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Students' Attitudes to Mathematics Learning and Assessment in Turkey and Ireland

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ABSTRACT

Affective variables and traits such as confidence and motivation have been shown to impact students' achievement in science and mathematics as well as students' willingness to continue to study these subjects. In addition, high-stakes examinations have been shown to negatively affect students' confidence and motivation. Although Turkey and Ireland both have high-stakes examinations at the end of secondary school which determine entry to university, the examination systems differ in a number of ways. In this paper we compare the traits and attitudes of students in these two countries in relation to aspects of the teaching, learning and assessment of mathematics, and investigate the role that high-stakes examinations play. To do this, we use data collected from over 1200 students in Ireland and Turkey using the same instrument. We found that Turkish students were on average more confident and less anxious about mathematics than the Irish students. We also found exam-related differences in students' views on teaching and study methods as well as on alternative assessment systems.

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1. Introduction

This study is a part of a larger project that compared mathematics education in Ireland and Turkey. The purpose of this large project was to explore the effects of the high-stakes examination systems in the two countries on the teaching and learning of mathematics in post-primary education. It was comprised of three parts: an exploration of teachers' teaching practices and their views on the high-stakes examinations in their countries, a comparison of students' attitudes and study methods, and a classification of examination questions from recent examination papers. This paper considers the views reported by students in Turkey and Ireland on their experiences of mathematics learning and assessment. We will first describe the Irish and Turkish education systems and the differences in the assessment systems in the two countries. Then we will review the literature on students' attitudes and study methods, describe the design of the research undertaken, the methods used to analyse the data collected, and finally discuss the results of our analysis.

1.1. The Turkish and Irish Education Systems

Primary education is compulsory for children between six and fourteen years of age in Turkey. Secondary education continues for four years after primary level and it is not compulsory (MEB, 2018). In order to progress to university, secondary school students need to sit the national university entrance examination (which we will denote UEE). This multiple choice examination, which is taken by students nationwide, is administered centrally by The Student Selection and Placement Centre

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(OSYM). Pupils' UEE score is combined with their high school grade point average to create a composite admission score; this composite score determines whether they can attend university or not. In 2018, the university entrance examination had some changes and it is now called YKS (examinations for higher education institutions) (OSYM, 2019).

In Ireland, attendance at full time education is compulsory from six to fifteen years of age. The Irish school system is divided into two levels: Primary (8 years), and Secondary (5 or 6 years). Secondary school has two cycles: junior and senior cycle. Junior cycle is usually comprised of the first three years of second level schooling (Communications Unit Department of Education and Science, 2004). At the end of this cycle, students sit a state examination called the Junior Certificate (JC) examination, usually in nine or more subjects. Senior cycle accounts for the last two years of secondary education, culminating in the state Leaving Certificate (LC) examination in which most students take seven subjects. Most subjects are offered at Ordinary and Higher Level; however, in English and mathematics there is also a Foundation Level paper. The questions on all papers are partial credit questions. The LC examination is centrally administered by the State Examinations Commission (SEC, 2018)) and students sit two 2.5 hour examinations in mathematics. In 2018, 55,770 students sat the Leaving Certificate Examination of which approximately 37% took Higher Level and approximately 60% took Ordinary Level mathematics. The Central Admissions Office (CAO) coordinates admission to third level education in Ireland. Students are awarded points according to their LC scores in six subjects, and the CAO then matches institutions and students based on students' points and their choice of institutions and programs (Helms, 2008).

1.2. High-Stakes Examinations

Heubert (2001) described high-stakes assessments as those used to make significant educational decisions about students, teachers, schools or school districts; while the Economic and Social Research Institute in Ireland described 'high-stakes tests as standardized examinations, the results of which have significant consequences for schools and/or students' (Smyth, Banks and Calvert 2011, p.5). Thus both countries in our study have high-stakes examinations which are used for admission to university, albeit in different ways. Helms (2008) studied processes for admission to third level education in twenty-seven countries and grouped them into categories, placing Ireland and Turkey in different groups. In Ireland entrance to a university is based totally on the LC score, while in Turkey it is based on a combination of the university entrance examination (UEE) score plus a measure of the student's academic performance during secondary school. Both LC and UEE examinations are administered by State authorities: this reflects the most common method of selecting students for university education according to Bakker and Wolf (2001).

Nevertheless, the examination systems in Ireland and Turkey are quite different from each other (Aysel, O'Shea and Breen, 2011) and we were interested to explore whether there were also differences in the students' views. Examinations which have high-stakes for students can affect their attitudes to and their learning of mathematics (Harlen and Crick, 2003). The purpose of our paper is to report students' views on mathematics learning and assessment in two different educational systems each of which has a high-stakes examination at the end of secondary school.

2. Literature Review

Affective variables such as confidence and anxiety have been studied for many years. Reyes (1984) provided an overview of research on affective variables and mathematics education and concluded that people who have more confidence in their ability in mathematics will usually study mathematics more often and for longer than those who do not have this confidence. More recently, Maltese and Tai (2011) showed that the majority of students who study STEM subjects at university make their career choice while in secondary school, and that students' interest and confidence in their own ability is correlated with persistence with STEM subjects. In fact, Gunderson, Park, Maloney, Beilock and Levine (2018) found that even at primary level, students' mathematics anxiety is negatively correlated with mathematics achievement, while students' motivation is also an important factor in achievement.

Students with performance goals engage with tasks to receive positive feedback on their abilities from themselves or others, and to avoid demonstrating a lack of ability. Students with learning goals however, wish to increase their competence and acquire new understanding (Dweck, 1986). Middleton and Spanias (1999) conducted a review of research on motivation and reported that students who are intrinsically motivated focus on learning goals, while students who are extrinsically motivated have performance goals and work primarily to obtain rewards.

Given the link between affective variables and achievement, it makes sense to ask what factors influence students' attitudes and motivation. Savelsbergh, Prins, Rietbergen, Fechner, Vaessen, Draijer and Bakker (2016) conducted a meta-analysis of the effects of different teaching styles and found that there is evidence that some teaching practices can positively influence students' attitudes and achievement in science and mathematics. However, there is also evidence that high-stakes examinations can have a negative effect on students' attitudes, confidence and anxiety. For example, Madaus (1991, p. 229) outlined the disadvantages of high-stakes examinations, stating that '[high-stakes examinations] can negatively affect such personality characteristics as self-esteem and self-concept.' Similarly, Harlen and Crick (2003) reviewed a number of studies on the impact of summative assessment and testing on students' motivation for learning. One of their aims was to examine evidence for claims that testing both raises standards and has a negative effect on motivation in learning. In this review, Harlen and Crick discussed the studies of Leonard and Davey (2001), and Reay and William (1999) and they showed that students did not like tests and they were anxious whether they performed at their best under test conditions. Another study mentioned in the Harlen and Crick (2003) review, carried out by Benmansour (1999) showed that assessment was related to low self-efficacy and to limited use of learning strategies.

Smyth and Banks (2012) carried out a longitudinal study on the impact of two high-stakes examinations (Junior Certificate and Leaving Certificate) in Ireland on students' experience. They found that these examinations have significant objective consequences that influence students' behaviour and attitudes. Students mentioned that they felt stressed as a result of their teachers' constant reminders of the Leaving Certificate examination in their classes, and the majority said that their teachers used the practice of Leaving Certificate examination papers as a teaching method. Students' opinions on what constitutes good teaching changed as they got closer to taking the final high-stakes examination, moving from favouring active learning approaches to valuing exam-oriented methods.

High-stakes tests have also been shown to influence students' study methods in Turkey (Yerdelen-Damar & Elby, 2016). In a study of students studying Physics, Yerdelen-Damar and Elby (2016) found that students adapted their study methods according to context; they employed surface-learning techniques while studying for the university entrance examination and valued deep-learning techniques in situations where their goal was conceptual understanding and not grades. Similarly, Karatas, Alci and Aydin (2013) focused on relationships between post-primary senior cycle students' test anxiety scores, academic performance (GPA) and points on the university entrance examination (UEE) in Turkey. They found that there was a significant positive correlation between GPA and students' scores on the UEE. A significant negative correlation was found between the UEE and anxiety test scores, and also between GPA and anxiety test scores.

Although there is general evidence about the effects of high-stakes examinations and the nature of students' attitudes in the two countries (Ireland and Turkey) separately, our study aims to compare and contrast these effects by using the same survey instrument.

3. Research Design and Methodology

We designed a questionnaire (see Appendix) focusing on students' views on and traits in relation to learning, assessment and the teaching of mathematics. There were a few differences between the versions for Irish and Turkish students. However, the questionnaires had fifty-five Likert-type items in common exploring learning goals, performance goals, confidence, anxiety, pressure, usefulness of

mathematics, good teaching, mathematics learning, assessment and study methods. Most of these questions were taken from other studies, namely the Fennema-Sherman Mathematics Attitudes Scales (FSMAS) (Sherman and Fennema, 1978), Stipek and Gralinski (1996), Mulhern and Rae's (1998) shortened form of the FSMAS, and the PISA (Organisation for Economic Co-operation and Development, OECD 2003) students' questionnaire. Some of these were adapted, or reworded, to make them more relevant and comprehensible for the students participating in this study. In addition, some items were constructed especially for this project, for instance some items focusing on students' views of their state examinations and a study methods scale (as we were curious whether the examinations had an influence on their study habits). We also designed all of the multiple-choice questions in the pupils' survey for this study. These included two questions for the Irish students regarding the motivation for their choices of Leaving Certificate subjects and choices of syllabus level of mathematics taken for LC, and one question which asked which level of mathematics they were studying. There was also one different question in the Turkish questionnaire regarding whether the Turkish students had attended private tuition previously.

The questionnaire was designed in English. The first author translated it into Turkish and a Turkish researcher at Maynooth University checked the translation of the questionnaire. Before administering the questionnaire in Turkey, an official translation service had a final check on the translation. Ethical approval was sought and received in both countries.

3.1. Data Collection

The Turkish schools participating in this study were drawn from across the spectrum of science schools, Anatolian high schools, ordinary secondary schools, vocational schools and private schools. (Private schools are fee paying whereas the rest are not.) Similarly, students from Irish schools of all types (secondary, vocational, comprehensive and community schools) participated. The survey was conducted in the same school year in both countries. In total 666 Irish students and 661 Turkish students took part. The Irish students and the Turkish students were in the final year of post-primary school, and all were taught by teachers participating in this study. Irish students taking Mathematics at each of higher, ordinary and foundation levels participated. The Turkish participants were in the science or Turkish-mathematics groups because these groups in their schools had mathematics, geometry, and analytic geometry classes. The teachers who took part in this survey administered the students' questionnaire.

3.1. Rasch Analysis

The Likert-scale data collected was examined using Rasch analysis by means of Winsteps software (Linacre, 2009). The Rasch model is an Item Response Theory model (Bond & Fox, 2007) which can be used to evaluate tests or questionnaires, particularly those collecting Likert scale data. It is based on the assumption that useful measurement involves the consideration of a single trait or construct at a time. The aim of the Rasch model is to produce genuine interval measures of a construct (labelled 'estimates' in Table 1 on Learning Goal items below). The resulting measures or estimates enable researchers to test relationships between traits or to examine levels of a trait in different groups of people. These measures are standardized so that they lies in (-6, 6). Note that the error values in Table 1 indicate how precise the item estimates are.

Table 1. Learning Goal Items

Item	Estimate	Error of Estimate	Infit	Outfit
I work at mathematics because I want to learn as much as possible	-.34	.04	1.19	1.20
I work at mathematics because it is important for me that I understood the ideas	-.51	.04	1.21	1.22
I work at mathematics because I like figuring things out.	.26	.04	1.00	1.01
I work at mathematics because I like learning new things.	.31	.04	.75	.74
I work at mathematics because I like finding new ways of doing things.	.28	.04	.82	.82

When designing an instrument such as this one to explore participants' views, it is important to consider whether it is valid and reliable. Validity refers to the extent to which the instrument measures the constructs that it is intended to measure, (e.g. confidence, anxiety etc.) (Gravetter and Forzano 2012, p. 78) and whether the items pertaining to a particular construct (e.g. confidence) combine to give a measure of one single trait (i.e. unidimensioniality). Incorporated in the Rasch model is a quality control mechanism using error estimates and fit statistics to verify unidimensionality - a reasonable range for the fit statistics is 0.7 to 1.3 (Bond & Fox 2007, p.243). All items whose statistics fall within this range are deemed to be contributing to the measurement of this single construct. For instance, we can see from Table 1 that all items on the Learning Goal scale were behaving well.

Reliability refers to the stability or consistency of the measure (Gravetter and Forzano 2012 p. 85). The item reliability index, on a scale of 0 to 1, was computed by the Rasch model to estimate 'the replicability of item placement within a hierarchy of items along the measured variable if these same items were to be given to another sample of comparable ability'(Bond & Fox 2007, p.311). Similarly, we computed the person reliability index (which is analogous to the Cronbach alpha coefficient and measures how robust the person ordering would be if a similar questionnaire was used with the same group of students). For the Learning Goal scale, item reliability was computed to be 0.99, while person reliability was 0.78 indicating that the scale was internally consistent and that the measures computed by the model of the level of learning goals possessed by each participant are reliable. Cronbach's alpha was computed to be 0.822.

Similarly, for each of the Anxiety and Usefulness of Mathematics scales, the infit and outfit statistics showed that all items were contributing appropriately to the measure of the trait. On the Confidence scale, one item (I have trouble understanding anything with Mathematics in it) was found not to be performing well and was subsequently removed. Repeating the analysis using a modified Confidence scale, consisting of the 5 remaining items, resulted in all infit and outfit statistics lying within the allowable range. Person and item reliabilities for these scales are shown below:

Table 2. Reliability of Confidence, Anxiety & Usefulness of Mathematics scales

	Person reliability	Item reliability	Cronbach's alpha
Anxiety	0.80	1.00	0.851
Usefulness of Mathematics	0.79	0.99	0.843
Confidence (modified)	0.83	0.97	0.889

Thus, the measures produced from the set of Likert-scale items on each of Learning Goals, Confidence, Anxiety and Usefulness of Mathematics enabled relationships between these traits to be tested. The other scales did not perform well under the Rasch Analysis and so we did not compute measures for these scales.

4. Results

We will outline below the results of our analysis of the survey data. We will first consider the information gained from the scales that were validated using Rasch Analysis, and then look at the responses to some individual items from the questionnaire.

4.1. Summary of analysis using Rasch measures

We computed mean scores for each nationality from the Learning Goals, Confidence, Anxiety and Usefulness of Mathematics measures (Table 3). We found no difference between the mean scores of students in the two countries on the learning goals scale (p-value = 0.211). However, there was a difference between the countries on the confidence scale (p-value < 0.001) with the Turkish students being more confident than their Irish counterparts and similarly Turkish students displaying significantly higher measures on the Anxiety scale (p-value < 0.001) and on the Usefulness of Mathematics scale (p-value = 0.001). (Note that because of the coding of the items, high measures on the Anxiety scale indicate that students experienced low levels of anxiety and vice versa.)

Table 3: Mean Scores on the Scales

Measures	Country	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	Std Error of Difference	p-value
Learning Goals	Irish	666	.2477	1.74203	.06750	-0.1256	0.10032	0.211
	Turkish	661	.3733	1.90904	.07425			
Confidence	Irish	666	.2664	1.76984	.06858	-0.38469	0.10206	<0.001
	Turkish	661	.6511	1.94435	.07563			
Anxiety	Irish	666	-.0599	1.27970	.04959	-0.34762	0.08033	<0.001
	Turkish	660	.2877	1.62628	.06330			
Usefulness of Maths	Irish	666	.3716	1.66582	.06455	-0.2892	0.08725	0.001
	Turkish	661	.6608	1.50788	.05865			

A correlation analysis (Table 4) was carried out to examine the correlations between the Learning Goal, the Confidence, the Anxiety, and Usefulness scales. The correlations were all statistically significant, however, the correlations between the Learning Goal scale and the Anxiety scale, and the Anxiety scale and the Usefulness scale were quite low. The highest correlations were between the Learning Goal scale and Usefulness scale, and between the Confidence scale and the Anxiety scale. The Confidence scale was highly correlated with all of the other variables.

Table 4: Correlations between the measures [* Correlation is significant at the 0.01 level (2-tailed)]

Pearson Correlations	Learning Goals	Confidence	Anxiety	Usefulness
Learning Goals	1	0.577**	0.355**	0.627**
Confidence	0.577**	1	0.620**	0.509**
Anxiety	0.355**	0.620**	1	0.345**
Usefulness	0.627**	0.509**	0.345**	1

4.2. Summary of Responses to Some Likert-type Items

Even though we were not able to compute measures for the Performance Goal, Good Teaching and Assessment scales some of the individual questions gave us useful information about students' attitudes in the two countries. Tables 5, 6 and 7 show the percentages of students for the disagree/neutral/agree categories, missing values and p-values. We merged strongly agree and agree, and strongly disagree and disagree responses to compute these percentages. In addition, we carried out Chi squared tests to see if there was a significant difference between the two countries on each item and the p-values in the tables refer to these tests.

Table 5: Percentages of the Irish and Turkish Pupil Responses to Performance Goal Items

Performance goals		Disagree	Neutral	Agree	Missing	p-value
Item 1. I work at mathematics because it is important to me that I do well on the LC/UEE mathematics exam.	Irish	5.3%	11%	83.6%	0.2% (1)	.095
	Turkish	7.9%	11.2%	77.3%	3.6% (24)	
Item 2. I work at mathematics because it is important for me to get as many CAO/UEE points as I can.	Irish	7.4%	16.4%	75.5%	0.8% (5)	.222
	Turkish	8.2%	12.6%	73.9%	5.3% (35)	

From Table 5, we see that the majority of the Irish students and Turkish students responded that they worked at mathematics because it was important to do well on LC/UEE mathematics examinations and important for them to get as many as CAO/UEE examination points as they could. They seemed to be focused on the examination as they wanted to do well on the examination and they wanted to get as many points as possible. The missing values are relatively high for the Turkish students for items 1 and 2. This might be a consequence of the fact that one of the private schools wanted to use the English form of the pupils' questionnaire but the meaning of LC and CAO points was not explained to the students so they could not respond to these items.

From Table 6, we see that the majority of the students in both countries also agreed that good mathematics teachers should show them the exact way to answer the mathematics questions they would be tested on. When compared to the Turkish students a significantly higher proportion ($p<0.001$) of the Irish students agreed that good mathematics teachers did not spend class time talking about topics that will not be on the examination. However, in both countries, higher-achieving

students were less likely than lower-achieving students to agree with this statement ($p<0.001$ in Ireland and Turkey).

Table 6: Percentages of the Irish and Turkish Pupil Responses to Good-Teaching Items

Good-teaching		Disagree	Neutral	Agree	Missing	p-value
Item 2. Good mathematics teachers show you the exact way to answer the mathematics questions you'll be tested on.	Irish	9.2%	18.8%	71.9%	0.2% (1)	.024
	Turkish	13.9%	17.1%	68.8%	0.2% (1)	
Item 5. Good mathematics teachers do not spend class time talking about topics that will not be on the examination.	Irish	20.6%	18.9%	59.9%	0.6% (4)	< .001
	Turkish	40.4%	18.9%	40.1%	0.6% (4)	

Table 7. Percentages of the Irish and Turkish Pupil Responses to Assessment Items

Assessment		Disagree	Neutral	Agree	Missing	p-value
Item 1. I think the Leaving Certification / UEE examination is a fair way of assessing mathematical ability.	Irish	27.1%	29.1%	43.3%	0.6% (4)	< .001
	Turkish	39.3%	27.5%	27.8%	5.3% (35)	
Item 2. I think project work would be fair way of assessing mathematical ability.	Irish	44%	27.2%	28.5%	0.3% (2)	< .001
	Turkish	33.9%	42.2%	23.4%	0.5% (3)	
Item 3. I think a number of short examinations over number of years would be fair way of assessing mathematical ability.	Irish	13.1%	20.3%	66.5%	0.3% (1)	< .001
	Turkish	30%	40.8%	28.9%	0.3% (2)	

We found significant differences (see Table 7) between Irish and Turkish students' views on whether the LC/UEE examination is a fair way of assessing mathematical ability. Fewer Turkish students than Irish students agreed that the examination system was fair and this difference was statistically significant. Turkish students seemed not to have strong thoughts on the different assessment systems suggested with approximately 40% remaining neutral to and less than 30% agreeing with the suggestions made in items 2 and 3. However, we found that the majority of Irish students in our study would favour a change to a continuous assessment system involving a number of examinations over a number of years but the Turkish students were not enthusiastic about this option.

Table 8. Percentages of the Irish and Turkish Pupil Responses to Study Methods Items

Study methods		Very important	Quite important	Not very important	Not at all important	Missing	p-value
Reading the textbook	Irish	21.8%	47.6%	24.3%	3.8%	2.6%	< .001
	Turkish	12.4%	23%	39%	23%	2.6%	
Trying to understand the mathematical ideas	Irish	65.8%	25.4%	4.8%	1.2 %	2.9%	< .001
	Turkish	48%	35.4%	10.1%	3.8%	2.7%	
Memorizing formulae and procedures	Irish	49.2%	35.1%	11.1%	1.5%	3%	< .001
	Turkish	31.8%	43.9%	18%	4.1%	2.3%	
Practicing questions from the textbook	Irish	60.8%	30.2%	5.4%	0.9%	2.7%	< .001
	Turkish	25.4%	36.3%	23.4%	12.1%	2.7%	
Practicing questions from past examination papers	Irish	76.1%	17.1%	3.2%	1.1%	2.6%	< .001
	Turkish	38.4%	34.9%	18.8%	5.7%	2.1%	
Using examination revision guide	Irish	27%	47.3%	17.7%	5.1%	2.9%	< .001
	Turkish	19.1%	29.3%	30.7%	17.4%	3.5%	

4.3. Study Methods

Students were asked to rank study methods from 'not at all important' to 'very important' and the results for both countries are given in Table 8. It can be seen that there were statistically significant differences between the two countries on all questions. Reading the textbook was very important or quite important for 68.4% of Irish students while only 35.4% of Turkish students felt the same. The majority of students in both Ireland and Turkey said that reading class notes was important. The majority of the Irish (91.2%) and Turkish students (83.4%) said understanding mathematical ideas were important. Irish students felt that practicing questions from the textbook (91%) and old examination papers (93.2%) was important and this was significantly different from the responses of the Turkish students to these questions (61.7% and 73.3% respectively). Irish students (74%) said that

it was important to use examination revision guides and Turkish students again had mixed feelings on this subject.

Students were also asked how often the LC/UEE examination was mentioned in their classes; 89% of Turkish pupils and 88% of Irish pupils responded that it was mentioned in every class/week. When asked if they attended private classes in mathematics, the majority of Turkish students (80.2%) said they attended private tuition whereas 88.9% of Irish students did not attend any mathematics classes outside of school during that school year.

4.4. Choice of Subjects

In the Irish students' questionnaire, there were two questions, which asked the students for their reasons for choosing Leaving Certificate subjects. In the first question, 54.7% of students responded that their interest in the subject was the most important factor while 41.1% of them said they wanted to maximize CAO points. The second question asked them whether the most important factor in their choice of level of mathematics they studied for Leaving Certificate was interest in mathematics or maximizing CAO points. 32.3% of them responded that they were interested in mathematics, however, 62.3% of them stated they wanted to maximize CAO points.

5. Discussion

As mentioned earlier, high-stakes examinations are important in society because they are often the mechanism used to select university students and therefore future leaders (Heyneman, 2009). High-stakes assessments are used to make significant educational decisions not only about students, but also teachers, schools or school districts (Heubert, 2001). For this reason, we were interested to explore links between high-stakes examinations and students' attitudes and study methods in Ireland and Turkey. We observed both similarities and differences in the views of mathematics itself and mathematics teaching and learning from the perspectives of students taking the UEE and those taking the LC examination. Some previous studies undertaken in Turkey or Ireland have mentioned the effects of the high-stakes examinations. However, these studies did not set out to specifically compare the two countries in the contexts of their high-stakes assessment systems.

In some sense the LC examination in Ireland could be seen as having higher stakes than the UEE in Turkey; in Ireland, entry to third-level education is completely determined by LC results, whereas in Turkey a composite score, which combines UEE results and a GPA for each student, is used. Also, students usually only resit the LC examinations once and cannot combine results from two sittings for their CAO points for entry to third-level. However, the UEE examinations may be taken multiple times. All of the student participants in this study were in their final year of secondary school when the survey was undertaken and so were approaching their first opportunity to sit the LC or UEE examinations. It would seem that there was much emphasis in school on the imminent examinations with almost 90% of both Turkish and Irish students stating that the examinations were mentioned in every class/week. This may have been a source of stress for students: Smyth and Banks (2012) found that students reported feeling stressed as a result of their teachers' constant reminders of the Leaving Certificate examination in their classes. Some differences arose between Ireland and Turkey, however, in students' descriptions of the study methods they used. Irish students placed significantly more importance on practicing questions from past examinations papers compared with Turkish students. In fact, it may not merely have been the students who were focussing on past examination papers; Smyth and Banks (2012) found that the majority of students in their study said that teachers used the practice of Leaving Certificate examination papers as a teaching method. Furthermore, in the research reported here, 74.3% of Irish participants reported that it was quite or very important to use an examination revision guide compared with 48.4% of Turkish participants. These differences could possibly be explained by the higher stakes associated with the examination in the Irish system. It may also have played a role in the difference observed between the responses from the students in the two countries in relation to whether good mathematics teachers do not spend time talking about topics

that will not be on the examination – 59.9% of Irish and 40.1% of Turkish respondents agreed with this statement.

One interesting finding arises then from the students' responses to the items on assessment. The Irish students showed a preference for a number of short examinations over a number of years with 66.5% agreeing and 13.1% disagreeing that this would be a fair way of assessing mathematical ability. In contrast, 43.3% agreed that the existing LC examination was a fair means of assessment and 28.5% agreed that project work would be fair. It would seem that Irish students would have liked to distribute the risk associated with a high-stakes assessment system over a longer time period, but were not in favor of project work. However, the responses for the Turkish students were more uniform with respect to what a fair means of assessment would be, with 28.9% agreeing with a number of short examinations over a number of years, 27.8% agreeing with the UEE examination system, and 23.4% agreeing with the suggestion of project work. Perhaps it is the case that 'the grass is always greener on the other side' given that the Turkish system already combines GPA and UEE scores for entry to university.

The measures produced by Rasch analysis showed that Turkish students seemed to be more confident at mathematics than Irish students and Irish students were more anxious than their Turkish counterparts. Also, looking specifically at mathematics tests, Irish students were more anxious on the whole than their counterparts in Turkey. Maybe a reason for this latter result is that Turkish students are regularly assessed in secondary schools by their teachers. They have experienced mathematics examinations many times before sitting the UEE, whereas Irish students' first experience of a mathematics examination which will impact their potential to continue to third-level education is the LC. This again puts forward the view that there are higher stakes associated with the Irish examination system. These findings on confidence and anxiety are important, as anxiety has been found to be negatively correlated with achievement by a number of studies, e.g. Karatas et al. (2013); Gunderson et al. (2018). In addition, Maltese and Tai (2011) showed that students' confidence in their own ability is correlated with persistence with STEM subjects and that the majority of students who study STEM subjects at university make their career choice while in secondary school.

Students who prepare for high-stakes examinations often attend private tuition. Yet our study showed that most of the Irish students (88.9%) did not engage in private tuition in mathematics (or 'take grinds' as it is known in Ireland) whereas most of the Turkish students (80.2%) did have private tuition in mathematics in their final year of school. It would seem that the majority of Turkish students attend such classes before sitting the OSS examinations and that such private tuition focusses on examination preparation. This may go some way to explain some of the findings reported here. As Turkish students engage in preparation for the examinations during private tuition they may not feel as strongly about their school teachers talking about topics that will not be on the examination during school mathematics lessons. It may also underlie their responses as to the importance of practicing questions from past examinations and using an examination revision guide as they study, although our questions did not specifically refer to study associated with school only.

The items on study methods presented to participants shed light on another apparent difference in practice in the two countries. It would seem that Irish students rely more heavily on a textbook than their Turkish counterparts. In our study 69.4% of Irish students, compared with 35.4% of Turkish students, reported that reading their textbook was quite or very important. Furthermore, 60.8% of Irish students indicated that practicing questions from the textbook was very important while only 25.4% of Turkish students did so. There was also a discrepancy between the proportions of students in the two countries who believed memorizing formulae and procedures was very important. 49.2% of Irish students compared with 31.8% of Turkish students chose this option. Despite this, 91.2% of Irish and 83.4% of Turkish felt that trying to understand the mathematical ideas was very or quite important showing that they appreciated the need for conceptual understanding too. Furthermore, the majority of the students in both countries described good mathematics teachers as the teachers who help students to understand mathematical ideas.

Yerdelen-Damar and Elby (2016) found that students adapt their learning strategies when studying for different purposes and examinations such as the UEE seemed to encourage students to employ surface-learning techniques. Benmansour (1999) also found that high-stakes assessment is linked to limited use of learning strategies. This would seem to be borne out in our study. Although the UEE and LC examinations differ (the UEE uses multiple-choice questions and the LC uses partial credit questions) they are both traditional in format and have been found to contain mostly procedural questions (Aysel et al. 2011). The Irish students in our study seemed very focused on practicing questions (both from previous examinations and textbooks), and this may be related to the fact that the LC has been found to be quite predictable (Elwood and Carlisle, 2003). We also found that the majority of students (approximately 70%) in each of Turkey and Ireland believed that good mathematics teachers show them the exact way to answer the mathematics questions they would be tested on. However, it should be remembered that our questionnaire was administered to students in their final year of secondary school and Smyth and Banks (2012) found that students' opinions in relation to good teaching changed as they got closer to taking a high-stakes examination, putting more value on exam-oriented methods. It might be expected that multiple choice tests would engender higher levels of anxiety than those with partial credit questions but we did not find evidence of this in our study.

Heyneman (2009) explains that 'standardised' tests such as the UEE or LC have advantages in that they are considered fair and easy to administer. While assessment practices involving oral examinations or project work might encourage students to employ deeper learning techniques, particularly if they emphasised conceptual understanding, they would also be open to accusations of subjectivity and would present organisational difficulties. In future work, it would be interesting to study the attitudes of students in countries with education systems which put less emphasis on standardised high-stakes examinations, and to compare them to the views of the Irish and Turkish students in our study. This would shed further light on the effect of high-stakes assessment on the teaching and learning of mathematics.

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Appendix: Irish and Turkish Students' Questionnaire[2]

Which of the following was **most** important in your choice of Leaving Cert subjects? ***(Irish students only)***

Interest in the subject ☐ Maximising CAO points ☐

Which of the following was **most** important in your choice of the level of maths to study for Leaving Cert? ***(Irish students only)***

Interest in maths ☐ Maximising CAO points ☐

For each of the following please rate on a scale of 1-5 how strongly you agree with the statement, where 1 means *disagree strongly*, 2 means *disagree*, 3 means *neutral*, 4 means *agree*, and 5 means *agree strongly*.

Learning Goals

1. I work at Maths because I want to learn as much as possible
2. I work at Maths because it is important for me that I understand the ideas.
3. I work at Maths because I like figuring things out
4. I work at Maths because I like learning new things.
5. I work at Maths because I like finding new ways of doing things.

Performance Goals

6. I work at Maths because it is important to me that I do well on the LC/UEE Maths exam.
7. I work at Maths because it is important for me to get as many CAO/UEE points as I can.
8. I work at Maths because it is important to me that the teacher thinks I do a good job.
9. I work at Maths because it is important to me to do better than the other students.
10. I work at Maths because I don't want people to think that I'm stupid.

Confidence

11. Generally I have felt confident about approaching Maths.
12. I'm no good at Maths.
13. For some reason even though I study, Maths seems unusually hard for me.
14. Mathematics is one of my best subjects.
15. I learn mathematics quickly.
16. I have trouble understanding anything with mathematics in it.

Anxiety

17. I usually have been at ease during Maths classes
18. Mathematics makes me feel uncomfortable and nervous.
19. I get a sinking feeling when I think of trying Maths problems
20. I almost never have got nervous during a Maths test.
21. I usually have been at ease during Maths tests.

[2] In this questionnaire, the items were randomly reordered before they were administered to students.

22. A Maths test would worry me more than a test in another subject.
23. My mind goes blank and I am unable to think clearly during a Maths test.

Pressure

24. It is not important to my parents that I do well at Maths.
25. My parents think that mathematics is one of the most important subjects I have studied. (F-S Mother/Father scales)
26. It is important to my parents that I do well in school.
27. I work at Maths because I don't want to worse than the other students in the class. (S&G above repeated)

Usefulness of Mathematics

28. I study Mathematics because I know how useful it is.
29. Mathematics is a worthwhile and necessary subject.
30. I'll need mathematics for my work in the future.
31. I will use mathematics in many ways as an adult.
32. Mathematics is of no relevance to my life.
33. I see mathematics as a subject I will rarely use in daily life as an adult.

Good Teaching

34. Good Maths teachers show students lots of different ways to look at the same question.
35. Good Maths teachers show you the exact way to answer the Maths questions you'll be tested on.
36. Good Maths teachers help students to understand mathematical ideas.
37. Good Maths teachers show students how Maths is used in the real world.
38. Good Maths teachers do not spend class time talking about topics that will not be on the exam.

Maths Learning

39. The Maths I learn at school is mostly facts and procedures that have to be memorized.
40. The Maths I learn at school encourages me to think for myself.
41. The Maths I learn at school is not relevant to real life.
42. The Maths I learn at school is mostly about understanding ideas.
43. The Maths I learn at school is about identifying patterns and relationships.

Assessment

44. I think the LC/UEE exam is a fair way of assessing mathematical ability.
45. I think project work would be a fair way of assessing mathematical ability.
46. I think a number of short exams over a number of years would be a fair way of assessing mathematical ability.
47. How often is the Leaving Cert/UEE exam mentioned in class?
48. Every class ☐ Every week ☐ Every month ☐ Every term ☐ Only before the exam ☐
49. Do you attend maths grinds? Yes ☐ No ☐
50. At what level are you studying Maths? Higher ☐ Ordinary ☐ Foundation ☐ (Irish only)
51. What age are you? ☐
52. Gender M ☐ F ☐ (Irish only)
53. Did you attend grinds previously? Yes ☐ No ☐ ***(Turkish Only)***

Study Methods

1.Reading the textbook, 2.Reading the notes from class, 3.Trying to understand the mathematical ideas, 4.Memorizing formulae and procedures, 5.Practicing questions from the textbook, 6.Practicing questions from past exam papers, 7. Discussing mathematical ideas with classmates, 8.Using the internet, 9. Using exam revision guides, 10.Other (please specify)