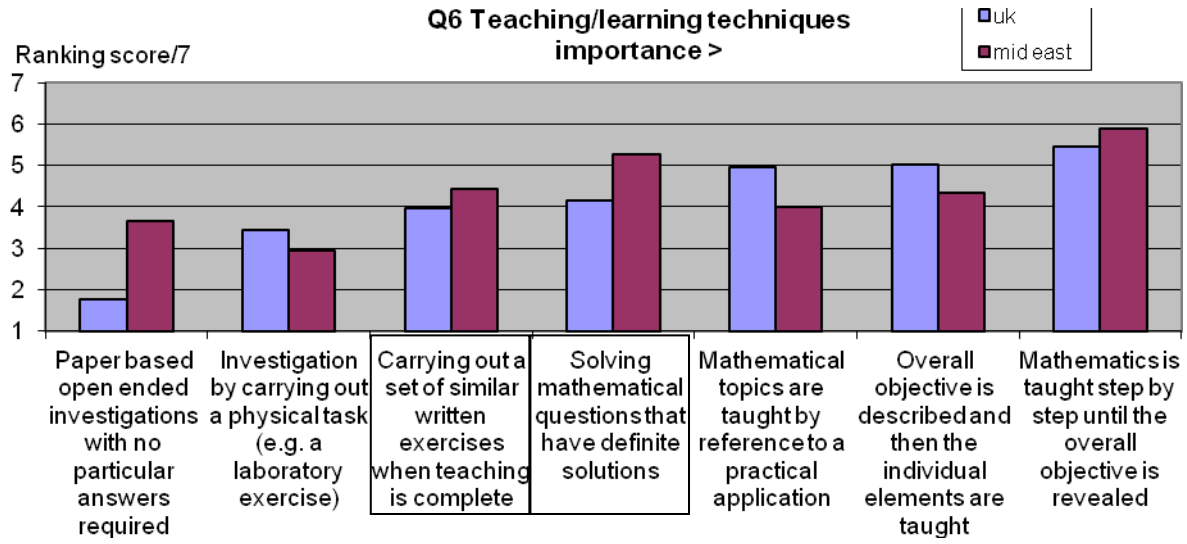

Figure 3: Qu. 6 Teaching and Learning Techniques

This question revealed significant differences. Middle Eastern students clearly prefer solving closed questions and working on problems similar to those that have been taught and see learning much more in these terms than students from the UK. Teaching by practical application is not included in the Middle Eastern top three possibly suggesting that mathematics is seen as a pure rather than an applied study by this group.

Although least preference selections are not generally commented on it is interesting to note that open ended investigations are ranked higher by Middle Eastern students than by UK students. 95% of UK students placed this option in their bottom three with 56% placing it last. This compares with 59% of Middle Eastern students placing it in the bottom three with 4% placing it last. This may suggest a previous bad experience by UK students, Middle Eastern students may be basing their response on unfamiliarity with this type of assessment.

Analysis of the results of Question 7 (Figure 4)

Q7 Methods of revision: ↓	most important least important
UK students	Middle East students
Using class notes	**Using class notes**
Completing previous examination papers	**Attending revision classes**
Working through exercises	**Completing previous examination papers**
Attending revision classes	Working through exercises
Using revision books	Writing own revision notes
Writing own revision notes	Using revision books
Using text books	Using text books
Attending a practice examination	Attending a practice examination

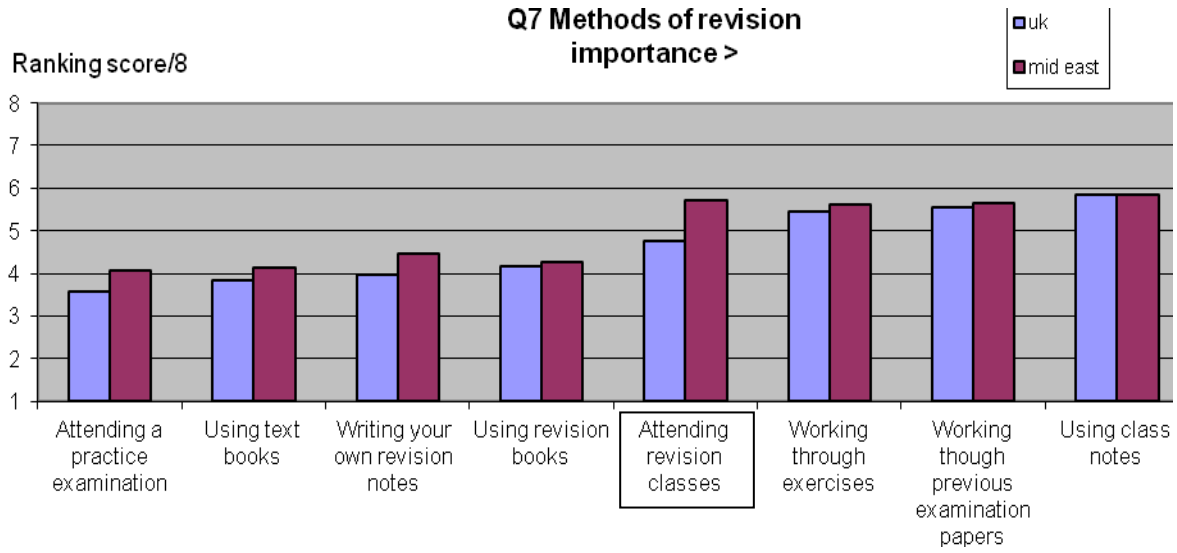

Figure 4: Qu. 7 Methods of Revision

The results are similar for both groups and do not show strong differentiated preferences, although there is more importance attached to attending revision classes by Middle Eastern students. This may be linked to student expectations that clear instructions about the content of an examination are likely to be given although the evidence from this data is not entirely clear.

Analysis of the results of Question 8 (Figure 5)

Q8 Reliability of assessment techniques: ↓ most important / least important	
UK students	Middle East students
Regular submission of portfolio of work	**Coursework with clear objectives to answer**
Coursework with clear objectives to answer	**Regular submission of portfolio of work**
Examinations with pre published questions	**Examinations with pre published questions**
Examinations without pre publication of questions	Oral examination
Investigation with outcomes self determined	Investigation with outcomes self determined
Oral examination	Examinations without pre publication of questions

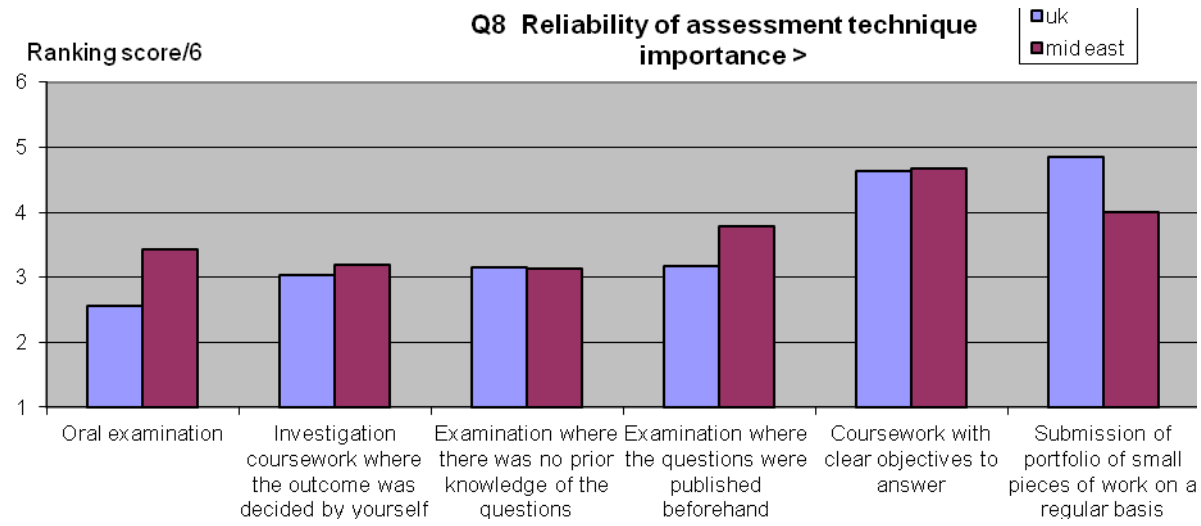

Figure 5: Qu. 8 Techniques of Assessment

Although the top 3 preferred assessment techniques were the same for both groups there was a greater preference by Middle Eastern students for clearly directed coursework. This supports a Middle Eastern student preference for clear direction and closed questions. It also may be a result of unfamiliarity with the submission of a portfolio of work used as graded coursework and used at Derby in many modules. The use of coursework was one of the main themes of difference that were highlighted during the student interviews. Students from the Middle East were unfamiliar with the concept of coursework in assessment as it had played no part in assessment or grading of awards in their previous school study although one student was very familiar with the practice.

The use of oral examinations was significantly more popular amongst Middle Eastern students. This was an unexpected result as the use of a foreign language for assessment would not appear to be an attractive option. However a subsequent discussion with a mature student who was also a Technical College teacher in Saudi Arabia pointed out that informal oral assessment in Arabic was widely used as a supplement to written formative assessment and so Middle Eastern students felt comfortable with this technique in their native language.

It was perhaps an oversight in the questionnaire design that “open book” examinations were not included although pre-published examination questions were included. It should be noted that the questionnaire asked about *reliability* of assessment methods so a certain degree of honesty was expected from students, responses may well be more based on *satisfaction* of grades achieved.

Analysis of the results of Question 9 (Figure 6)

Q9 Feelings about mathematics: ↓ most important / least important	
UK students	Middle East students
Important	**Important**
Useful	**Useful**
Difficult	**Enjoyable**
Enjoyable	Difficult
Fascinating	Easy
Boring	Fascinating
Easy	Boring
Irrelevant	Irrelevant

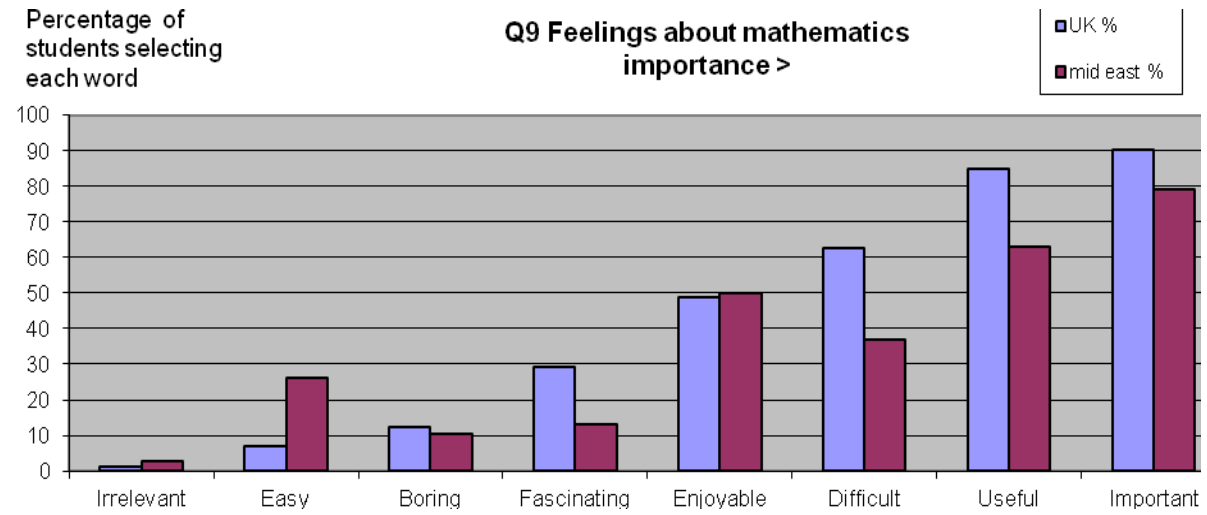

Figure 6: Qu. 9 Feelings about Mathematics

There were similar responses from both groups with 85% of all students selecting “important” and 75% of all students selecting “useful” in their top 3 reflecting views about utility and significance rather than empathy. There were differences however, “difficult” being chosen more often by UK students than “enjoyable” whereas these two were reversed by Middle Eastern students. Other interesting minor differences are between the numbers of times easy and fascinating were selected by the different groups, UK students preferring fascinating to easy, Middle Eastern students reversing these two.

Analysis of the results of Question 10 (Figure 7)

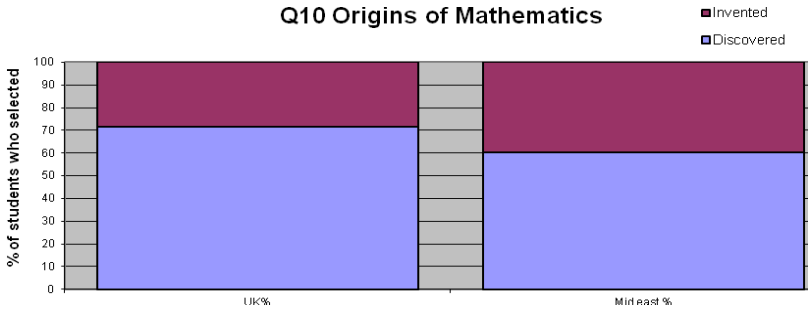

Figure 7: Qu. 10 Origins of Mathematics

The results from the two groups are very similar with discovered favoured by about twice as many students as invented. As previously noted, the depth of understanding of the question was probably not present during the questionnaire,although it more interesting to note that the result is clearly not a random answer which would have given a 50/50 split. The answer is in agreement with the assertion that "...absolutist philosophies of mathematics are still the dominant view. Absolutists believe that mathematical truths are universal, independent of humankind (mathematics is discovered, not invented), and culture- and value-free. (Ernest, P., 1998)

In a subsequent Middle East student interview it was clear that the student was prepared to engage in a discussion of this point and eventually summarised the situation as "...we invent new ways to discover mathematics...". neatly sidestepping the rather academic philosophical point.

Analysis of the results of Question 11; Differences

The level of response to this question was considerably higher from UK students than Middle Eastern students probably due to a facility with language but also possibly a reluctance on the part of Middle Eastern students to be critical. Only 50% of Middle Eastern students responded other than yes, no or a blank and although the difference of Language was mentioned in several Middle East responses there were no other major differences noted.

Analysis of Question 12 Definition of a straight line

The answers to this question by most students reflected the difficulty of the question. A brief selection is given.

UK students
"A straight line is the average distance between a curved line"
"Infinite radius"
"A line which runs at the same angle for its full length"
"A straight line could be drawn through an angle of 180deg. A straight line has no curves and is consistent"
"How long is a piece of string? A straight line can be anything"
"By describing everything that it isn't"

Middle Eastern students
"A line that moves only in one direction from the first point toward the second and in a straight direction without doing any turning"
"It is a line traced by a point travelling in a constant direction"
"180deg"
"A line between - infinity and + infinity
"Straight line is a straight line it doesn't matter if its shortest or longest distance between two points"
"Length of anything else"

Again the use of language was clearly a factor for all students but the ability of UK students to explain their understanding of the term "straight line" using their native language was disappointing. The data does not show that that language was a major differentiating factor between UK and Middle Eastern students in the responses offered to this question although this barrier has been noted elsewhere. (Yushau, B. and Bokhari, M.A., 2005)

Student interviews and Colleague discussions

Interviews with students from the Middle East indicated a typical mathematics learning experience of teacher led learning followed by extensive practice and mastery of techniques using textbooks as the source of exercises. The understanding of a textbook's content was seen as the necessary and sufficient source of information required for assessment success. The use of coursework in summative assessment was very unusual and examinations were often in the form of multiple choice answers. The use of investigative mathematical exercises was entirely unknown. There was a mix of languages used in secondary education, the majority of students having been taught in Arabic but with some taught in English, generally in private high schools.

Teaching colleagues felt that Middle Eastern students were often more competent than their UK peers at the operational aspects of mathematics, but were less confident about applying techniques in different or unfamiliar applications. Although these were stereotypical responses as noted elsewhere (Caruana, V. and Spurling, N., 2007) there was some supporting evidence in the data and student interviews. There were anecdotes about students repeating rote learnt solutions from previous examination papers and the author has experienced instances of the submission of large amounts of only marginally relevant information, rather than task specific information, in coursework. The author also experienced one very competent Middle Eastern student who was indignant that mathematics was being taught in a very graphical way (especially calculus), an approach he found vastly inferior to the methods he was familiar with.

The University international student support officer provided a wider non subject specific perspective of the academic problems encountered by international students. These included unclear direction about what was required in coursework, an expectation that lectures were the complete source of information required and a difficulty in understanding the contestability of information given. Students were unfamiliar with presentations and having to support their opinions.

Recommendations

Although the data from this research provide some evidence of differences between Middle Eastern and UK students, it is inconclusive about the link between cultural background and mathematical approach. Further research with students from other cultural backgrounds (especially from China and from western Asia) may clarify whether or not there is a relationship between culture and approaches to mathematics and provide more evidence for comparitive studies with students from the UK.

There are some excellent published materials about working with international students in Engineering which contain many practical ideas to help with the integration of International students, especially in the use of Group and Project Based Work (Dales, R., McClaren, M., Steiner, S., 2011). Integration is one of the key ways in which the experience of international and UK students can be enhanced and academic performance improved.

Information from International colleagues describing student expectations of UK Higher Education would be particularly useful so that UK colleagues can prepare effective induction programmes specific to mathematics disciplines.

Teaching colleagues can mitigate cultural differences by being aware of them, respecting them, and discussing them with students. Mathematics is an international language. It is expressed mainly through the medium of numeric and operational characters although linguistic problems should not be ignored, especially with the use of terminology. It does not have the same problems as many other academic disciplines which use an alphabetic and culturally based language for communication and assessment. For this reason it should be more easy to minimise the effect of cultural background on academic achievement in mathematically based subjects than in other non numeric disciplines.

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Appendix A Questionnaire

Prior experiences of Mathematics Education

The purpose of this questionnaire is to collect information about the mathematical experience of students prior to studying here.

The information will help the University ensure that students from different backgrounds are not at a disadvantage because of the ways in which they have learnt, been taught and assessed previously.

The information will not be used for any other purpose and will not be disclosed to any third party without the express permission of participants.

Reporting of findings will not refer to individual participants in an identifiable way. The requirement for a student ID is only made so that follow up interviews with selected participants can be requested in the future.

Thank you for agreeing to participate.

The first questions are about you		
1	What is your student ID?	
2	What is your age?	
3	In which country(s) did you study mathematics from the age of 14 to 18 or immediately before joining the University of Derby (UoD)?	
4	What mathematical qualifications did you achieve prior to joining UoD? (e.g. A levels, National Certificate/Diploma, NVQ, HNC/D, other- please specify)	

The next 2 questions are about your experience of learning mathematics		
5	There are many sources that have been used in your mathematics education. Please rank them in order of importance to you giving 1 for most important to for 7 least important.	RANK
	Class notes	
	Text book	
	Other students	
	Teacher	
	Self study	
	Family	
	Other sources e.g. on line	

6	There are various ways in which students are taught mathematics. Please rank them in order giving 1 for your most preferred to 7 for your least preferred.	RANK
	Overall objective is described and then the individual elements are taught	
	Mathematical topics are taught by reference to a practical application	
	Mathematics is taught step by step until the overall objective is revealed	
	Solving mathematical questions that have definite solutions	
	Paper based open ended investigations with no particular answers required	
	Investigation by carrying out a physical task (e.g. a laboratory exercise)	
	Carrying out a set of similar written exercises when teaching is complete	

The next 2 questions are about mathematics assessment		
7	Which methods of revision have you found most useful when revising for an examination ? Please rank in order from 1 most useful to 8 for least useful	RANK
	Using revision books	
	Using text books	
	Attending revision classes	
	Working though previous exam papers	
	Using class notes	
	Writing your own revision notes	
	Working through exercises	
	Attending a practice examination	

8	Which methods of mathematical assessment do you feel gives the most reliable indication of your mathematical ability? Please rank in order from 1 most reliable to 6 least reliable	RANK
	Coursework with clear objectives to answer	
	Oral examination	
	Examination where there was no prior knowledge of the questions	
	Submission of portfolio of small pieces of work on a regular basis	
	Investigation coursework where the outcome was decided by yourself	
	Examination where the questions were published beforehand	

The next 2 questions are about your views of mathematics		
9	Underline three words that most accurately describe your feelings about mathematics:- Easy boring important irrelevant useful enjoyable difficult fascinating	

10	Do you believe that all mathematics already exists and can be discovered or do you think that it is invented by mathematicians. Please underline discovered or invented	

The last 2 questions are open for you to write whatever you wish	
11	Have you noticed any significant differences between the ways in which you are now being taught, are learning and being assessed in mathematics, compared with your previous experience?
12	Many people would describe a straight line as the shortest distance between two points. How else would you define a straight line?

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