

**The effect of Learner Autonomy on student
performance in GCSE Mathematics in a private
school in Dubai, U.A.E.**

أثر التعلم الذاتي على أداء الطلاب في مادة الرياضيات
في المدارس الثانوية الخاصة في دبي بدولة الامارات العربية المتحدة

By

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Abstract

The teaching, learning and assessment of Mathematics has become a cause of concern from educational stakeholders the world over. One of the main causes of concern is that student's around the globe are underperforming in Mathematics assessments. According to the Programme for International Student Assessment (PISA) Mathematics assessment in 2009, just 30.7% of participating countries were above the international benchmark mean expectation. One of the roots of this underperformance in mathematics is based on students' maths anxiety, which is akin to an unwanted feeling by students towards mathematical problems. A possible method of reducing students' maths anxiety is for them to become more autonomous with their own learning and have a higher sense of self efficacy. Learner autonomy is a concept mainly found in an ELT context, and at its core were concepts that could be applicable to a mathematics context. The impact of learner autonomy on student's performance in a GCSE Mathematics exam was investigated in this study. The study took place in a private school in Dubai, United Arab Emirates over a four month period. Students participated in Yellis assessment at the beginning of Grade 10 that predicted their performance in their GCSE examinations. Data collected in this study was a combination of both qualitative and quantitative data, gathered from three questionnaires given to the participants. Additionally a statistical analysis was undertaken comparing Yellis baseline predictions, students own predictions and actual GCSE performance. The findings suggest that improved autonomous learning by students improved their performance in GCSE Mathematics. The students had become more reflective on their own learning, set realistic targets for themselves, could identify different learning strategies and became more responsible for their learning. The findings also showed that students own predictions were closer to actual performance than the Yellis baseline predictions. The study recommends that core aspects of learner autonomy be implemented into a learners' educational life earlier and the need for a student centred curriculum be implemented, similar to the International Primary Curriculum (IPC) currently in existence. The study also recommends the further investigation into the role of teacher autonomy impacting on learner autonomy.

Keywords: Student performance, Mathematics, Maths self efficacy, Learner Autonomy, GCSE Mathematics, Yellis, Maths Anxiety.

ملخص

أصبح التعليم والتعلم والتقييم لمادة الرياضيات من الأمور المسببة للقلق لكل المختصين وأصحاب المصلحة التعليمية في كل أنحاء العالم . ومن أهم الاسباب الرئيسية لهذا القلق هو أن الأداء العام لجميع الطلبة في أنحاء العالم أصبح ضعيفاً. فوفقاً للبرنامج الدولي لتقييم الطلبة (PISA) فان نسبة تقييم مادة الرياضيات للعام 2009 كانت (30.7%) فقط فوق المؤشر المتوسط الدولي المتوقع بالنسبة للدول المشاركة.

ومن أسباب هذا الأداء الضعيف في مادة الرياضيات هو القلق من قبل الطلبة تجاه هذه المادة ، بالإضافة إلى شعورهم غير المرغوب فيه تجاه المسائل الرياضية.

لذا فإن هناك طريقة ممكنة للحد من قلق الطلاب حيال هذه المادة ، كما تساعد على الإستقلال في العملية التعليمية بالإضافة الى أنها تمكنهم من رفع مستوى أدائهم الذاتي. وهذه الطريقة هي "التعلم الذاتي" وهو مفهوم وجد في سياق الـ ELT وفي جوهرها وهو ينطبق مع سياق مادة الرياضيات.

لقد تم إجراء دراسة على تأثير التعلم الذاتي على الطلبة في أداء امتحان مادة الرياضيات في الـ GCSE في إحدى المدارس الخاصة في دبي وعلى مدى أربعة أشهر. وقد شارك في التقييم طلاب من الصف العاشر الذين تم تقييم أدائهم في امتحانات الـ GCSE مسبقاً خلال اختبار الـ Yellis.

كما تم جمع مجموعة من البيانات النوعية والكمية تخص هذا التقييم من خلال ثلاث استبانات تعطى للمشاركين. بالإضافة إلى التحليل الإحصائي لاختبارات الـ Yellis ومعه التقييم في الأداء الفعلي للـ GCSE.

هنا نجد أن النتائج تشير إلى أن التعلم الذاتي من قبل الطلاب أدى إلى تحسين الأداء في مادة الرياضيات في الـ GCSE. فقد أظهر الطلاب تعبيراً أكثر عن العملية التعليمية الخاصة بهم ، كما وضعوا أهدافاً واقعية لأنفسهم بالإضافة إلى أنهم حددوا استراتيجيات مختلفة في التعلم وأصبح لديهم إحساس بالمسؤولية أكثر تجاه تعلمهم. ونجد أيضاً أن النتائج قد أظهرت أن العلامات التي حصلوا عليها وجدت أفضل من التي حصلوا عليها من اختبار الـ Yellis.

ويجدر بالذكر هنا أن هذه الدراسة تؤكد على أن يتم تنفيذ أسلوب التعلم الذاتي في وقت مبكر أكثر من عمر الطالب على غرار المنهاج الدراسي الابتدائي الدولي (IPC). كما تؤكد على دور المعلم في تطبيق أسلوب التعلم الذاتي على الطالب.

النتائج الرئيسية: أداء الطلاب، الرياضيات ، الرياضيات والتعلم الذاتي ، الطالب والتعلم الذاتي رياضيات الـ GCSE ، اختبار الـ Yellis ، القلق من مادة الرياضيات.

Dedication

I would like to dedicate the time and effort that I devoted to this project to my family. To my mother and father, for always helping me out, supporting me and guiding me, this is for you. To Siobhán, Brigid and Seán for always being there for me. To my grandmothers' Nana O'Shea and Nana Dundon (R.I.P.) your prayers and wishes have gotten me to where I am today, I am grateful beyond words to you both. To Helena for being so supportive, understanding and sacrificing so much for me and the time to do this project. Finally, to Matthew, for all those Saturdays together, I may have left you behind but it has been a pleasure working alongside you, good luck with the completion of your own study (shake and bake!).

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Chapter 1 Introduction

1.1 Overview

The teaching, learning and assessment of mathematics, has been an area of concern for some time now. In 2009 the Organisation for Economic Co-operation and Development (OECD) continued with its Programme for International Student Assessment (PISA) testing around the world. PISA testing is administered every three years in several countries around the world, it tests English reading, mathematics and science each time all areas are tested but the focus of each test changes from year to year. In 2009 its focus was English reading and in 2012 its focus will be Mathematics. Students aged between 15 and 16 years of age are tested and are selected randomly. Reviewing the 2009 data (see Appendix 1), on the Mathematics PISA scale, of the 65 countries participating only 20 scored above the recommended mean score of 500 which means that only 30.7% countries are above the recommended benchmark. The average mean score was 496 points. The top five positions were occupied by Asian countries China (600 points), Singapore (562 points), Hong Kong (555 points), Korea (546 points) and Chinese Taipei (543 points). If we look at the Middle East and North Africa (MENA) region it alarming as the results were Qatar (368 points), Tunisia (371 points), Jordan (387 points) and Dubai, United Arab Emirates (453 points). This shows that students in the MENA region are significantly under achieving in mathematics in comparison to global standards and alarming behind Asian countries.

1.2 The Dubai Context

According to the Dubai Statistics Office (DSC, 2010, p1) in 2010 the population of the emirate of Dubai, U.A.E. was 1,905,476 people, of which 217,985 people are in full time education. The dominant religion is Sunni Muslim and the dominant languages spoken are Arabic and English. The Knowledge & Human Development Authority (KHDA) is a recently

established wing of the Dubai Government. “The Dubai Schools Inspections Bureau (DSIB) is an organisation within the KHDA developed to define and measure education quality in order to support the improvement of education in Dubai” (KHDA WEBSITE). It has been conducting inspections in Dubai for the past 3 academic years (2008/2009, 2009/2010 and 2010/2011) in both private and public sector schools. According to Jameela Al Muhairi, Chief of DSIB, “only through inspection can we understand where we are excelling in education and where we need to focus our attention on development” (DSIB, 2008, p.1). DSIB awards schools a rating as follows 1 Outstanding, 2 Good, 3 Acceptable and 4 Unsatisfactory. The ratings are based on KHDA quality indicators that are available to all schools. Figure 1 shows that 215 schools were inspected in this past academic year. A total of 12 schools out of 215 were awarded the ‘outstanding’ rating by KHDA/DSIB. Dr. Abdulla Al Karam, Chairman and Director General of KHDA, stated that “private schools have seen a 13% improvement and public schools a 22% improvement in their performance since 2009/2010” (KHDA, 2011, P.8).

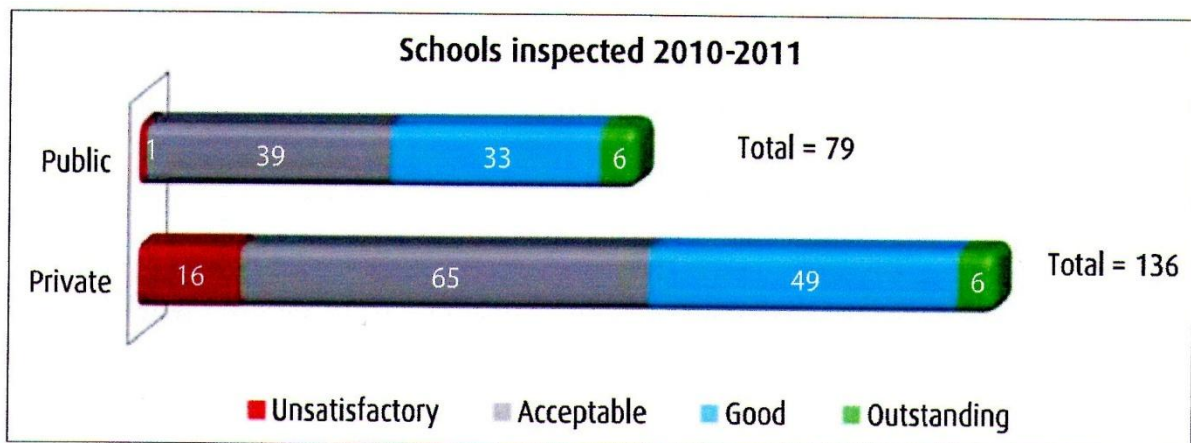


Figure 1. Schools inspected by KHDA in the academic year 2010/2011 (KHDA Annual Report 2011)

1.3 Statement of the problem

On a normal school day thousands of students around the world feel the same way. They have an increased heart rate, sweaty palms and sweat on their brow no it is not the school bully but more likely to be Maths class. There has been a decrease in student performances in Maths assessments around the world. One cause that has contributed to this decrease is maths anxiety. Richardson and Suinn (1972, p 551) defined maths anxiety as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations”. Ma & Xu (2004) explain that maths anxiety is a distasteful feeling students experience while doing assignments or performing math related daily routine. Maths anxiety is an emotional not an intellectual obstacle faced by students and adults alike. Maths anxiety is related but distinct from test anxiety. Hembree (1990) conducted a meta-analysis of students and concluded that mathematics anxiety correlated with, but was separate from test anxiety. Sheffield and Hunt (2007) conducted a study of 48 students in relation to maths anxiety and performance and concluded that “maths anxiety has a direct effect on performance on maths tasks” (p22). They went on to conclude that “a brief behavioural intervention decreased maths anxiety and improved performance”. In fact Bandura (1997) suggested that the most diminishing effect of maths anxiety concerned maths efficacy. Empowering students to become more autonomous with their learning should help students to improve their performance in mathematical assessments. Students with better autonomy of learning will reflect more on the learning that has taken place and set themselves realistic goals with which they can achieve their targets. Learners take a greater responsibility for their own learning as well as mastering information at their own pace. Maths efficacy and learner autonomy will be discussed further in the Literature Review chapter of this study.

1.4 Research Context

School X has a strong Islamic ethos at its core and as such male and female students are taught on different sides of the secondary school. In the primary school males and females are grouped by sex and taught as a single sex class by a teacher. The school is located in Dubai, U.A.E. and was established in 1998 to meet the needs of ambitious children in the local community. It provides the English National Curriculum plus Arabic and Islamic Studies & History. There are 1520 students on roll and 98% of them speak English as a second language, with Arabic being the language used at home.

According to the KHDA the U.K. curriculum had the second highest student population in the academic year 2008/2009 (see figure 2). This shows that a large population of students are entered into the U.K. curriculum but very few of them are U.A.E. national students. This is what makes School X somewhat unique in Dubai in that it offers a dual curriculum and have a high U.A.E. National student population (77.8%) attending the school. In figure 3 we can see the breakdown of school in sections in 2010/2011 by curriculum.

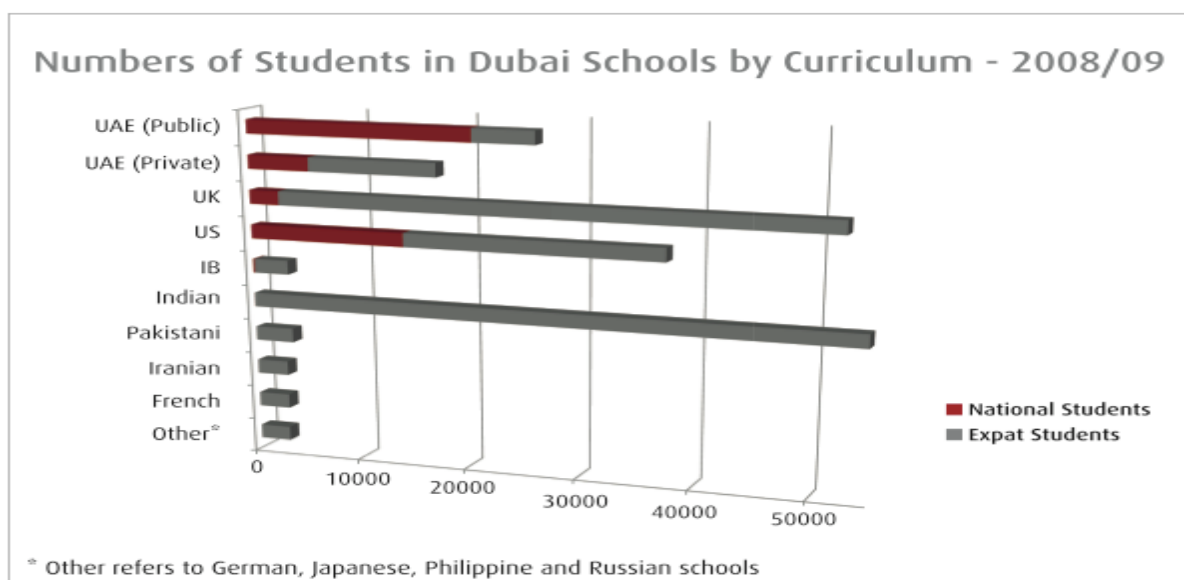


Figure 2: The breakdown of National students in Dubai schools by curriculum. Source: *The Role of International Assessments and School Inspections in the Reform of Education in Dubai, 2009*: (KHDA 2009, p.4)

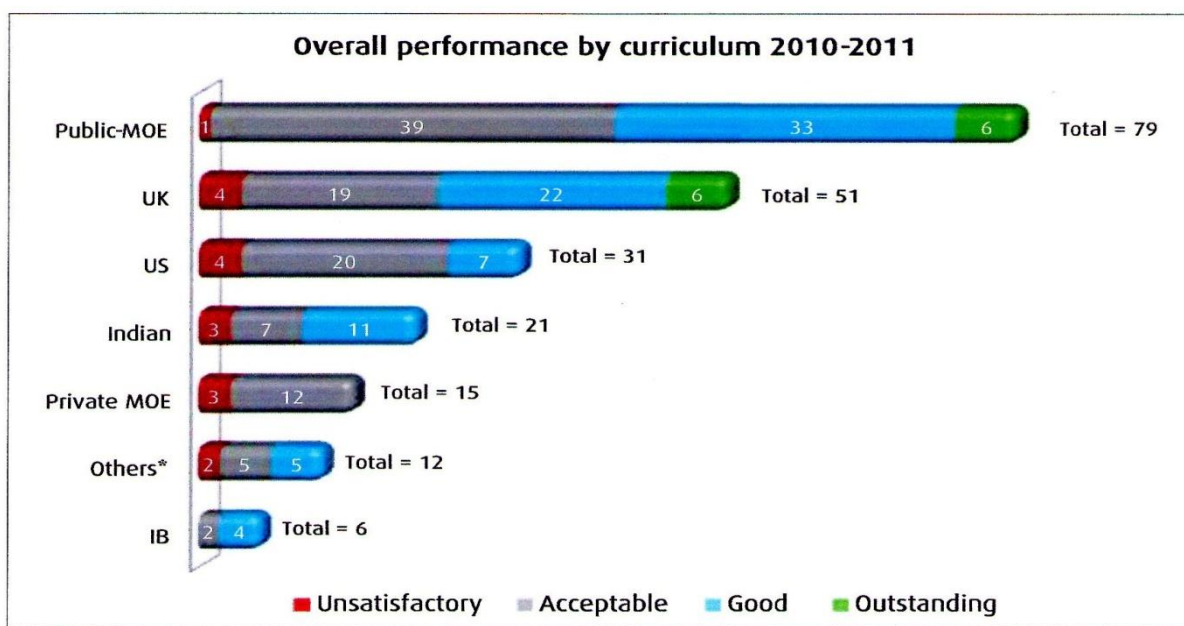


Figure 3: Schools inspected by KHDA by Curriculum in the academic year 2010/2011 (KHDA 2011, p. 21)

In the last 3 academic years School X has been rated by the KHDA as follows; 2008/2009 ‘Acceptable’, 2009/2010 ‘Good’, 2010/2011 ‘Good’ but with some outstanding features. School X has shown a continued improvement in ratings by KHDA standards since the school inspections started in Dubai. On June 2nd 2011 an additional inspection was done of School X by the British Schools Overseas (BSO) inspection team. The team was made up of 3 inspectors who were all Ofsted qualified. The BSO rated School X as ‘outstanding’, in accordance with the Ofsted quality indicators.

1.5 Mathematics in School X

Mathematics is taught five times a week at Key Stage 4/GCSE level. There are two sets of students at GCSE level, the higher and lower sets. The sets to which students were assigned is based upon student performance in a National Curriculum Key Stage 3 SAT Exam. This exam was taken at the end of Grade 9 and is a levelled exam e.g. papers are set

by difficulty Level 3-5, 4-6, 5-7, 6-8 (see Appendix 6, Mathematics Level descriptors). The participants in this investigation have been taught by the same teacher in Grade 10 and 11. In the DSIB inspection in February 2011 the Mathematics department ‘attainment’ was rated as ‘outstanding’. The BSO inspection in June 2011 in which the Mathematics department was again rated as outstanding with particular mention of the Mathematics attainment results. The verification of these rating is shown below. Table one shows how School X GCSE performance measures as compared with the U.K. National Average, this is a cumulative total of results. It is a cumulative frequency table that shows that School X had 89% of its students score A* to C in Mathematics in 2010. The U.K average of 57.25% shows that School X’s mathematical results are 31.75% better than the U.K. schools. According to Ofsted examiner guidelines, if a school’s attainment is 20% or better compared with U.K. average then that school has outstanding student attainment in that subject. Table two shows the Mathematical results School X has achieved in the past 4 year. This was used to estimate the 2011 performance along with teacher predictions as well.

2010 GCSE Maths	A*	A	B	C
School X	28.5%	42.7%	78.4%	89%
U.K. National Average	4.6%	15.4%	30.9%	57.25%

Table 1: School X Mathematics performance in 2010 compared with the U.K National Average.

A* - C	2007	2008	2009	2010
School X	68%	63%	79%	89%

Table 2: School X A*-C Mathematics performance for the past 4 academic years.

1.6 Background to the research

1.6.1 Trends in International Mathematics and Science Study (TIMSS)

In 2007 Dubai participated in the TIMSS testing for the first time. TIMSS tested students' mathematical and scientific ability at Grade 4 and Grade 8. TIMSS conducts these tests every four years. In 2007 a select number of schools were chosen for students to take the test, School X was one of the chosen schools. The male students who took part in TIMSS 2007 from School X are also the same students in this investigation. TIMSS tests put an emphasis on questions and tasks that offer better insight into the analytical, problem-solving, and inquiry skills and capabilities of students. Dubai's overall performance in 2007 is shown by curriculum in Table. It shows that Dubai National Average for Year 8 Mathematics was 461, this falls below the TIMSS International Average score of 500.

Dubai TIMSS 2007 achievement by curriculum²			
Type of Curriculum	% of students	Mathematics Mean	Science Mean
Year 4			
<i>Public schools</i>			
National Curriculum	16	398	404
<i>Private schools</i>			
National Curriculum	7	374	367
CBSE (Indian)	27	422	458
US	9	461	465
UK	41	480	496
National Average		444	460
Year 8			
<i>Public schools</i>			
National Curriculum	22	378	427
<i>Private schools</i>			
National Curriculum	8	424	453
CBSE (Indian)	26	474	507
US	9	471	488
UK	35	505	522
National Average		461	489
International Average		500	500

Table 3: TIMSS results by curriculum in Dubai. (KHDA 2009, P. 7)

It is worth noting that the U.K curriculum is the only curriculum in Dubai to score over the TIMSS International Average. According to TIMSS Dubai's performance was significantly higher than all other Gulf Cooperation Countries (GCC) in Maths and Science. These statistics reflect the Mathematical standard of students within Dubai and across the GCC region.

1.6.2 Baseline Testing: Yellis

Yellis is a skills based assessment and not a knowledge based assessment.

“(Year 11 Information System) is a value-added monitoring system that provides a wide range of performance indicators and attitudinal measures for students in the last two years of compulsory schooling (i.e. aged 14-16). It is part of the family of information systems offered by the Centre for Evaluation and Monitoring (CEM) at Durham University and is one of the most comprehensive monitoring systems in use today.” (CEM website <http://www.cemcentre.org/yellis>)

School X has been using Yellis as its baseline testing for the past 4 years. The school uses the Computer Adaptive Baseline Test (CABT) instead of the traditional baseline test from CEM. All of the students in Grade 10 in School X sit the CABT in the first term of the year, usually in late September or early October. The CABT is broken down into 4 different sections; Patterns, Maths, Vocabulary and Questionnaire sections. The CABT is an adaptive test that asks the student a moderately simple question, if the student answers correctly he will be asked a more difficult question. In the event the student answers incorrectly a slightly easier question is asked. This process continues within the time allocated so the test gathers an accurate measure of the ability of the student being tested. This measure is then compared with all students in the CEM database to narrow down students UK National Curriculum level/GCSE Grade. The CABT provides the school with the probability of the students GCSE

grade in their subject choices but it does not predict the grade. The CEM also carries out a Value Added analysis when the school submits the students GCSE grades to them. Feedback is provided at the student, subject and school level with the data for each baseline cohort analysed separately.

1.6.3 Students sitting GCSE Assessments

In the United Kingdom, students sit a General Certificate of Secondary Education (GCSE) at Key Stage 4. GCSE's are the chief qualification taken by students aged 14 and 16 years, GCSE's are usually studied full time at school or in a secondary college and take a minimum of five school terms to complete. GCSEs are available in a wide range of subject areas and such variety is used to assist students further in life in higher education. GCSE has different assessment requirements as well, subjects such as art and design or English have a large portion of course work and fewer exams, the sciences (physics, chemistry and biology) can be set in modular or linear courses. The GCSE has 2 difficulty levels as well, these being higher tier (grades A* - E) and a foundation tier (grades C – U). There are five examination boards of which schools can be members. School X is a member of the Edexcel examination board (www.edexcel.org.uk). GCSEs form the lower levels (levels 1 and 2) of the National Qualifications Framework (NQF) and the Qualifications and Credit Framework (QCF) within the United Kingdom, see table 4. The students from School X who participated in this study studied a linear Mathematics course which took place over 2 academic years and the same students were taught by the same teachers over that period of time. Mathematics at School X is assessed by 2 linear papers, one non calculator paper and one calculator paper, both papers have a total of 100 marks on offer and each paper is 90 minutes in duration.

Level	Examples of NQF qualifications	Examples of QCF qualifications
Entry	<ul style="list-style-type: none"> - Entry level certificates - English for Speakers of Other Languages (ESOL) - Skills for Life - Functional Skills at entry level (English, maths and ICT) 	<ul style="list-style-type: none"> - Awards, Certificates, and Diplomas at entry level - Foundation Learning at entry level - Functional Skills at entry level
1	<ul style="list-style-type: none"> - GCSEs grades D-G - BTEC Introductory Diplomas and Certificates - OCR Nationals - Key Skills at level 1 - Skills for Life - Functional Skills at Level 1 	<ul style="list-style-type: none"> - BTEC Awards, Certificates, and Diplomas at level 1 - Functional Skills at level 1 - Foundation Learning Tier pathways - NVQs at level 1
2	<ul style="list-style-type: none"> - GCSEs grades A*-C - Key Skills level 2 - Skills for Life - Functional Skills at Level 1 	<ul style="list-style-type: none"> - BTEC Awards, Certificates, and Diplomas at level 2 - Functional Skills at level 2 - OCR Nationals - NVQs at level 2
3	<ul style="list-style-type: none"> - A levels - GCE in applied subjects - International Baccalaureate - Key Skills level 3 	<ul style="list-style-type: none"> - BTEC Awards, Certificates, and Diplomas at level 3 - BTEC Nationals - OCR Nationals - NVQs at level 3
4	<ul style="list-style-type: none"> - Certificates of Higher Education 	<ul style="list-style-type: none"> - BTEC Professional Diplomas Certificates and Awards - HNCs - NVQs at level 4
5	<ul style="list-style-type: none"> - HNCs and HNDs - Other higher diplomas 	<ul style="list-style-type: none"> - HNDs - BTEC Professional Diplomas, Certificates and Awards - NVQs at level 5
6	<ul style="list-style-type: none"> - National Diploma in Professional Production Skills - BTEC Advanced Professional Diplomas, Certificates and Awards 	<ul style="list-style-type: none"> - BTEC Advanced Professional Diplomas, Certificates and Awards
7	<ul style="list-style-type: none"> - Diploma in Translation - BTEC Advanced Professional Diplomas, Certificates and Awards 	<ul style="list-style-type: none"> - BTEC Advanced Professional Diplomas, Certificates and Awards
8	<ul style="list-style-type: none"> - specialist awards 	<ul style="list-style-type: none"> - Award, Certificate and Diploma in strategic direction

Table 4: U.K. Qualifications by level across the NQF and QCF (U.K. Governmental website)

1.7 Research Aims

This investigation will explore what the impact learner autonomy has on their performance in a GCSE Mathematics exam. Students were set a Yellis prediction for their performance in Mathematics and by improving students' autonomy can that impact on them improving upon their predicted grade. The investigation is looking at a way of improving

students' perception and performance in Mathematics as well starting them on the path to become lifelong learners. The study examined how to improve student's performance by helping them to become more autonomous with their learning of Mathematics. The investigation ran from February until June of 2011. There was a single sex sample of 20 students, of Grade 11 male students. To discover students' attitudes, ideologies, predictions and responsibilities three questionnaires were distributed over the course of the experiment. A mixed methodology approach was taken: quantitative and qualitative questions were asked to students in the questionnaires as well as a statistical analysis of Yellis predictions, student's own predictions and actual student performance. The Yellis baseline testing formed the empirical basis for analysis along with students own predictions. The following 3 research questions guided this investigation:

- To what extent does the effect of students own predictions and responsibilities have on their actual performance in a GCSE Mathematics exam?
- To what extent does the effect of students own attitudes and ideologies have on their actual performance in a GCSE Mathematics exam?
- How has the availability of additional classes aided the performance of the participants in the GCSE Mathematics exam?

1.8 Significance of Research

In these times where mathematical student achievement has been established as being low compared with international standards, students are not performing significantly well in mathematical assessments. The cause of this poor performance is maths anxiety. One way of overcoming maths anxiety is for students to become more autonomous in their learning and as a result better their own mathematical self efficacy and go on to achieve significantly

better mathematics grades. If students can become more autonomous with their learning, will this impact their own beliefs about their ability and therefore affect the mathematical grade they achieve compared with what an independent external baseline test estimates what students will get? If this is found to be true then it may be a possible method to be used in the battle by educators to improve student attainment in mathematics around the world.

Chapter 2 Literature Review

2.1 Overview

For a number of years education around the world was ingrained in a paradigm that Barr & Tagg (1995, p.13) describe as ‘the instruction paradigm’. They describe the need for a paradigm shift from the instruction paradigm and into the learning paradigm (see table 5). They suggest that education’s ‘mission is not instruction but rather to produce learning with every student by whatever means is best’ (p.1). Modern education should be concerned with learner outcomes and not learner summative attainment outcomes. This suggested change in paradigm showed that the focus of classrooms around the world should not be on teachers but rather on the student and the quality of learning that is taking place. This alternative approach to educational thinking places the learner at the fulcrum of the education experience and assists in bringing about this paradigm shift. It placed learning and student success outcomes at the centre of any success criteria in a classroom. Teachers are no longer to be seen as lecturer’s acting independently from their students, but instead working together to improve student learning and develop competencies. This different perspective on education verifies that a paradigm shift has taken place, conceptually but not practically. Modern education has moved away from positivist and behaviourist approach toward a constructivist and socio-cognitive approach to education.

Comparing Paradigms	
The Instruction Paradigm	The Learning Paradigm
<i>Mission & Purposes</i>	
Provide and Deliver Instruction Transfer Knowledge from faculty to students Offer courses and programs Improve the quality of instruction	Produce Learning Elicit student discovery and construction of knowledge Create powerful learning environments Improve the quality of learning
<i>Criteria for success</i>	
Inputs, resources Quality of entering students Curriculum development, expansion Quantity and quality of resources Enrollment, revenue growth Quality of faculty, instruction	Learning and student-success outcomes Quality of exiting students Learning technologies development, expansion Quantity and quality of outcomes Aggregate learning growth, efficiency Quality of student, learning
<i>Nature of Roles</i>	
Teachers are primarily lecturers Teachers and students act independently and in isolation Teachers classify and sort students Staff support the process of instruction Any expert can teach Line governance, independent actors	Teachers are primarily designers of learning methods and environments Teachers and students work in teams with each other Teachers develop every students competencies and talents Staff are educators who produce student learning and success Empowering learning is challenging and complex Shared governance; teamwork

Table 5: Comparing Educational Paradigms (Tagg & Barr, 1995, p.13)

According to Watson & Reigeluth (2008, p 42) ‘the current school system strives for standardization and was not designed to meet individual learners’ needs’. They also mention that ‘current schools were established to fit the needs of an Industrial Age society’ while the rest of the world has moved from the ‘Industrial Age’ to the ‘Information Age’ education has stayed rooted in the past and not adapted to the needs or demands of it modern society. The current system needs to ‘meet the needs of Information Age learners and their communities by allowing students the time that each needs to reach proficiency’ (Watson & Reigeluth 2008, p 43). Reigeluth (1994) went further and compared the two ages directly (see Table 2). Additionally Reigeluth (1994) maintained that the ‘Industrial Age school system was highly compartmentalised learning into subject areas, and students are expected to learn the same

content in the same amount of time'. This type of approach to schooling does not take account of different learners, approaches to teaching and developments in teaching and learning. It brands all students like a factory would with a production date, and all students move along at the same pace, learning the same material regardless of cognitive functioning ability or multiple intelligences. Watson & Reigeluth (2008, p 44) stated that students need to be given ' flexibility to achieve levels at their own pace, not having to wait to see for the rest of the class or being pushed into learning beyond their developmental level'. The developments since the Industrial Age signal the demand for modern day education to be learner centered and not simply classify learners based on their birth dates. For this to happen it cannot just be a basic change in a school or classroom, there needs to be a seismic shift in education focus across the world and by all stakeholders involved in education.

Industrial Age	Information Age
Autocratic leadership	Shared Leadership
Centralized control	Autonomy, accountability
Adversarial relationships	Cooperative relationships
Standardization (production/marketing/communications)	Customization (production/marketing/communications)
Compliance	Initiative
Conformity	Diversity
One way communications	Networking
Compartmentalization (division of labour)	Holism (integration of tasks)

Table 6: Key components of Industrial Age vs. Information Age (Reigeluth (1994) p43)

Within this movement towards a new learning paradigm there has been an impetus for students to learn more by themselves than to be dependent on a teacher or instructor. For a long time students relied upon teachers for all aspects of their learning, Moore asserts that "this kind of learning too easily reflects the goals of the teacher, and ignores the values and ends of the learner himself" (Moore 1972, p81). Students are to be seen as more independent than dependent on others for their learning. This new concept of independent learning soon became a broad umbrella under which a number of education concepts were related to

include individualization, studentship, self efficacy, student centred learning, autonomous learning and self directed learning. Jacobs and Farrell (2001, p4) listed eight changes that form part of the paradigm shift conceptually toward a learning paradigm. These eight suggested changes were 1) learner autonomy, 2) cooperative learning, 3) curricular integration, 4) focus on meaning, 5) diversity, 6) thinking skills, 7) alternative assessment and 8) teachers as co-learners. For a number of years autonomous learning suffered from an identity crisis as there was a misconception within education that autonomous learning was the same concept as independent learning. The confusion occurred when researchers favoured the expression 'independence' to 'autonomy' which created two terms for the same concept. If 'independence' and 'autonomy' were the same concept then the opposite of these terms is 'dependence' which is an over-dependence on teachers and the materials that they used. The same can be said therefore of 'interdependence' being the opposite of 'independence'. Yet Benson (2001, p.15) claims that "many researchers would argue that autonomy does imply interdependence". This crisis of identity was resolved when researchers looked at autonomy in a classroom situation and as a 'social context' for learning and communication (Breen 1985; Breen & Chandlin 1980). The most prominent research in this area was done by Leni Dam in Denmark, where autonomy developed through negotiation of curriculum and classroom tasks (Dam 1995). The success of this research incited a movement in the direction that research took and classroom practice became the focal point of it. Autonomous learning had therefore broken free of the shackles of independent learning and became a concept by itself. In fact Deci (1996, p89) points out that :

“Independence means to do for yourself, to not rely on others for personal nourishment and support. Autonomy, in contrast, means to act freely with a sense of volition and choice. It is thus possible for a person to be independent and autonomous.”

2.2 So what is Learner Autonomy?

The foundational definition for learner autonomy was given by Holec in “Autonomy and Foreign Language Learning”, a report which was commissioned and published by the Council of Europe in 1979 (cited here as Holec 1981). Holec stated that learner autonomy is the ability to take charge of one’s own learning. This definition is based on the belief that education should “develop the individual’s freedom by developing those abilities which will enable him to act more responsibly in running the affairs of society in which he lives”(Holec 1981, p.1). Learner autonomy thus appears to sit comfortably with constructivist theories of learning (Little 2007, p.16). This definition by Holec has in the past been allied with Western liberal democracy and as a result it has been linked to a prospective tool of colonialism. Education is often viewed as a political tool used by countries and this educational concept could have been viewed as a form of colonialism. Western countries could have been viewed as using Holec’s concept as a form of manipulation over countries who implemented it into their own educational systems. Others felt that because it originated in Western civilisation that the concept would not transmit across borders and cultures. Since Holec, there has been both extensive and diverse research done on learner autonomy (Arnold 1999; Boud 1988; Benson 2001; Chan 2001; Cotterall 1995; Crabbe 1993; Dam 1995; Dickinson 1995; Lee 1998; Little 1995). Learner autonomy has predominantly been used in an English as an Additional Language (EAL) classroom and by English Language Teachers (ELT) across the world as a way for students to master the English language and to improve proficiency and understanding of the English language by non-native speakers. According to Cotterall (1995, p220) “the practical argument for promoting learner autonomy is quite simply that a teacher may not always be available to assist”. The American psychologist Deci (1996, p2) stated that “autonomy is one of the three basic needs that humans need to satisfy so that they gain a

sense of self- fulfilment”, the other two being competence and relatedness. The “concept of autonomy serves less as a focal point for educational reform and more as a means of identifying the interests of learners within this changing landscape of teaching and learning” (Benson, 2007, p734).

Holec (1981, p.3) defined autonomy as “the ability to take charge of one’s own learning” but what specifically does that mean to us as educators? A later definition was put forward by Little (1991, p4):

“Autonomy is a *capacity*- for detachment, critical reflection, decision making and independent action. It presupposes, but also entails, that the learner will develop a particular kind of psychological relation to the process and content of his learning. The capacity for autonomy will be displayed both in the way the learner learns and in the way he or she transfers what has been learned to wider contexts.”

This quote by Little is more specific than Holec’s definition as it gives a broader and more in depth meaning to the concept. It briefly outlines the intrinsic aspects (critical reflection etc) of the concept as well as stating the parts of the capacity that are linked to autonomy. He also outlined the way in which the learner displays their autonomy which lends itself to measurement and further analysis. Holec’s definition was the starting point of this concept but Little has taken that idea and evolved into something more tangible, meaningful and measureable while Holec’s definition was indistinct and formless. Broadly speaking autonomy consists of a combination of capacities and abilities that involve behavioural and psychological aspects of learning. According to Benson (2007, p738) the “essence of autonomous behaviour does not lie in the behaviour itself, but in the fact that it is authentic, self initiated and considered—factors that are extremely hard to assess”. Arnold (1999, p 144) takes the “view that the core of learner autonomy is a psychological construct.....as important a construct as it can influence the feeling of autonomy”. Breen & Mann (1997, p 52) suggest

that learners who are expected to develop autonomous learning may just 'put on the mask of autonomous behaviour' in order to meet the requirements of a course. Little (1991, p7) also outlined what it means to take charge of one's own learning in that the learner is responsible for all decisions concerning all aspects of this learning:

- Determining objectives
- Defining the contents and progressions
- Selecting methods and techniques to be used
- Monitoring the procedure of acquisition
- Evaluating what has been acquired

Little (1991, p3) went further and described what autonomy is not:

- Synonymous with self direction
- A matter of how learning is organized
- Something that teachers do to their learners
- An easily describable behaviour
- Is not a steady state achieved by certain learners

These guidelines outlined by Little have impacted classrooms around the globe. Looking at these guidelines shows that the learner will become more involved in the curriculum mapping as well as the objectives of lessons. Also places a large onus on the learner to be motivated to learn each day. This may be difficult to adapt in classrooms as it transfers some of the power from the teacher into the hands of the learner. This is a huge hurdle to overcome by teachers as they may fear losing control in their classrooms if such events occurred. Little also pointed out that it is not something that teachers do to their student's, this in itself is difficult to comprehend as a teacher as many of them see themselves as the only source of

control and knowledge within a classroom environment. One area where Little fails to mention is students intrinsic motivation to learn everyday and start taking ownership for their learning regularly. The intrinsic motivation is different from student to student but additionally the extrinsic motivation shown to these students by their teachers and their learning environments will differ hugely from student to student.

Learner autonomy is not just an ideal but can be grown intrinsically by learners from a starting point that learners already possess in some form. Learner autonomy is not learners attempting to be responsible or taking control of their Learning. It is their capacity to manage their learning by determining the goals that they can achieve and how to achieve them, as well as reflecting on past successes and failures. Learner autonomy can be viewed as an inborn capacity that learners possess which has basically been subdued by the approaches of modern day education which is institutionalised education. There has been a shortage of any type of student-centred curriculum developed and seen to have been successful, as a student-centred curriculum would focus on formative assessments while most curriculum are dependent on summative assessments. The vast number of educational shareholders determines that modern schools are accountable for the results they get every year and as such summative assessments will always be viewed as more important than formative assessments. For students to cultivate their own autonomous self they must not just be isolated from a teacher and left to their own devices but through guidance and encouragement students develop the capacities they need to become autonomous. Additionally, students' who lack autonomy are more than capable of advancing their learning if they are given the correct guidance and encouragement in certain conditions and environments. Candy (1991, p. 9) spoke about the situation when teachers "deliberately surrender certain prerogatives" about students learning and is followed by a "concomitant acceptance of responsibility by the learner or learner". The role of teacher autonomy and the role it places in developing learner

autonomy will not be examined further in this investigation because teacher autonomy is a multifaceted concept in itself and needs further examination and research. Autonomous learning can be stated as being more effectual compared with non-autonomous learning for student learning and attainment of knowledge. Learner autonomy must not therefore be seen as a totem that will manufacture better learners but as a skill that learners can use along with their own cognitive processes in becoming a better learner both inside and outside of the classroom.

2.3 Self Efficacy

According to Cobb (1990) learning involves both a personal and social construction of meaning. Banduras' (1986) social cognitive theory pointed out that self-referent thought mediates between knowledge and action, and through self-reflection individuals evaluate their own experiences and thought processes. Bandura (1995) goes on to mention a concept called 'self efficacy' which he defined as the "beliefs in one's capabilities to organize and execute the course of action required to manage prospective situations"(p.2). Ehrman (1996, p.137) stated that it was the "degree to which the student thinks he or she has the capacity to cope with the learning challenge". Ehrman here uses the term capacity that Little used to describe autonomy in learning. Erhman mentions the capacity to cope with the learning challenge but here fails to give any reference as to how a learner could possible cope with this learning challenge. Little outlines aspects of the capacity with autonomy but Erhman here fails to do likewise as what he has mentioned is imprecise. Pajares (1996, p 545) went further and stated that "self efficacy beliefs are strong determinants and predictors of the level of accomplishment that individuals finally attain." Pajares in the same article (p546) spoke about the individual's own "capabilities to attain designated types of performances and achieve specific results". Pajares mentioned a learners' cognitive beliefs and structures. It is the learners' intrinsic capability to generate realistic goals for themselves based on previous

experiences and also approaches as to how to attain the targets set by themselves. Bandura (2008, p 129) has stated that “self-efficacy thus exerts a substantial independent effect on performance”. Furthermore self-efficacy judgements are both task and situation specific in that individuals make use of these judgements in reference to some type of goal (Bandura, 1986 with; Pintrich and Schunk, 1995). Pajares and Miller (1994, p194) stated that “self-efficacy is a context-specific assessment of competence to perform a specific task, a judgment of one's capabilities to execute specific behaviours in specific situations.”

An area of interest among researchers has been the relationship between student performance in mathematics and students mathematical self efficacy beliefs. According to Hackett & Betz (1989, p262) “maths self efficacy is a situational or problem specific assessment of an individual’s confidence in her or his ability to successfully perform or accomplish a particular task or problem.” Mathematics self efficacy is a mediator variable between mathematics attitudes and mathematics achievement (Randhawa, Beamer and Lundberg 1993, p46). Based on these definitions we can assume that students who have high self-efficacy will be more successful in tasks they approach and assessments they undertake. Jaafar and Ayub (2010, p520) pointed out that students self efficacy towards mathematics has an influence on mathematics performance. Additionally Hackett & Betz (1989) found that there is a moderately strong relationship between mathematics self efficacy and mathematics performance. Furthermore studies conducted by Campbell and Hackett (1986) as well as Hackett, Betz, O’Halloran and Romac (1990) found that students’ own beliefs in their mathematical ability played an important factor that contributed to their achievement in mathematics. Bandura (1986) and Schunk (1991) verified that self efficacy beliefs can determine student’s performance in mathematics. Bandura (1986) deemed self efficacy to be more predictive of future performances than such global indicators as confidence in learning

mathematics. A study by Siegel, Galassi & Ware (1985, p56) found that the self efficacy model enhanced student performance in mathematics compared with the mathematics aptitude/anxiety model.

According to Iossi (2007), maths anxiety accounts for the worrying statistic of academic failure in mathematics. Bandura (1997, p137) defined anxiety as, “a state of anticipatory apprehension over possible deleterious happenings”. Furthermore Ma & Xu (2004) define maths anxiety as ‘a distasteful feeling students experience while doing assignments or performing math related daily routine’. Bandura (1997) went on to suggest that the most diminishing effect of maths anxiety concerned maths efficacy. Lavasani, Hejazi & Varzaneh (2011, p 561) proposed that any action that can increase the person’s sense of efficacy is the most powerful action in avoiding maths anxiety. They also go on to mention that “supporting student’s autonomy and providing him/her with the opportunity to make mistakes...will increase self efficacy and therefore the individual’s maths anxiety will decrease”.

2.4 Self efficacy and Learner Autonomy

A learner who has a high self efficacy value will direct his learning processes and attainments by setting challenging goals for himself (Bandura, 1989; Schunk, 1989). Zimmerman (1989 and 1990) mentioned that learners exhibit a high sense of efficacy in their capabilities, which influences the knowledge and skill goals they set for themselves and their commitment to fulfil these challenges. Furthermore Zimmerman (1992, p664) mentioned that studies have shown that teaching low achieving students to set proximal goals for themselves enhances their sense of cognitive efficacy, their academic achievement, and their intrinsic

interest in the subject matter (Bandura & Schunk, 1981; Schunk, 1984). According to Bandura (1986), goals increase people's cognitive and affective reactions to performance outcomes because goals satisfy the requirements for personal success. This is similar to Holec's viewpoint that autonomous learners determine learning outcomes for themselves. Additionally Zimmerman (1989) stated that self-regulated learners (who have a high self-efficacy value) apply appropriate strategies to achieve their goals. This compares with Holec's ideology that autonomous learners 'select methods and techniques' to be used in their own learning and in order for their own learning to progress further. Bandura & Cervone (1983) noted that students whose self-efficacy was high would also enlist self-regulative influences that motivate and guide their efforts. This belief is akin to Holec's standpoint that autonomous learners 'monitor and evaluate' how learners acquire new information and use it for their own progression. Students with a high belief of their own efficacy values will show greater persistence in overcoming tasks and an improved work ethic that will help them view hurdles to learning as challenges that need to be mastered and not obstacles that need to be avoided. Autonomous learners will also exhibit traits of persistence and effort as their own learning progresses. They will use both intrinsic abilities & capabilities to further their own learning and can further use collaboration with peers and a teacher intervention to assist them in mastering their own learning progress. These two concepts, self-efficacy and autonomous learning, fit together in that a student's self-efficacy is based upon his own cognitive functioning and processing while a student's autonomy will be a behavioural approach to his own learning. A student who has high self-efficacy can also be an autonomous learner. Both concepts have similar approaches to goal setting; students select their own methods of learning and progression, students monitor and take corrective action for their learning and that learners are reflective on the paths and methods they have chosen for their own learning.

As identified in a previous chapter, one of the causes of students poor mathematical achievement is a concept called maths anxiety. Learner autonomy and maths self-efficacy have been recognised as possible solutions to the problem of maths anxiety amongst learners. Maths self-efficacy is the cognitive functioning of students concerning their own beliefs and goal setting capacities which is strongly linked and very similar to learner autonomy. Learner autonomy is the practical application of students setting their own targets and approaches about how to improve their performance.

Chapter 3 The Present Study

3.1 Overview

The investigation phase of this study sought to discover if students becoming autonomous with their own learning had an impact on their performance in a Mathematical GCSE exam. Also it looked at how students own perceptions of their ability contrasted with Yellis baseline probabilities and their actual performance. The empirical research application of this study was in the form of three questionnaires administered to participants at various stages of the study. These questionnaires provided the researcher with the student predictions, own responsibilities, attitudes and ideologies necessary for this investigation. Additionally, a statistical analysis was undertaken to contrast the Yellis baseline probabilities, student's own predictions with actual performance. Lastly, one group of participants was given extra contact time with their teacher in order to establish if increased student/teacher contact time improves autonomy in students. The offer of additional contact time was originally offered to both groups but the higher set felt they did not need more assistance, thus the additional time available was for the lower set students only.

3.2 Gaining Entry & Ethical Issues

The researcher worked at School X during the time frame of this investigation. Verbal approval to carry out the experiment was received from the principal of the school so long as students' real names were not used in the findings (see Appendix 5, Ethical approval form). The researcher used student numbers in gathering and presenting data in order to protect the real identities of the students who took part in the experiment. The researcher also received the approval of the Director of Studies to utilize data from Yellis and students actual GCSE results. The study was conducted between the February and June of 2011. Initially the study was supposed to be conducted with both male and female participants involved. This approach would have provided data on both gender and nationality comparisons as well as the value added performance of all sets of students. This approach was adjusted due to the cultural and traditional values/morals of young Arab women spending time with a male. To overcome these issues and barriers the study evolved into an investigation into the GCSE Mathematics performance of male students only within a private British curriculum school in Dubai.

3.3 Methods of Data Collection

For the purposes of this study the researcher used questionnaires as the method of data collection. Oppenheim (1998) refers to questionnaires "as an important instrument of research, a tool for data collection". Questionnaires were used as it was not as time consuming as a case study or interview, but it also has a high response rate. The respondents were school students in Grade 11 and as such the questionnaire was designed on the belief that "it should look as easy as possible to the respondent but also look professionally designed (Bradburn & Sudman, 1982)". The researcher was very aware of the effect bias has on data collection and as thus chose questionnaires as the method for data collection.

“This method of data collection ensures a high response rate; accurate sampling and a minimum of interviewer bias, while permitting interviewer assessments, providing necessary explanations (but not the interpretation of questions) and gives the benefit of a degree of personal contact.(Oppenheim, 1998)” “Unlike oral response methods, questionnaires remove interviewer bias and permit the respondents answers to remain anonymous.”

These questionnaires were administered to the respondents during a Mathematics class time so they were done as group administered questionnaires. The disadvantage of group administered questionnaires is that “contamination (through copying talking or asking questions) is a constant danger” (Bradburn & Sudman, 1982).

3.4 Collection of Quantitative Data

The quantitative data collection carried out in this experiment was broken down into two areas. The first is the Yellis student probability compared with the students own prediction and their actual GCSE performance. (Table shows the Yellis probability and the students own predictions about their performance.) The GCSE results would not be released by the examination board until August. This quantitative data was used to calculate the student’s performance in terms of ‘value added’ (Yellis baseline probability compared with actual performance). It also provided an insight into students own evaluative ability as it looks at how students thought they would do in their GCSE and how they actually did perform.

Student	Yellis Maths		Student Own Prediction	Actual GCSE Result
	Score	Probability		
A1	133	A*	A*	
A2	97	C/D	A*	
A3	86	D/E	A*	
A4	97	B/C	A*	
A5	94	C/D	A*/A	
A6	111	B/C	A*	
A7	108	A/B	A*	
A8	100	B/C	B	
A9	124	B	A*	
A10	107	C	B	
B1	84	F	B/C	
B2	84	E/F	C	
B3	84	F	C	
B4	95	C	B/C	
B5	97	D	B	
B6	90	D	B	
B7	85	E/F	B	
B8	97	E	B/C	
B9	75	F	C	
B10	83	F	C	

Table 7: This study's Sampling Frame

The second area of quantitative data collection took place in the form of student questionnaires. There were three student questionnaires administered to students over the course of the experiment. In Questionnaire one (Appendix 2) the second and third questions asked student about the amount of time spent studying at home and how much study they had done previously. The goal of these questions was to form a basis of the amount of time students spent preparing for their upcoming Mathematics exam. This basis helped establish the study habits of the students within the experiment. In question seven students were asked about how much time they spent playing video games and watching television. The intention of these questions was to ascertain what students spent their time doing when at home. This was used to compare the amount of time studying at home compared with the amount of time spent on recreational activities. In question 8, students were asked about their sporting habits outside of school life. The purpose of this question was to find out how much time students

spent on sporting activities and this built on the information gathered in questions six and seven. The 9th question asked students about the number of times they sat down with one or both parents for a meal during the week. The rationale behind this question was to gather information about parental involvement in the students' daily life. According to TIMMS (2007) data, students who had a greater parental involvement in their lives performed better in examinations. The penultimate question asked if students intend to pursue a third level education after their secondary schooling ended. The aim of this question was to ascertain how many students had the ambition to improve their education by pursuing a higher qualification. The final question in the questionnaire sought to establish if students would use Mathematics after their secondary schooling. This question challenged students to see if Mathematics was a subject they were obliged to study or a skill they would use in later life.

Questionnaire two (Appendix 3) was administered to students after they had received their feedback on their performance in the Mathematics exam during School X's Mock Exam Week. This questionnaire was made up predominantly of quantitative questions with only one question generating a qualitative answer. The first question sought to gather information about how the students felt about their performance. This question was asked to help students in the development of the reflective skills as an autonomous learner. To further develop reflective skills in students the third question asked to reflect on the amount of their time spent on studying. In the fifth question students were asked about their methods of preparation. The purpose of this question was to determine students' thoughts on the best way to prepare for a Mathematics exam. The sixth question sought to establish if students had an external private tutor in their homes and if they intended to use one. The purpose of this question was to ascertain if external assistance was being utilised by the students. Question seven was asked to verify if students were interested in an after school support class, and the reason they would attend this class. In the penultimate quantitative question, students were

asked about members of their family helping them with their Mathematics at home. This question sought to confirm the presence with or absence of family members helping students. In this experiment one group is made up entirely of Emirati students and this question would establish if Emirati parents assisted students with their Mathematics at home. The final question was relevant as it found out what the students own beliefs were about their ability by asking them what grade they believed they could achieve. This was used in the comparison with the Yellis student probability as well as students actual performance.

Questionnaire three (Appendix 4) was administered to students shortly before the students went on 'Study Leave' from school. Study leave occurs at the start of May, when the Grade 11 students are allowed to remain at home to study and prepare for their GCSE examinations. Students only return to school to sit their GCSE examinations. The questionnaire comprised of 42 questions and encompassed a combination of quantitative and qualitative questions. The first quantitative question asked students to rate their teachers' preparation and their own preparation for the GCSE exam. The purpose of this question was to draw on student evaluative and reflective skills, one of the functions of an autonomous learner. Questions 14, 15 and 16 explored the way in which the students perceived their teacher's role in their learning. These questioned served to discover and identify the different perceptions students have of their own learning. In questions 18 and 19 students were asked to assign responsibility for the grade they got in their GCSE exams. Question 18 asked if it was the teachers responsibility and question 19 asked if it was the students own responsibility. These questions were crucial to the investigation as they attempted to identify if students were taking responsibility for their own learning based on the format of the results that they got. Question 22 asked students about the relationship they understood to exist between the effort they put in and the result they were to get. This question would determine if students saw the relationship between the effort they put in to improve their learning with

the result they would get in August. In questions 23, 24 and 25 students were asked to reflect upon the impact their GCSE result would have on their family, the school and the U.A.E. The motive for this question builds on previous questions (18 and 19) and asks students to be reflective upon the exam they were about to take and the result they would get in the future. In questions 26 to 34 the researcher attempted to identify the type of learner the students were and the way in which they favoured studying and learning. Questions 26 to 30 asked students about their studying habits in order to ascertain the way in which these students approached the study of Mathematics. Questions 31 to 34 enquired about the way in which students liked to learn. These questions sought to determine the way the different students approached becoming autonomous within their own learning.

3.5 Collection of Qualitative Data

The qualitative data for this investigation were gathered in the format of questionnaires administered to the students. In question one of Questionnaire one, students were asked about their opinions on having to study Maths five times a week in a school week. This question was asked to determine what students' attitudes were toward Maths and why they needed to study it every day at school. In question 5b students were asked if Maths was an optional subject, would they choose to study it. The purpose of this was to ascertain the significance students placed on Mathematics and how they perceived Mathematics to be in the school life. Question 12b asked students if they would use Mathematics after they left school. This question served to determine if students could reflect on the current and future impact of Mathematics in their lives. In Questionnaire 2 students were asked one open-ended question (Number 9) and it asked them how they were going to better their exam grade. This question was posed by the researcher to determine what approaches/methods students intended to use in the future to become more autonomous.

Questionnaire 3 consisted of 18 qualitative questions being asked to students. The purpose of this questionnaire was to establish if students have become reflective learners, started to take responsibility for their learning and to find out the type of learner that each student was. Questions 4 and 5 asked students about the job occupations of both their parents. These questions linked with the previous questionnaires in that it helped to establish a picture of the students' home lives towards enhancing the breadth of the research. Both groups in the experiment have parents who are from different nationalities and as such will form a solid picture of a student life outside of school. In question 5 and 6 students were asked about their third level education preferences; this helped the researcher to discover if some students had already decided on their future career path and those who were still undecided. Question 8 sought to determine the confidence students had in their GCSE performance by asking them to name the subjects they hoped to study in Grade 12. This question helped the researcher to try and uncover if students intended to study Mathematics after their GCSE examinations had been completed. The questions 35, 36 and 37 asked students to reflect on the Mathematics course they had just completed and to suggest changes to it. The aim of these questions was to encourage the students to reflect on the past two years of mathematics study and suggest ways in which the course could be improved upon. The final three questions asked students about their feelings in relation to the target grade they had set themselves. The objective of these questions was to prompt students to delve into their reflective process and anticipate their feelings about their possible future performance at GCSE level.

3.6 Timeline of data collection

The following table is a synopsis of the timescale under which the experiment was run.

Date	3 rd February	6 th – 10 th February	13 -15 th February	16 th February – 4 th May	5 th May												
Event	<p>1st Questionnaire This questionnaire was administered to all students at the same time during a Mathematics class. This questionnaire sought to gather information about students study habits and their life outside of school. This was done shortly before the students started their Mock Exam Week. This was a short questionnaire and contained 12 questions.</p>	<p>Exam week Students were taken off timetable for the duration of the week. They sat 2 Maths mock exams under standardised GCSE exam conditions and protocol. They were supervised by the school’s exam officer as well as various members of the teaching staff. The Mathematics exam was a mock exam provided to the school by Edexcel (the examination board that the students will sit their GCSE exam for). The duration of both papers was 90 minutes. The results of this mock exam would assist the student and teacher with an indication of performance.</p>	<p>Feedback to students Students were given feedback on their performance in the Mock Exam. The feedback involved showing all students the correct answers according to the official mark scheme. Peer assessment took place to show the difference in quality of answers given by students.</p> <p>2nd Questionnaire This questionnaire was administered to all students at the same time during a Mathematics class. Students were asked to reflect on their performance during Exam Week and what steps they would be taking to improve their performance.</p>	<p>The participants in the experiment had 5 periods of mathematics each week and no double periods so mathematics was taught once every day. The length of each period was 45 minutes. The experiment ran for 12 school weeks, which was 60 periods of Mathematics or 45 hours of teacher/student contact time.</p> <table border="1" data-bbox="794 728 1198 922"> <thead> <tr> <th>Day</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>Sunday</td> <td>8.25-9.10 am</td> </tr> <tr> <td>Monday</td> <td>10.15-11am</td> </tr> <tr> <td>Tuesday</td> <td>10.15-11am</td> </tr> <tr> <td>Wednesday</td> <td>11.45-12.30pm</td> </tr> <tr> <td>Thursday</td> <td>11-11.45am</td> </tr> </tbody> </table> <p><i>Table: Breakdown of Maths classes</i></p> <p>The content of classes and way the students worked was determined by the students themselves. They chose the material they wanted to work on and they also decided what way they would work (individual/pair/group).</p> <p>3rd Questionnaire This questionnaire was administered to all students at the same time during a Mathematics class. Students were asked to comment and reflect upon their own beliefs on the Mathematics course they had just finished. They were asked to rate their own preparation as well as their teachers preparation for their GCSE course. This was the longest questionnaire that students were asked to complete and it took place at the end of their time in the school.</p>	Day	Time	Sunday	8.25-9.10 am	Monday	10.15-11am	Tuesday	10.15-11am	Wednesday	11.45-12.30pm	Thursday	11-11.45am	<p>All students left the school and went home on their annual ‘Study Leave’. Students returned to school only to sit the GCSE exams.</p> <p>The Mathematics GCSE exams took place on the 6th June and the 10th of June.</p>
Day	Time																
Sunday	8.25-9.10 am																
Monday	10.15-11am																
Tuesday	10.15-11am																
Wednesday	11.45-12.30pm																
Thursday	11-11.45am																
<p>Additional support classes run for the bottom set class. These classes were for 45 minutes and happened twice a week after regular school timings. They ran for 10 weeks which was 15 hours of contact time.</p>																	

Table 8: Timeline of Data Collection

3.7 Problems in Data Collection

Over the course of the study, the researcher encountered some small problems which only arose when the third questionnaire was given to students. Some students failed to answer all of the questionnaire questions and some left the last few questions blank. This is significant as it rendered some of the data on some questions incomplete and as such a full comparative description could not be undertaken. Also when the questionnaire was given to students, two students were absent from school at that time. This obstacle meant that some participants in the study were given the last questionnaire a day after the other participants. These students completed the questionnaire outside of class time and during the students lunch break under the supervision of the researcher. This meant that these students were not under any group dynamic environment and that these questionnaires were completed under different conditions to that of the other students.

The next two chapters will display the findings of the investigation and a discussion based on those findings. The final chapter will explore the conclusions drawn from the study as well as recommendation for future areas of study.

Chapter 4 Findings, Discussion and Limitations

The findings from this investigation were gathered firstly from three questionnaires administered to participants at various stages of the study and secondly by a statistical analysis of student's performance compared with their own predictions and the Yellis predictions. Over the course of this chapter each questionnaire's findings will be examined

separately. This chapter goes on to discuss the key findings of this study and conclude by identifying the limitations of the study.

4.1 Questionnaire one

The purpose of Questionnaire one was to establish an insight into the students’ life at home and also what their preparation was like for their mock exam. Students are divided into two sets based on ability. Top set students are grouped based on a score of 6a or better in Grade 9 mathematics, as well as a Yellis prediction of ‘C’ or better. The lower set students are grouped based on a score of 6b or lower in Grade 9 mathematics, as well as a Yellis prediction of ‘D’ or lower. Table 9 shows a comparative breakdown between the top and lower sets of students. In total students spent 55% of their time playing between 1 and 3 hours of video games and 55% of their time watching between 1 and 3 hours of television. This contrasts with 70% who spent between 1 and 6 hours a week engaging in a sporting activity.

Hours Spent	0		1 -3		4-6		7-9		10+	
	Top	Lower	Top	Lower	Top	Lower	Top	Lower	Top	Lower
Playing video games	0	40%	50%	30%	30%	20%	20%	0	0	10%
Watching television	10%	0	40%	70%	40%	10%	0	10%	10%	10%
Playing sports	10%	0	50%	20%	20%	50%	10%	30%	10%	0

Table 9: Breakdown of participant’s time spent playing video games, watching television and playing sports.

In relation to playing video games, the top set spent 50% of their time playing between 1 and 3 hours of video games yet 40% of the bottom set did not play video games at all. This can be compared with 70% of the bottom set spending between 1 and 3 hours watching television and 80% of the top set spending between 1 and 6 hours watching television. Finally, 50% of the top set spent between 1 and 3 hours playing sports compared with the 50% of the bottom set playing between 4 and 6 hours of sports a week. Overall the

higher set students had more parental contact time and spent more time studying at home, while the lower set students had less parental contact time and spent less time studying.

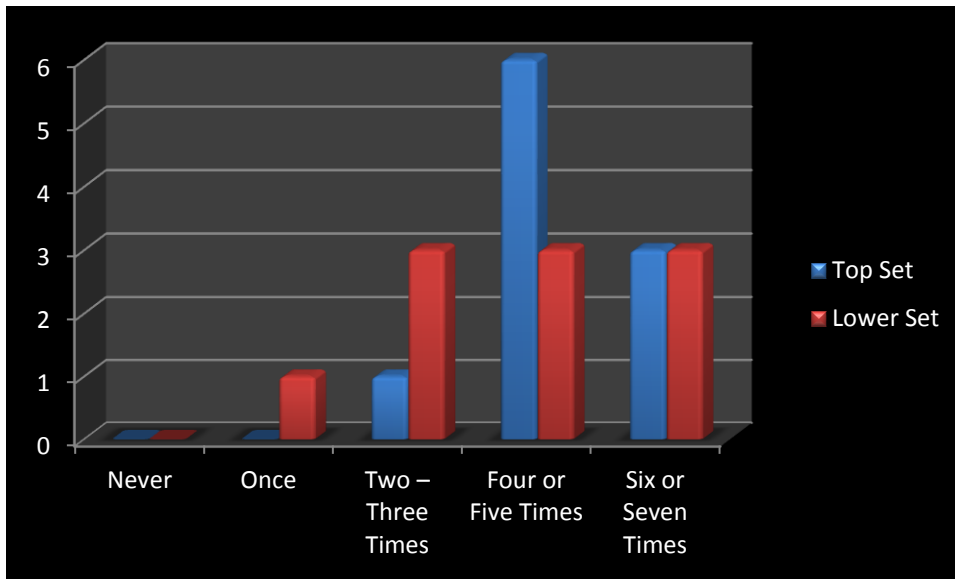


Figure 3: Time spent having dinner with one or both parents each week.

In question 1 student’s were asked about why they thought they should study Maths five times a week at school. Table 10 shows a summary of the responses received from students. Both sets of students frequently referred to Maths as being ‘important’; the lower set just stated that is was important but the top set often mention why they thought it was ‘important’. The lower set also mentioned that the reason they studied Maths five times a week was to get a good GCSE grade while the top set students remarked that they would use it later in life and when they would join the workforce. The lower set students recurrently refer to Maths as being both ‘important’ yet ‘hard’ also. The top set refer to the length of the Maths syllabus and the time available to cover the course, which showed a broader understanding of the role Maths played in their secondary school life.

Top Set Students	Low Set Students
It is a very important subject and will help me in the future	To get a good mark at GCSE
It is an important subject that is needed every day in life	Maths is hard and long and requires hard work
One of the most important subjects we need to know for the future	It is an important subject
Compulsory subject that is required for most jobs	It might help me later on
Large syllabus that needs to be revised daily	It is a very important lesson
Vital subject in most fields and requires more work	So I can get good marks in my GCSE
Portion of Maths is a lot to do in limited time so have to utilise the time available to us	Maths is hard and long and requires hard work

Table 10: Participant's opinions of Mathematics

Question five asked students if Maths was optional for GCSE, would they choose it and why? The purpose of this question was to ascertain the importance students placed on Maths in their school lives. Of the lower set students, 70% stated that they would want to take the subject, with 100% of the top set wanting to take Mathematics at GCSE level. Overall these results show that 85% of students at GCSE level would take Mathematics if it were an optional subject. Table 11 shows the reasons both sets of students gave for selecting/not selecting Mathematics. The top set students link the subject mathematics with their future careers and as a requirement for the universities that they wanted to attend. This compares with the lower set who answered it in relation to subjects they wanted to study and not university requirements. Also, of the lower set 30% of students would not take Mathematics if it was an optional subject. The top set (100%) and lower set (70%) stated that they would take Mathematics at GCSE level, this suggests that the top set had better awareness and appreciation for the role that Mathematics has played and will play in their future lives.

Top Set Students	Low Set Students
Maths is the most important subject because is found in every basis of our life	Because I want to do engineering
Maths is an important factor in the subject I intend to study in university	Maths is important to get into university
It is required by all respected universities	It will help in the future
The college I want to go requires Maths	I must use it for business studies
It is required in the fields I have thought of doing in the future	It is a hard subject
I like Maths and need it for college	I won't need it in college
It is needed every day and is required by most universities for most courses	It makes you smart and is a good subject

Table 11: Participant reasons for studying/not studying Mathematics

The final question in Questionnaire one asked students, if they would use Maths in their future lives. Over all 75% of all students stated that they would use Mathematics in their future and 25% stated they would not. Table 12 shows a sample of the students' responses to this question. The top set students mentioned 'career' and 'life' in many responses and thus showed that they have the knowledge that Mathematics will place a part in their lives in the future. This differs from the lower set who see Mathematics as a path to a future subject in university and some stated that they would not use it in future. In the lower set, 30% stated they would not use Mathematics after leaving school. This shows that there is a parallel with the top set, as 20% of these students stated they would not use Mathematics after school.

Top Set Students	Low Set Students
We need Maths in most things we do in life	To use it in my life
Depends on my career	I need maths for engineering
It can be used at work and in everyday life	For business
Depends on what job I choose	Not sure I will use it
It is something we need and is important in life	I will study business

Table 12: Selection of participant responses about using Maths in their future lives

The remaining questions in Questionnaire one gathered information about students' thoughts on career paths and study habits at home. On the whole 85% of students stated they would like to attend a college/university after they completed their secondary schooling. The

course most frequently mentioned by the top set was 'Engineering' while the lower set mentioned 'Law/Finance' with the greatest frequency. Additionally 55% of students spent between 1 and 3 hours studying any subjects at home over the course of a school week. This is comparable with hours spent studying Maths in that 65% of students only spent between 1 and 3 hours preparing for their mock exam.

4.2 Questionnaire two

Questionnaire two was administered to students after they had received feedback on their performance in the Maths mock exam. The function of this questionnaire was to gather information about students' reflective processes in relation to their own performance and what they thought they could improve. The second question asked students if they had achieved their target grade or not. In the top set students only 30% achieved their target grade while 100% of the lower set students failed to achieve their target grade. Over all (in question three) 70% of all student's felt that they had not done enough study to prepare for the mock exam. This contrasted with 45% of students being 'satisfied' (question one) with their performance and 35% being 'unhappy' with their performance.

The penultimate question was where students wrote down what they believed was the best way to improve their Mathematics grade. Table 13 shows student responses. The top set students most common responses were 'past papers' and doing 'revision' or revising. The lower set students' most common responses mentioned 'tutors' and 'after school lessons' as well as 'study'.

Top Set Students	Low Set Students
Practice more in class and do past papers with better concentration	Studying more
Finish past papers, ask teacher, study with friends frequently	Study every day for 1 hour
Do more past papers revise weak points study more	Do past papers and attend after school lessons
Past papers and study more from copybook and textbook	Do hard study and maybe bring a tutor
Do past papers and revise difficult topics	Increase work time and work harder with my tutor and attend after school classes

Table 13: Participant responses about how they thought to improve their Maths grade.

Question 8 asked students about the family support they received at home in relation to Mathematics. Table 14 shows the students responses. Of the top set students, a total of 40% did not receive any additional help from a family member at home while 90% of the lower set students had no additional help. Of the assistance provided to the top set students, 50% of it came from their fathers, while no father of a lower set child assisted their child. These results showed that on average 65% of all students had no assistance from a family member at home with their Mathematics. Question 6 was asked to seek if students had a private tutor at home and overall 65% of all students said ‘no’. These results showed that the majority of students participating in the study received no additional help from a family member or from a private tutor, this showed that these students had to work independently at home to better their grades and understanding of Mathematics.

	Mother	Father	Sister	Brother	Nobody
Top Set	10%	50%	10%	0	40%
Lower Set	0	0	10%	0	90%

Table14: Family members who assisted students at home with Maths

The concluding question in the questionnaire uncovered the students own beliefs on what they could achieve in their GCSE Mathematics exam. Table shows the student’s responses. In the top set group 70% of students said they could achieve an A* and that they perceived that none of them would get lower than a B. The lower set group 50% of them set

themselves a target of 50% and 40% believed that they would get a B grade in Mathematics. These student grades were compared against the Yellis baseline predictions and also the student actual GCSE performance in Mathematics. Table 15 shows that students own belief in their ability was undiminished by their poor performance in the mock exam.

	A*	A	B	C	D	E	F
Top Set	70%	10%	20%	0	0	0	0
Lower Set	0	10%	40%	50%	0	0	0

Table 15: Summary of participants own predictions

These target grades set by students were aspirational by nature and were not based on any teacher based targets. The participants set these targets themselves as it was their belief that was the standard of performance that was achievable for them.

4.3 Questionnaire three

Questionnaire three was the longest questionnaire administered to the participants and it came at the end of the study. The purpose of this questionnaire was to try and indentify characteristics of learner autonomy in the participants at the end of the study. In table 16 we can see the participants response's when asked to reflect on whom their final grade affected. In the top set students 10% agreed and 50% strongly agreed that the effort they put in would be a reflection of their final grade. This compares with the lower set students whom 50% agreed and a further 40% strongly agreed that their effort was a reflection on their final grade. Also the lower set consists of a 100% student population of local Emirati students. The participants were asked about their final grade being a reflection on the country and 40% agreed and 30% strongly agreed. The higher set students had a majority of non Emirati students, 30% disagreed and 30% strongly disagreed that it was a reflection on the country.

	Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree	
	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set
The final grade I get is a reflection..										
of the effort I have put in?	10%	0%	0%	0%	30%	10%	10%	50%	50%	40%
on my family as well as me?	40%	10%	30%	40%	10%	0%	20%	30%	0%	20%
on the school?	0%	0%	20%	20%	40%	10%	20%	30%	20%	40%
on the UAE?	30%	20%	30%	10%	10%	0%	0%	40%	30%	30%

Table 16: Participant responses about reflection on final grade.

Table 17 shows the participants sense of responsibility for their final grade. Of the lower set students 60% strongly agreed it was their responsibility and 40% agreed it was their responsibility for the grade that they got. In the top set students 20% disagreed, 20% agreed and 30% strongly agreed that it was their own responsibility for their final exam grade. Also 40% of the lower set students disagreed that it was their teachers responsibility for their grade, while 30% of the top set students agreed that it was their teachers responsibility for the grade that they got.

	Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree	
	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set
....responsible for the final GCSE grade that I get										
The teacher is	0%	10%	10%	40%	30%	20%	30%	20%	30%	10%
I am	10%	0%	20%	0%	20%	0%	20%	40%	30%	60%

Table 17: Participants responsibility for their final grade

Table 18 shows the results of the participant views on the type of learner they are and the type of learning that they prefer to participate in. Regards the lower set where 40% ‘sometimes’ prefer to study alone, while 30% of the higher set ‘generally’ prefer to study alone. 50% of lower set students ‘rarely’ preferred studying in small groups while 40% of the top set students ‘never’ preferred to study in small groups. In terms of using a private tutor 50% of the lower set students ‘generally’ used a tutor, while 50% of the top set students ‘never’ used a tutor. At the end of the study 50% of lower and top set students preferred to learn from their mistakes first.

	Never		Rarely		Sometimes		Generally		Always	
	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set	Top Set	Lower Set
I like.....										
to study by myself.	0%	10%	40%	0%	10%	40%	30%	40%	20%	10%
to study with a partner.	20%	10%	40%	40%	40%	40%	0%	10%	0%	0%
to study in small groups.	40%	0%	10%	50%	40%	30%	10%	20%	0%	0%
to study with a private tutor.	50%	0%	30%	0%	10%	30%	10%	50%	0%	20%
to study with a older family member.	60%	50%	10%	20%	20%	30%	10%	0%	0%	0%
to learn by investigation work.	30%	10%	0%	10%	50%	50%	0%	30%	20%	0%
to learn by the teacher showing me and then I copy it	30%	10%	20%	30%	40%	10%	10%	50%	0%	0%
to learn from my own mistakes first.	0%	0%	0%	20%	30%	30%	50%	50%	20%	0%
to study Maths.	10%	0%	10%	10%	50%	40%	20%	20%	10%	30%

Table 18: Participants identify learning styles

4.4 Statistical Analysis of Student Performance

For the purposes of the following statistical analysis N stands for the number of participants and df stands for degrees of freedom. Firstly an analysis of the mean scores from Yellis, own predictions and actual performance was carried out. The higher set students have a higher mean score (see Table 19) compared with the lower set students in all three sections

(Yellis 5.580, own prediction 7.3 and actual performance 6.7). Also there is a difference in mean between the higher set and lower set groups scores in Yellis, own predictions and actual results. The higher set students' have a higher mean score in all three sections. In Yellis the difference in mean is 2.430, in own predictions the difference is 1.8. In actual results the difference in mean was 1.6.

	Student Sets	N	Mean	Std. Deviation	Std. Error Mean
Yellis	Higher	10	5.580	1.1641	.3681
	Lower	10	3.150	1.0168	.3215
Own Prediction	Higher	10	7.300	.9487	.3000
	Lower	10	5.500	.5270	.1667
Actual Result	Higher	10	6.700	.9487	.3000
	Lower	10	5.100	.5676	.1795

Table 19: Group Statistics

To see if a statistical significance exists the independent T test (see Table 20) was carried out. The independent *t*-test allows for a comparison of the two groups based on their performance. Both sets consist of male only participants, where the lower set students were given an extra 15 hours of contact time compared with the higher set group. If Levene's $p > .05$ the equality of variance is assumed, while if Levene's $p \leq .05$ then there is not an equality of variance. This table shows in all three cases a significant difference exists. There is a statistically significant difference in means when comparing the achievement of higher set students and lower set students achievement in Yellis scores ($t = 4.972$, $df = 18$, $p < 0.001$). It can be noted with 95% confidence that the mean difference in Yellis scores falls between 1.4031 and 3.4569. There is a statistically significant difference in means when comparing the achievement of UAE local students and expat students achievement in own predictions ($t = 5.245$, $df = 14.072$, $p < 0.001$). It can be noted with 95% confidence that the mean difference in own prediction scores falls between 1.0643 and 2.5357. There is a statistically

significant difference in means when comparing the achievement of UAE local students and expat students achievement in actual student results ($t = 4.577$, $df = 18$, $p < 0.001$). It can be noted with 95% confidence that the mean difference in actual performance scores falls between 0.8655 and 2.3345.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Yellis	Equal variances assumed	.016	.902	4.972	18	.000	2.4300	.4888	1.4031	3.4569
	Equal variances not assumed			4.972	17.680	.000	2.4300	.4888	1.4018	3.4582
Own Prediction	Equal variances assumed	9.966	.005	5.245	18	.000	1.8000	.3432	1.0790	2.5210
	Equal variances not assumed			5.245	14.072	.000	1.8000	.3432	1.0643	2.5357
Actual Result	Equal variances assumed	3.666	.072	4.577	18	.000	1.6000	.3496	.8655	2.3345
	Equal variances not assumed			4.577	14.712	.000	1.6000	.3496	.8536	2.3464

Table 19: Independent *t*-test analysis

In the next stage of statistical analysis a paired *t*-test was carried out. This statistical test considers pairs of data together, and examines the mean scores of pairs rather than independently looking at them. Pair 1, Yellis and own predictions, shows a difference in mean with own predictions having a higher mean score of 6.4. Also participants' own predictions has a lower standard deviation score (1.1877) than Yellis (1.6388). Pair 2, own predictions and actual results, shows a difference in mean with own predictions having a higher mean score of 6.4. Although participants' own predictions has a higher standard

deviation score (1.1877) than actual results (1.1192). Pair 3, Yellis and actual results, shows a difference in mean with actual results having a higher mean score of 5.9. Also participants' actual results has a higher standard deviation score (1.1192) than Yellis (1.6388).

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Yellis	4.365	20	1.6388	.3664
	Own Prediction	6.400	20	1.1877	.2656
Pair 2	Own Prediction	6.400	20	1.1877	.2656
	Actual Result	5.900	20	1.1192	.2503
Pair 3	Yellis	4.365	20	1.6388	.3664
	Actual Result	5.900	20	1.1192	.2503

Table 20: Paired Samples Statistics

To study if this difference was statistical significant or not the paired *t*-test was carried out. This is examined through two steps. The first step being a Pearson's correlation (see Table 21) analysis, referred to below as Rho, which looks at the correlation that exists between the pairs of data. The Rho examined the statistical significant correlation between the different sets of paired data. These results show that there is exists a stronger correlation in own predictions and actual results (Rho = 0.863, N=20) than with Yellis and actual results (Rho = 0.781, N=20). The weakest correlated pair compared with the others was the Yellis and own predictions (Rho = 0.735, N=20).

		N	Correlation	Sig.
Pair 1	Yellis & Own Prediction	20	.735	.000
Pair 2	Own Prediction & Actual Result	20	.863	.000
Pair 3	Yellis & Actual Result	20	.781	.000

Table 21: Paired Samples Correlations

Finally a paired samples test (see Table 22) was carried out looking again at the same three categories of data. In pair one the t score of -8.189 shows that the mean value for Yellis is lower than the mean value of own predictions ($t = -8.189$, $df = 19$, $p < 0.00$). The sig. score for pair one is 0.00 which is less than .05 and as such shows that a statistical difference is present. In pair two the t score of 3.684 shows that the mean value for own predictions is higher than the mean value of actual result ($t = 3.684$, $df = 19$, $p < 0.02$). The sig. score for pair two is 0.02 which is less than .05 and as such shows that a statistical difference is present. In pair three the t score of -6.631 shows that the mean value for Yellis is lower than the mean value of actual performance ($t = -6.631$, $df = 19$, $p < 0.01$). The sig. score for pair three is 0.00 which is less than .05 and as such shows that a statistical difference is present.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Yellis - Own Prediction	-2.0350	1.1113	.2485	-2.5551	-1.5149	-8.189	19	.000
Pair 2	Own Prediction - Actual Result	.5000	.6070	.1357	.2159	.7841	3.684	19	.002
Pair 3	Yellis - Actual Result	-1.5350	1.0353	.2315	-2.0195	-1.0505	-6.631	19	.000

Table 22: Paired Samples Test

The next section of this chapter will discuss the key findings that have been stated in this chapter.

4.5 Discussion

The core objective of this study was to determine if greater learner autonomy in participants improved student's performance in GCSE Mathematics. In this study the lower set students were given more opportunity for contact time and the findings showed that they were more autonomous than their peers in the top set. Students' own predictions of results were closer to actual performance than the Yellis baseline prediction. The confirmation of this is displayed in Table 23, which shows students performance in a mock exam at the start of the study, the Yellis baseline prediction, their own targets and their actual performance in the GCSE exam. According to the Pearson's correlation analysis the strongest positive correlation existed between students own predictions and their actual performance ($Rho = 0.863$, $N=20$). This shows that students own predictions were closer to actual performance compared with Yellis predictions and actual performance ($Rho = 0.781$, $N=20$). Students in this study either achieved or exceeded their Yellis prediction and as such this suggests that learner autonomy improved student's grades. Students in this study displayed evidence of

having acquired the core aspects (reflection, target setting, identifying learner styles and responsibility for learning) of learner autonomy at the end of the study. Discussion on these aspects of learner autonomy will follow shortly in this chapter. The results of the mock exam showed the participants in this study their level of performance before the study was undertaken. The Yellis baseline prediction was important as it gave the expected or predicted performance of these students based on an adaptive test that they all took part in. These predictions allowed for a basis of comparison, to see if students who became more autonomous would improve their actual performance in mathematics. These results suggest that when students became more autonomous in their mathematics learning that it generally improved their end performance in their GCSE Mathematics.

Student	Set	Mock Exam	Yellis	Own prediction	Actual performance
A1	Higher	A*	A*	A*	A*
A2	Higher	A	C/D	A*	A
A3	Higher	B	D/E	A*	A
A4	Higher	B	B/C	A*	B
A5	Higher	B	C/D	A*/A	B
A6	Higher	B	B/C	A*	A
A7	Higher	B	A/B	A*	B
A8	Higher	C	B/C	B	C
A9	Higher	A	B	A*	A*
A10	Higher	B	C	B	A
B1	Lower	E	F	B/C	C
B2	Lower	E	E/F	C	C
B3	Lower	E	F	C	C
B4	Lower	D	C	B/C	B
B5	Lower	D	D	B	D
B6	Lower	D	D	B	B
B7	Lower	E	E/F	B	C
B8	Lower	D	E	B/C	C
B9	Lower	E	F	C	C
B10	Lower	E	F	C	C

Table 23: Results from participants Mock exam, Yellis, Own predictions and actual performance.

In relation to students setting targets, the mock exam performance gave students a sense of what level they were operating. After the mock performance participants set

themselves a target of what they believed they could achieve. The grade they set was a grade that they aspired to achieve and it was not based on their previous performance in mathematics. These targets became the basis for the participants hoped to achieve in mathematics. The goals they set for themselves, was not dictated to them by a teacher or data but a self belief that they could achieve a certain level of performance. In table 19 that showed the group statistics, students own prediction's in the lower set had a mean score of 5.5. and an actual result score of 5.1. This contrasts with the student's own predictions from the higher set which had a mean score of 7.3 and an actual result score of 6.7. These statistics show that the lower set students were more realistic and autonomous in their target setting. The additional 15 hours of contact time suggests that it aided the lowers set becoming more autonomous. Zimmerman (1989) mentioned that goals or targets which are self generated had an impact on the commitment shown by the students to achieve those goals. In the majority of cases the targets that students set for themselves were nearer to actual performance than the Yellis predictions were. This finding has theoretical supported from Bandura (1997), who mentioned that targets that are self generated are more likely to be realised than external targets. He went on to speak about self generated goals that satisfy the needs of individuals to achieve a personal reward of some kind. The participants generated their own targets and as such began to take possession of their learning. The targets set by the participants began to fuel the sense of responsibility within themselves as it was their own belief that they could achieve a certain standard and that belief motivated them further to achieve this target. They had a self generated target to strive for and then they set about trying to achieve it.

For learner autonomy to be present, participants must take what Holec (1981) called 'responsibility' for their learning. In the third questionnaire students were asked who was 'responsible for the final GCSE grade that they get?' Of the lower set students, 40% disagreed that it was the responsibility of their teacher and 60% of them strongly agreed that

it was their own responsibility. This provides evidence that students viewed the grade that they achieved as their own responsibility. It contrasts with the top set students of whom 30% agreed the grade that they achieved was the teachers' responsibility for but 50% of the same set had either 'agreed' or 'strongly agreed' that the grades they got were their own responsibility. This again shows that participants had taken ownership of their own performance in their GCSE examination. This questionnaire was administered at the end of the study and suggests that students had greater ownership of the role they play in their own learning.

Little (1991) has noted that an indicator of autonomous learning is that learners monitor their method of knowledge acquisition and evaluate the knowledge they now possess. For learner autonomy to be present students must be capable of demonstrating some form of reflective practice. In questionnaire three students were asked about upon whom their 'final grade would be a reflection?', 90% of the lower set and 60% of the top set either agreed or strongly agreed that it was a reflection of the effort that they themselves put in. These percentages show that students were aware that the effort they put into their learning of mathematics had an impact on the final grade that they would get. In contrast 70% of the top set students strongly disagreed or disagreed that their grades were a reflection on their family, while 50% of the lower set students agreed or strongly agreed that it reflected on their family. Displayed in the findings we can see that the top set students (90% ate dinner with their parents at least four times a week) spent more time in contact with parents while the lower set (40% only at dinner with parents between one and three times a week) spent less time in contact with parents, yet the lower set students believed that their performance would impact on the family members that they saw less than their peers in the other set. The lower set students spent more time playing sports than studying while the higher set spent more time studying than playing sports and yet the lower set students had a closer appreciation of the

impact their grades would have on their family. The lower set student population was made up of 100% local Emirati students and 70% of them reported that their grades would be a reflection on their country, as well as themselves. The higher set student population was made up 90% expatriate students and 10% local Emirati students. The higher set students reported that 60% disagreed or strongly disagreed that their grade was a reflection of the U.A.E. These percentages confirm that the lower set students felt a greater responsibility for their grades and displayed greater reflective practices as they revealed the impact their performance would have on their family and the country..

Over the course of this study students were encouraged to determine which learning style or strategy they preferred to use to solve certain tasks. The participants in the study experienced a variety of learning strategies which included working independently, paired problem solving, group work and to learn by investigation work. Following on from these experiences, students were guided in determining which strategy to employ for certain tasks. Over the course of the study the participants determined the content to be covered as well as the way in which they could possibly solve the obstacles or problems they faced. Holec (1981) mentioned previously that learners can choose the method or strategy to use in their own learning in order for their learning to develop in something further. The findings show that 50% of the top set participants either 'generally' (30%) or 'always' (20%) prefer to study by themselves. This is the same with the bottom set participants either 'generally' (40%) or 'always' (10%) prefer to study by themselves. When asked about studying with a partner, where 40% of top set participants said they 'rarely' preferred to study with a partner. Although 40% of lower set participants stated they 'sometimes' preferred to study with a partner. Furthermore 50% of the lower set 'rarely' studied in small groups and 40% of the top set 'never' preferred to study in a small group. These comparable percentages demonstrate that although differences existed in characteristics of reflection and responsibility, both

groups of participants were similar in their studying habits and in the way in which they studied. Although some percentages showed similarities shared between the groups, the findings of the participants study habits with private tutors were not similar. Some 50% of top set participants stated that they ‘never’ preferred to study with a private tutor, which contrasts with 50% of the lower set stating they ‘generally’ preferred to study with a private tutor. Both sets were asked about ‘learning from their own mistakes first’ and 50% of both sets of participants ‘generally’ liked to learn this way. This reveals again that there are strong similarities between both groups when participants determined the way in which they preferred to learn or attempt to complete a task. Differences exist between both sets of participants in terms of nationalities, ability ranges, reflective practices and views of responsibility yet there is evidence that suggests that students often prefer to learn in the same way regardless of to which ability set they belong.

The three questionnaires administered to the participants sought to gather information in relation to how the participants viewed mathematics. The first questionnaire asked the participants that if mathematics was an optional subject, would they study it and why? Both sets of students viewed mathematics as an ‘important’ subject in relation to them getting into the third level education that they wanted to enter after secondary school. The answers given by both sets included “it is a very important subject and will help me in the future”, “compulsory subject that is required for most jobs” and “it is an important subject”. These responses display that at this stage in the study participants are aware of the need to do well in mathematics in for their future but fail to mention specifics other than to get into a university. The participants do not seem to be aware of the uses of mathematics outside of a mathematics classroom. The participants in the lower set refer to mathematics as being ‘hard’ or a ‘difficult’ subject that requires a lot of time and study. While the top set participants

stated the length of the course and the importance to do well in relation to future career prospects.

To summarise, within the context of this study, improved learner autonomy has not changed participants attitudes towards mathematics but has given them the skills necessary to overcome future obstacles so that they can continue to hopefully grow into lifelong learners. Improved learner autonomy helps students to deal with maths anxiety, or to decrease the feeling caused by maths anxiety within students. Learner autonomy is not a solution to solving maths anxiety but rather it equips learners with the skills necessary to deal with the mathematical challenges they face in the years to come.

4.6 Limitations

Reflecting on the study that was undertaken three limiting factors have been identified about the study. The first limitation being the sample size involved in this study. The sample size of 20 was small but satisfactory for this study. A larger sample size would have strengthened the findings of the study. The sample size of students suited this study as there were 10 of each participant in each class. If this study was to be extended then a larger sample size would definitely be incorporated into the study.

The second limitation was that it was a single sex study made up entirely of male participants. The possibility of using female participants in this study was looked at, but a concern was raised about female students spending extra time with male teachers after school for the duration of the study. This was in line with the strong Islamic values and ethos within the school. Also the majority of participants were from one ethnic background, that background being Arab. Two of the participants were from India and they both were in the higher set class of participants. This limitation of the study shows that the conclusions that will drawn from this study are specific to the Middle East region and the study would need

further expansion involving a wider ethnic background make up of participants. As the participants in this study are predominately Arab, the findings of this study are specific to that region only.

The third limitation was that the extra classes provided after school were for the lower set students and none of the higher set students were given additional contact time. If the higher set students had been given the same amount of extra contact time then could this have improved their performance in their GCSE Mathematics exam, both in terms of scores and grades achieved by participants. The extra contact time was a contributing factor for the lower set achieving improved autonomy with their learning, so if the higher set had also the same contact time then they too may have improved further their own autonomy as well as the grades that they eventually achieved at GCSE level.

Chapter 5 Conclusion and Recommendations

The core objective of this study was to encourage students to become more autonomous with their learning and examining if that improved sense of autonomy impacted on their performance in a GCSE Mathematics exam. The participants were from a private school in Dubai, U.A.E. The school has been in existence since 1998 and it runs a dual curriculum of British National Curriculum as well as the Arabic and Islamic curriculum in accordance with the Ministry of Education's expectations. The school has a high percentage of local Emirati students with the remaining student population being made up of students of Arab background. There were 20 participants in this study and it was a single sex study of male students. There were two sets of students, referred to as the higher and lower set, with both sets comprised of 10 participants each. The lower set of students was composed entirely of local Emirati students, with the top set students being a mixture of nationalities, with only

one student in the higher set being Emirati. The students were in Grade 11 in the school and preparing for a GCSE exam in June 2011. The timeframe for this study was from February to May 2011. The participants were given three questionnaires over the course of the study, the first questionnaire was given shortly before the students participated in a mock exam and questionnaires were used to establish study patterns and attitudes toward mathematics. The second questionnaire was distributed after the participants were given feedback on their performance in the mock exam. This questionnaire sought to find out the reflective practices of the participants by asking them about their performance, what they intended to do to better their mathematics exam grade and what final exam grade they believed they would achieve.

The final questionnaire was distributed at the end of the study timeframe, it sought to examine if students had become more autonomous with their learning by asking them reflective questions related to the course they had just completed as well as the type of the learning strategies they had used over the course of the GCSE program. There was also a statistical analysis of Yellis baseline predictions, student's own predictions and actual student performance in the GCSE Mathematics exam. Students sat 2 exam papers in June 2011 for their GCSE Mathematics course. The 2 papers lasted 90 minutes each, with one paper being a non-calculator paper and the other being a calculator allowed paper. These exam papers were sent to the examining board in England for evaluation and grading. The grades were made available in late August 2011.

5.1 Conclusion

The study found that improved learner autonomy in students increased students achievement in a GCSE mathematics exam compared with Yellis baseline predictions. The Yellis predictions were less accurate when compared with the students own predictions about

their own performance. The students' predictions were based on the student's own sense of self worth in relation to what they believed they were capable of achieving. The mock exam provided students with an indicator of what grade they were operating at that time. The improvement in learner autonomy created a better sense of students self worth which fostered improved reflective practices and realistic target setting. The student's had a greater role in their learning and became more responsible for their own learning. Students identified learning strategies themselves that they would employ to better their grades and then set about using those strategies. At the end of the study students were aware of the grades they attained would also be a reflection upon themselves as well as their family, teachers, school and country. The students own prediction's about their performance was closer to their actual performance grade, than the Yellis baseline prediction was. This is supported by looking at the Pearson's correlation analysis where a stronger positive correlation score existed between own predictions and actual performance ($Rho = 0.863$, $N=20$) than with Yellis predictions and actual performance ($Rho = 0.781$, $N=20$). They set themselves a target that they felt was appropriate for themselves and the majority of participant achieved their target grade and some bettered their own target grades. The participants in this study improved their reflective skills as well, because at the end of the study they placed more responsibility on themselves rather than others when asked about the final grades achieved. They took more responsibility for their learning and the consequences for the grades that they achieved. The participants recognised which learning environment they preferred to learn in, which was group, individual or paired learning. The students improved learner autonomy has equipped them with the skills necessary to grow into lifelong learners. Improved autonomy in students is not a solution of nullifying maths anxiety within students, but it provided the participants with the tools they can use to overcome future challenges that they face. One of these challenges may well be maths anxiety, but the participants would now possess the tools needed to deal

with such anxiety and these tools will help to reduce one sense of maths anxiety, it would not however remove it completely.

This study showed that learner autonomy has a place in any mathematics classrooms. Although learner autonomy originated and is found in ELT contexts, this study has highlighted that the core components of learner autonomy (reflective skills, target setting, different learning strategies and greater responsibility for learning) can be applied to a mathematics context. These skills were enhanced by the additional contact time that was given to the lower set students. The participants at the end of the study showed that they possessed the characteristics of being more autonomous with their learning and as a result this assisted in improving student's performance in GCSE mathematics.

5.2 Recommendations

From the study that was performed I recommend that learner autonomy and self efficacy have a place in the teaching and learning of Mathematics. If the education around the world is to move toward the new paradigm of student centred learning, then students need to be involved in the processes in which they are participating. To fully reap the rewards of more autonomous learners the skills associated with learner autonomy should be fostered at an earlier age in a students' life. These skills of target setting and reflection should be implemented in the life of primary school children so that when they reach secondary and third level education they have the skills needed to succeed, better themselves and become lifelong learners.

5.2.1 Student centred curriculum

One of the stumbling blocks of student centred paradigm is that current curricula in schools is held accountable to a variety of educational stakeholders, as well as having no

input to curricula changes from the student's themselves. External stakeholders often only focus on student performance (summative assessment) as an indication of the school as a whole entity and fails to look at the environment or learning experience offered to the students that are in that educational setting. The curriculum employed by schools has restrictions, as it does not allow for formative assessments to carry equal weight as summative assessments. These curricula do not have students at its core but more so assessments and examination results and student performance. There needs to be a more child centred or student centred approach to curriculum design and implementation. Student input should be valued in education decision making and appropriate improvements can be implemented for future years. Students need to be shown reflection practices and we need to listen to what the student's have to say about the education they are participating in and not just continue to make decisions without looking at the potential impact they may have on a child's education. Students need to experience a wide selection of learning strategies so that they can possibly identify which strategy suits them best, as well as being able to use those strategies in overcoming future challenges. One curriculum that is similar to this is the International Primary Curriculum (IPC) which nurtures learning in primary schools by showcasing knowledge of students in a project or central themed basis throughout an academic school year.

5.2.3 Teacher Autonomy

A hurdle to improved learner autonomy in learners is teacher autonomy. The phenomena of teacher autonomy could be investigated further with a view of improving learner autonomy based on teachers being more autonomous themselves. For teacher autonomy to exist it will have to be undertaken by existing professional teachers and incorporated into future teacher training programs. Teachers may have a diminished view of their own autonomy as they are held accountable to external stakeholders, who view

performance in summative assessments as the basis for appraisal, reward or demotion.

Teachers may become more autonomous themselves if there was not the fear factor of high-stakes student performance hanging over them. A decrease on the onus placed on student performance in summative assessments and better acknowledgement of formative assessments may encourage teachers to become more autonomous themselves. Teacher autonomy would equip teachers with the tools to become a facilitator of students learning and assist them in guiding students into becoming more autonomous with their learning and develop into lifelong learners. After all, by nurturing autonomy in learners we will not only be assisting them in becoming better students now but enabling them and the generations that follow, to become lifelong learners.

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Appendix 1

2009 PISA Mathematics Results



WHAT STUDENTS KNOW AND CAN DO: STUDENT PERFORMANCE IN READING, MATHEMATICS AND SCIENCE

■ Figure 1. ■
COMPARING COUNTRIES' AND ECONOMIES' PERFORMANCE

	On the overall reading scale	On the reading subscales					On the mathematics scale	On the science scale
		Access and retrieve	Integrate and interpret	Reflect and evaluate	Continuous texts	Non-continuous texts		
OECD average	493	493	493	494	494	493	496	501
Shanghai-China	556	549	558	557	564	539	600	575
Korea	539	542	541	542	538	542	546	538
Finland	536	532	538	536	535	535	541	534
Hong Kong-China	533	530	530	540	538	522	555	549
Singapore	526	526	525	529	522	539	562	542
Canada	524	517	522	535	524	527	527	529
New Zealand	521	521	517	531	518	532	519	532
Japan	520	530	520	521	520	518	529	539
Australia	515	513	513	523	513	524	514	527
Netherlands	508	519	504	510	506	514	526	522
Belgium	506	513	504	505	504	511	515	507
Norway	503	512	502	505	505	498	498	500
Estonia	501	500	500	503	497	512	512	528
Switzerland	501	505	502	497	498	505	534	517
Poland	500	500	503	498	502	496	495	508
Iceland	500	507	503	496	501	499	507	496
United States	500	492	495	512	500	503	487	502
Liechtenstein	499	508	498	498	495	506	536	520
Sweden	497	505	494	502	499	498	494	495
Germany	497	501	501	491	496	497	513	520
Ireland	496	498	494	502	497	496	487	508
France	496	492	497	495	492	498	497	498
Chinese Taipei	495	496	499	493	496	500	543	520
Denmark	495	502	492	493	496	493	503	499
United Kingdom	494	491	491	503	492	506	492	514
Hungary	494	501	496	489	497	487	490	503
Portugal	483	488	487	496	492	488	487	493
Macao-China	487	493	488	481	488	481	523	511
Italy	486	482	490	482	489	476	483	489
Latvia	484	476	484	492	484	487	482	494
Slovenia	483	489	489	470	484	476	501	512
Greece	483	468	484	489	487	472	466	470
Spain	481	480	481	483	484	473	483	488
Czech Republic	478	479	488	462	479	474	493	500
Slovak Republic	477	491	481	466	479	471	497	490
Croatia	476	492	472	471	478	472	460	486
Israel	474	463	473	483	477	467	447	455
Luxembourg	472	471	475	471	471	472	489	484
Austria	470	477	471	463	470	472	496	494
Lithuania	468	476	469	463	470	462	477	491
Turkey	464	467	459	473	466	461	445	454
Dubai (UAE)	459	458	457	466	461	460	453	466
Russian Federation	459	469	467	441	461	452	466	478
Chile	449	444	452	452	453	444	421	447
Serbia	442	449	445	430	444	438	442	443
Bulgaria	429	430	436	417	433	421	428	439
Uruguay	428	424	423	436	429	421	427	427
Mexico	425	433	418	432	426	424	419	416
Romania	424	423	425	426	423	424	427	428
Thailand	421	431	416	420	423	423	419	425
Trinidad and Tobago	416	413	419	413	418	417	414	410
Colombia	413	404	411	422	415	409	381	402
Brazil	412	407	406	424	414	408	386	405
Montenegro	408	408	420	383	411	398	403	401
Jordan	405	394	410	407	417	387	387	415
Tunisia	404	393	393	427	408	393	371	401
Indonesia	402	399	397	409	405	399	371	383
Argentina	398	394	398	402	400	391	388	401
Kazakhstan	390	397	397	373	399	371	405	400
Albania	385	380	393	376	392	366	377	391
Qatar	372	354	379	376	375	361	368	379
Panama	371	363	372	377	373	359	360	376
Peru	370	364	371	368	374	356	365	369
Azerbaijan	362	361	373	335	362	351	431	373
Kyrgyzstan	314	299	327	300	319	293	331	330

Source: OECD, PISA 2009 Database.
StatLink <http://dx.doi.org/10.1787/888932343542>

Appendix 2.1.A

Questionnaire 1 Higher Set Sample Response

GCSE Maths Questionnaire

1. On your timetable you have Maths once a day every day at school. Why do you think you have to study it 5 times a week in school?

Because it has a large syllabus as needs to be revised daily.

2. How many hours a week do you spend studying at home by yourself?

0	1-3	4-6	7-9	10 +
		✓		

3. In the past week how many hours of Maths study have you done?

0	1-3	4-6	7-9	10 +
	✓			

4. (a) Do you think this is enough study time?

Yes	No
	✓

- (b) Why do you think so?

there is many things I don't understand

5. (a) As you know Maths is a core/compulsory subject at GCSE level. If Maths were an optional subject at GCSE would you select to do it?

Yes	No
✓	

- (b) Why do you think so?

It is compulsory in colleges and universities.

6. How many hours a week do you spend playing video/computer games?

0	1-3	4-6	7-9	10 +
		✓		

7. How many hours a week do you spend watching T.V.?

0	1-3	4-6	7-9	10 +
		✓		

8. How many hours a week do you engage in some form of sporting activity outside of school?

0	1-3	4-6	7-9	10 +
	✓			

9. How many times a week do you eat dinner with 1 or both of your parents?

Never	Once	Two – Three Times	Four or Five Times	Six or Seven Times
		✓		

10. After you leave school do you intend to go to college/university?

Yes	No
✓	

11. If you said yes to the last question what are you intending to study at college/university?

Logistics

12. (a) Do you think you will use Maths after you leave school?

Yes	No
✓	

(b) Why do you think so?

in Business Activities

Appendix 2.1.B

Questionnaire 1 Lower Set Sample Response

GCSE Maths Questionnaire

1. On your timetable you have Maths once a day every day at school. Why do you think you have to study it 5 times a week in school?

because it might help me later on,
it is the subject that let our brain works
the most.

2. How many hours a week do you spend studying at home by yourself?

0	1-3	4-6	7-9	10+
			✓	

3. In the past week how many hours of Maths study have you done?

0	1-3	4-6	7-9	10+
	✓			

4. (a) Do you think this is enough study time?

Yes	No
✓	

- (b) Why do you think so?

because I have other subject to
waste my time on.

5. (a) As you know Maths is a core/compulsory subject at GCSE level. If Maths were an optional subject at GCSE would you select to do it?

Yes	No
✓	

- (b) Why do you think so?

because in future I want to
be military pilot and they need
math certificate to pass.

6. How many hours a week do you spend playing video/computer games?

0	1-3 ✓	4-6	7-9	10 +

7. How many hours a week do you spend watching T.V.?

0	1-3 ✓	4-6	7-9	10 +

8. How many hours a week do you engage in some form of sporting activity outside of school?

0	1-3	4-6	7-9 ✓	10 +

9. How many times a week do you eat dinner with 1 or both of your parents?

Never	Once	Two – Three Times	Four or Five Times	Six or Seven Times
		✓		

10. After you leave school do you intend to go to college/university?

Yes ✓	No

11. If you said yes to the last question what are you intending to study at college/university?

study math and physics

12. (a) Do you think you will use Maths after you leave school?

Yes ✓	No

(b) Why do you think so?

because I want to be military pilot.

Appendix 3.1.A

Questionnaire 2 Higher Set Sample Response

GCSE Maths Questionnaire 2

1. On a scale of 1 to 5 please describe what best describes your performance in the mock exam. Place a tick in the correct box.

1	2	3	4	5
Very Unhappy	Unhappy	Satisfied	Happy	Very Happy
		✓		

2. Did you achieve your target Grade?

Yes	No
✓	

3. In the time before your mock exam how would you describe the time you spent studying/preparing for your exam.

1	2	3	4	5
Did not do any study	Did not do enough study	Did enough study	Did more than enough study	Did a lot of study
	✓			

4. In terms of the number of hours, how much extra Maths study did you do outside of school time.

0	1-3	4-6	7-9	10 +
	✓			

5. How best did you prepare for the Maths Mock Paper. Place a tick in as many as you used?

Doing Past Exam Papers	
Looking at my classwork copy book	✓
Using my textbook as a reference	
Attending after school Maths support classes	
Other (Please state what)	

6. Did you have a private Maths tutor to help with the mock exam?

How many hours did you have the tutor for?	Yes	No	Will you get one between now and before your final GCSE exam?
		✓	Probably

7. There is an after school Maths support lesson twice a week running free of charge. It's on Sunday and Monday, every week. How often do you think you will attend it?

1	2	3	4	5
Never because I do not need any more practice.	Sometimes because I only need practice with a little of the material.	Half the time because I only need practice with half the material.	More than half because I need practice with a lot of material.	Always because I need practice in every area of Maths.
	✓			

8. Is there any member(s) of your family that spend time with you helping you with your Maths at home?

Mother	Father	Sister	Brother	Nobody helps me
				✓

9. In the box provided describe what you are going to do to better your Maths grade in the next Mock Exam next month?

Practice more in class - doing the past papers with more concentration.
 Revise two days before the exam and ask questions to the teacher a day before.

10. What is the grade that you believe you can achieve in your final GCSE/IGCSE Maths Exam?

A*	A	B	C	D	E	F
✓						

Appendix 3.1.B

Questionnaire 2 Lower Set Sample Response

GCSE Maths Questionnaire 2

1. On a scale of 1 to 5 please describe what best describes your performance in the mock exam. Place a tick in the correct box.

1	2	3	4	5
Very Unhappy	Unhappy	Satisfied	Happy	Very Happy
			✓	

2. Did you achieve your target Grade?

Yes	No
	✓

3. In the time before your mock exam how would you describe the time you spent studying/preparing for your exam.

1	2	3	4	5
Did not do any study	Did not do enough study	Did enough study	Did more than enough study	Did a lot of study
	✓			

4. In terms of the number of hours, how much extra Maths study did you do outside of school time.

0	1-3	4-6	7-9	10 +
	✓			

5. How best did you prepare for the Maths Mock Paper. Place a tick in as many as you used?

Doing Past Exam Papers	✓
Looking at my classwork copy book	
Using my textbook as a reference	
Attending after school Maths support classes	
Other (Please state what)	

6. Did you have a private Maths tutor to help with the mock exam?

How many hours did you have the tutor for?	Yes	No	Will you get one between now and before your final GCSE exam?
		<input checked="" type="checkbox"/>	

7. There is an after school Maths support lesson twice a week running free of charge. It's on Sunday and ~~Monday~~ every week. How often do you think you will attend it?

Wednesday

1	2	3	4	5
Never because I do not need any more practice.	Sometimes because I only need practice with a little of the material.	Half the time because I only need practice with half the material.	More than half because I need practice with a lot of material.	Always because I need practice in every area of Maths.
				<input checked="" type="checkbox"/>

8. Is there any member(s) of your family that spend time with you helping you with your Maths at home?

Mother	Father	Sister	Brother	Nobody helps me
				<input checked="" type="checkbox"/>

9. In the box provided describe what you are going to do to better your Maths grade in the next Mock Exam next month?

I will stay revising Pass papers until I do ~~the~~ the ~~GCSE~~ GCSE exam.

10. What is the grade that you believe you can achieve in your final GCSE/IGCSE Maths Exam?

A*	A	B	C	D	E	F
		<input checked="" type="checkbox"/>				

Appendix 4.1.A

Questionnaire 3 Higher Set Sample Response

GCSE Questionnaire 3

Name	
Target Grade	A
Last Mock Exam Grade	B
Father's occupation	Professor Teacher
Mother's occupation	N/A
Topic you hope to study at University	Engineering
Preferred University that you want to go to	McMaster
Have you used a private tutor to prepare for your Maths exam? If yes please state for long you have had a tutor for.	No
What subjects have you selected to study in Grade 12?	Math, Physics, Economics, Chemistry
Do you intend to stay at your current school for Grade 12?	No

During your forthcoming Study Leave from school how best are you going to prepare for your Maths exam?

Do Past papers and correct my mistakes. Work on weak points.

Have you attended the after school Maths support classes? Please give a reason for your answer.

No ~~as~~ I don't need to.

	Poor	Bad	Good	Excellent
Rate the preparation you received from your teacher for your Maths exam.				✓
Rate your preparation thus far in school for your final Maths exam			✓	

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
I like the teacher to explain what I am learning?					✓
I prefer if my teacher let's me make my own mistakes?			.	✓	
I believe that my Maths teacher is					
(a) a resource person who gives me mathematical feedback				✓	
(b) someone who gives out information				✓	
(c) a facilitator				✓	
My teacher has helped me a great deal over the past 2 years?				.	✓
The teacher is responsible for the final GCSE grade that I get.				✓	
I am responsible for the final GCSE grade that I get.			.		✓
The mathematical content that I have studied is important?		✓			
The learning that has taken place over the past 2 years is important to me?				✓	
The final grade I get is reflection of the effort I have put in?	✓				
The final grade I get will be a reflection on my family as well as me?		✓			
The final grade that I get will be a reflection on the school?		✓			
The final grade that I get will be a reflection on the UAE?	✓				

	Never	Rarely	Sometimes	Generally	Always
I like to study by myself		✓			
I like to study with a partner	✓				
I like to study in small groups				✓	
I like to study with a private tutor				✓	
I like to study with an older family member	✓				
I like to learn by investigation work					
I like to learn by the teacher showing me and then I copy it	✓				
I like to learn from my own mistakes first.					
I like to study Maths					

I would like to recommend the following changes to the Maths course

Make more specific choices rather than just one
Maths course

Upon reflection please describe the way in which you were taught by your teacher?

He would explain the technique, give us practice questions, check and then give other questions and then sit with Guessoum

Next year for the Maths GCSE I recommend that my Maths teacher does the following with his students

Don't sit with Guessoum all the time!!!

How will you feel if you achieve the target/expected grade you hope to achieve in your Year 11 final Maths exam?

Bad, I expect to get an A*

How will you feel if you beat the target/expected grade you hope to achieve in your Year 11 final Maths exam?

Normal

How will you feel if you do not achieve the target/expected grade you hope to achieve in your Year 11 final Maths exam?

NA

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
I like the teacher to explain what I am learning?				✓	
I prefer if my teacher let's me make my own mistakes?				✓	
I believe that my Maths teacher is					
(a) a resource person who gives me mathematical feedback				✓	
(b) someone who gives out information		✓			
(c) a facilitator					✓
My teacher has helped me a great deal over the past 2 years?				✓	
The teacher is responsible for the final GCSE grade that I get.	✓				
I am responsible for the final GCSE grade that I get.					✓
The mathematical content that I have studied is important?				✓	
The learning that has taken place over the past 2 years is important to me?			✓		
The final grade I get is reflection of the effort I have put in?				✓	
The final grade I get will be a reflection on my family as well as me?		✓			
The final grade that I get will be a reflection on the school?					✓
The final grade that I get will be a reflection on the UAE?					✓

↳ Because I'm sure that I will get good mark.

	Never	Rarely	Sometimes	Generally	Always
I like to study by myself				✓	
I like to study with a partner			✓		
I like to study in small groups			✓		
I like to study with a private tutor			✓		
I like to study with a older family member	✓				
I like to learn by investigation work	✓				
I like to learn by the teacher showing me and then I copy it	✓				
I like to learn from my own mistakes first.					✓
I like to study Maths				✓	✓

I would like to recommend the following changes to the Maths course

NO recomend.

Upon reflection please describe the way in which you were taught by your teacher?

very good and confitable, good feeling when exams are close.

Next year for the Maths GCSE I recommend that my Maths teacher does the following with his students

yes.

How will you feel if you achieve the target/expected grade you hope to achieve in your Year 11 final Maths exam?

very nice feeling.

How will you feel if you beat the target/expected grade you hope to achieve in your Year 11 final Maths exam?

I will be full happy.

How will you feel if you do not achieve the target/expected grade you hope to achieve in your Year 11 final Maths exam?

I don't think that I will not achieve it.

Appendix 5

BUID Ethical Approval form

Guidelines for Ethics in Educational Research

Basic Principles

Three *basic ethical principles* underlie the Faculty of Education Guidelines for Ethics in Educational Research:

- **respect for persons**, that is, that persons should be treated as autonomous individuals, and that persons with diminished autonomy are entitled to protection;
- **beneficence**, that is, that there is an over-riding obligation to maximise possible benefits and minimise possible harms. Harm, in this context, includes psychological or emotional distress, discomfort and economic or social disadvantages. Researchers exercise beneficence in assessing the risks of harm and potential benefits to participants, in being sensitive to the rights and interests of people involved in their research, and in reflecting on the social and cultural implications of their work; and
- **justice**, that is, that the question of who ought to receive the benefits of research and bear its burdens should be explicitly addressed.

These principles apply to all forms of educational research, including research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behaviour.

Considerations in Data Collection

Researchers should take special care to avoid research activity in which the information collected is recorded in such a manner that:

- participants can be identified, directly or through identifiers linked to the subjects;
- any disclosure of the participants' responses outside the research could reasonably place the participants at risk of professional liability or be damaging to the participants' financial standing, employability or reputation; and
- the research deals with sensitive aspects of the participants' own behaviour, such as sexual preference, illegal conduct, use of alcohol, drug use, or includes information about health status.

Educational researchers should:

- ensure confidentiality;
- not use data of a confidential nature for their own personal advantage or that of a third party;
- obtain the free and informed consent of human subjects.

Informed Consent

The principle of obtaining informed consent from the participants in research is considered to be one of the most important ethical issues in research involving human participants. In almost all cases participants should be provided with a written summary of the research procedure, its benefits, harms and risks, and that they be able to retain this information. What is provided to potential participants should be brief and clearly written, and written from their point of view. When consent is obtained from research participants, it should be voluntary, competent; informed; and understood.

The decision of a person to consent to participating in a research project should always be based upon their knowledge of the research proposal and the requirements for their participation (as participants) in the project. Aspects of informed consent are:

- consent to participate in the research is given freely and without coercion;
- subjects have the capacity to understand the research project;
- the information sheets given to research subjects are understandable and have taken consideration of the anticipated level of competence of potential research subjects;
- inclusion of a clear explanation of the likely risks to the research subject arising from participation in the research project;
- the information sheet includes a clear explanation of the likely benefits of the research project itself;
- proper communication by the investigator of the risks and benefits of the research project to potential subjects;
- confirmation that the consent of the research subject is not influenced by financial inducement, improper pressure or any form of misrepresentation and that the research subject is competent to consent. It is the responsibility of the researcher to place the issue of payment within the context of the particular research project and determine as best she or he can at what point the incentive becomes an inducement that puts undue pressure on participants to take part;
- assurance that a research subject may withdraw at any time from the research without loss of benefit or penalty; and

- the need to exercise special care in cases where the subjects are unable to consent for themselves (for example, in the case of intellectually impaired students).

Responsibilities to Participants

Research involving treatment and control groups should be evaluated in terms of the benefit of the research and the individuals' overriding right to know and to have access to the best educational practice available in all circumstances. The methods should not result in harm to the participant. In assessing covert or deceptive research, the following two guidelines should be observed:

- participants should not be subject to any procedure which is reasonably likely to cause physical harm, psychological harm (which is distinguished from temporary embarrassment, mild alarm, etc), or enduring educational disadvantage ;
- participants should be fully informed at the conclusion of the study as to its nature and the disposition of results;
- the full benefits of the intervention should be made available to all participants as part of the outcome of the comparison of programs.

Ethics Form

To be completed by the student and submitted to the Ethics Research Committee

NAME OF RESEARCHER: Patrick Dundon

CONTACT TELEPHONE NUMBER: 050-8024795

EMAIL ADDRESS: dundonpatrick@hotmail.com

DATE:13/2/2011

PROJECT TITLE: Emirati boys attitudes and perceptions toward GCSE Maths at a private school in Dubai, UAE.

BRIEF OUTLINE OF PROJECT (100-250 words; this may be attached separately. You may prefer to use the abstract from the original bid):

Two Year 11 groups of boys on a parallel curriculum course Edexcel GCSE Maths. The bottom set is made up of 10 Emirati boys and the top set is made up of 9 non Emirati boys and 1 Emirati boy. I will offer intervention and support up to their exams in June and then analysis their performance against teacher predictions/student predictions and Yellis base line predictions. Value added graded worked out and compared with English language ability/lateness to lessons and absenteeism.

MAIN ETHICAL CONSIDERATION(S) OF THE PROJECT (e.g. working with vulnerable adults; children with disabilities; photographs of participants; material that could give offence etc):

Students names and school name not being used.

DURATION OF PROPOSED PROJECT (please provide dates as month/year):
Feb 2011 to June 2011

DATE YOU WISH TO START DATA COLLECTION:
1st Feb 2011

Please provide details on the following aspects of the research:

1. What are your intended methods of recruitment, data collection and analysis?

Please outline (100-250 words) the methods of data collection with each group of research participants.

Questionnaire

Exam preparation/intervention and mock exam grades

Mid Yis and Yellis baseline data

Final GCSE grade assessed in U.K.

2. How will you make sure that all participants understand the process in which they are to be engaged and that they provide their voluntary and informed consent? If the study involves working with children or other vulnerable groups, how have you considered their rights and protection?

Students to be informed that what the researcher is doing is finding ways to better understand them so that better intervention and exam preparation will be given.

3. How will you make sure that participants clearly understand their right to withdraw from the study?

Students can opt not to partake in the questionnaire study or not attend the extra support/intervention classes.

4. Please describe how will you ensure the confidentiality and anonymity of participants. Where this is not guaranteed, please justify your approach.

No student or school names will be used. Each name will be assigned a code (eg A1,A2 etc)

5. Describe any possible detrimental effects of the study and your strategies for dealing with them.

None that I can foresee at present.

6. How will you ensure the safe and appropriate storage and handling of data?

I will be solely responsible for all data collection and storage.

7. If during the course of the research you are made aware of harmful or illegal behaviour, how do you intend to handle disclosure or nondisclosure of such information (you may wish to refer to the BERA Revised Ethical Guidelines for Educational Research, 2004; paragraphs 27 & 28, p.8 for more information about this issue)?

I will disclose any thing that is ethically necessary.

8. If the research design demands some degree of subterfuge or undisclosed research activity, how have you justified this?

N/A at present

9. How do you intend to disseminate your research findings to participants?

All analysis will be available to the students should they wish to view it when final analysis is complete.

Declaration by the researcher

I have read the University's Code of Conduct for Research and the information contained herein is, to the best of my knowledge and belief, accurate.

I am satisfied that I have attempted to identify all risks related to the research that may arise in conducting this research and acknowledge my obligations as researcher and the rights of participants. I am satisfied that members of staff (including myself) working on the project have the appropriate qualifications, experience and facilities to conduct the research set out in the attached document and that I, as researcher take full responsibility for the ethical conduct of the research in accordance with the Faculty of Education Ethical Guidelines, and any other condition laid down by the BUID Ethics Committee.

Print name: Patrick Dundon

Signature: Patrick Dundon



Date: 13/2/2011

Declaration by the Chair of the School of Education Ethics Committee (only to be completed if making a formal submission for approval)

The Committee confirms that this project fits within the University's Code of Conduct for Research and I approve the proposal on behalf of BUID's Ethics Committee.

Print name: **PROF. ABDULLAH ALSHAMSI**
(Chair of the Ethics Committee)

Signature:

Date:



Appendix 6

Mathematics National Curriculum Level Descriptors (Level 5-8) for KS3

	Mathematical processes and applications	Number and Algebra	Geometry and Measures	Handling Data
Level 5	<p>In order to explore mathematical situations, carry out tasks or tackle problems, pupils identify the mathematical aspects and obtain necessary information. They calculate accurately, using ICT where appropriate. They check their working and results, considering whether these are sensible. They show understanding of situations by describing them mathematically using symbols, words and diagrams. They draw simple conclusions of their own and explain their reasoning.</p>	<p>Pupils use their understanding of place value to multiply and divide whole numbers and decimals. They order, add and subtract negative numbers in context. They use all four operations with decimals to two places. They solve simple problems involving ratio and direct proportion. They calculate fractional or percentage parts of quantities and measurements, using a calculator where appropriate. They construct, express in symbolic form and use simple formulae involving one or two operations. They use brackets appropriately. They use and interpret coordinates in all four quadrants.</p>	<p>When constructing models and drawing or using shapes, pupils measure and draw angles to the nearest degree and use language associated with angles. They know the angle sum of a triangle and that of angles at a point. They identify all the symmetries of 2D shapes. They convert one metric unit to another. They make sensible estimates of a range of measures in relation to everyday situations. They understand and use the formula for the area of a rectangle.</p>	<p>Pupils understand and use the mean of discrete data. They compare two simple distributions using the range and one of the mode, median or mean. They interpret graphs and diagrams, including pie charts, and draw conclusions. They understand and use the probability scale from 0 to 1. They find and justify probabilities and approximations to these by selecting and using methods based on equally likely outcomes and experimental evidence, as appropriate. They understand that different outcomes may result from repeating an experiment.</p>

	Mathematical processes and applications	Number and Algebra	Geometry and Measures	Handling Data
Level 6	<p>Pupils carry out substantial tasks and solve quite complex problems by independently and systematically breaking them down into smaller, more manageable tasks. They interpret, discuss and synthesise information presented in a variety of mathematical forms, relating findings to the original context. Their written and spoken language explains and informs their use of diagrams. They begin to give mathematical justifications, making connections between the current situation and situations they have encountered before.</p>	<p>Pupils order and approximate decimals when solving numerical problems and equations, using trial and improvement methods. They evaluate one number as a fraction or percentage of another. They understand and use the equivalences between fractions, decimals and percentages, and calculate using ratios in appropriate situations. They add and subtract fractions by writing them with a common denominator. They find and describe in words the rule for the next term or nth term of a sequence where the rule is linear. They formulate and solve linear equations with whole-number coefficients. They represent mappings expressed algebraically, and use Cartesian coordinates for graphical representation interpreting general features.</p>	<p>Pupils recognise and use common 2-D representations of 3-D objects. They know and use the properties of quadrilaterals. They solve problems using angle and symmetry, properties of polygons and angle properties of intersecting and parallel lines, and explain these properties. They devise instructions for a computer to generate and transform shapes and paths. They understand and use appropriate formulae for finding circumferences and areas of circles, areas of plane rectilinear figures and volumes of cuboids when solving problems.</p>	<p>Pupils collect and record continuous data, choosing appropriate equal class intervals over a sensible range to create frequency tables. They construct and interpret frequency diagrams. They construct pie charts. They draw conclusions from scatter diagrams, and have a basic understanding of correlation. When dealing with a combination of two experiments, they identify all the outcomes. When solving problems, they use their knowledge that the total probability of all the mutually exclusive outcomes of an experiment is 1.</p>

	Mathematical processes and applications	Number and Algebra	Geometry and Measures	Handling Data
Level 7	Starting from problems or contexts that have been presented to them, pupils explore the effects of varying values and look for invariance in models and representations, working with and without ICT. They progressively refine or extend the mathematics used, giving reasons for their choice of mathematical presentation and explaining features they have selected. They justify their generalisations, arguments or solutions, looking for equivalence to different problems with similar structures. They appreciate the difference between mathematical explanation and experimental evidence.	When making estimates, pupils round to one significant figure and multiply and divide mentally. They understand the effects of multiplying and dividing by numbers between 0 and 1. They solve numerical problems involving multiplication and division with numbers of any size, using a calculator efficiently and appropriately. They understand and use proportional changes, calculating the result of any proportional change using only multiplicative methods. They find and describe in symbols the next term or nth term of a sequence where the rule is quadratic. They use algebraic and graphical methods to solve simultaneous linear equations in two variables.	Pupils understand and apply Pythagoras' theorem when solving problems in two dimensions. They calculate lengths, areas and volumes in plane shapes and right prisms. They enlarge shapes by a fractional scale factor, and appreciate the similarity of the resulting shapes. They determine the locus of an object moving according to a rule. They appreciate the imprecision of measurement and recognise that a measurement given to the nearest whole number may be inaccurate by up to one half in either direction. They understand and use compound measures, such as speed.	Pupils specify hypotheses and test them by designing and using appropriate methods that take account of variability or bias. They determine the modal class and estimate the mean, median and range of sets of grouped data, selecting the statistic most appropriate to their line of enquiry. They use measures of average and range, with associated frequency polygons, as appropriate, to compare distributions and make inferences. They understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.

	Mathematical processes and applications	Number and Algebra	Geometry and Measures	Handling Data
Level 8	<p>Pupils develop and follow alternative approaches. They compare and evaluate representations of a situation, introducing and using a range of mathematical techniques. They reflect on their own lines of enquiry when exploring mathematical tasks. They communicate mathematical or statistical meaning to different audiences through precise and consistent use of symbols that is sustained throughout the work. They examine generalisations or solutions reached in an activity and make further progress in the activity as a result. They comment constructively on the reasoning and logic, the process employed and the results obtained</p>	<p>Pupils solve problems that involve calculating with powers, roots and numbers expressed in standard form. They choose to use fractions or percentages to solve problems involving repeated proportional changes or the calculation of the original quantity given the result of a proportional change. They evaluate algebraic formulae or calculate one variable, given the others, substituting fractions, decimals and negative numbers. They manipulate algebraic formulae, equations and expressions, finding common factors and multiplying two linear expressions. They solve inequalities in two variables. They sketch and interpret graphs of linear, quadratic, cubic and reciprocal functions, and graphs that model real situations.</p>	<p>Pupils understand and use congruence and mathematical similarity. They use sine, cosine and tangent in right-angled triangles when solving problems in two dimensions.</p>	<p>Pupils interpret and construct cumulative frequency tables and diagrams. They estimate the median and interquartile range and use these to compare distributions and make inferences. They understand how to calculate the probability of a compound event and use this in solving problems.</p>

QCDA Website *Curriculum Levels* [online]. [Accessed 10 October 2011] Available at: <http://curriculum.qcda.gov.uk/key-stages-3-and-4/subjects/key-stage-3/mathematics/Level-descriptions/index.aspx>