

## **How good at mathematics do students need to be on entry to primary school initial teacher education?**

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There is a momentum in Ireland towards recruiting students who are competent in mathematics into primary school teaching. It is hoped that by doing so, standards of teaching, learning and assessment will improve. The initiative instigated was to revisit current minimum entry requirements for mathematics with a view to increasing threshold levels. This paper attempts to ascertain if there is a correlation between attainment at Leaving Certificate (LC) level, a state run examination taken by students aged approximately 18, and competency in primary school mathematics. It goes further to determine if it is possible to establish a minimum threshold level. Finally it looks at the potential effects on enrolment into initial teacher education (ITE) should entry grades be increased. 95 first year ITE students completed a standardised attainment test that is typically taken by children in their final year in primary school. The results were compared with their LC mathematics grades. There was a moderate correlation between the two scores. A possible revised threshold level would have excluded 40% of students who are competent in mathematics from entering into ITE. Therefore, mathematics grades at LC appear to be an unsuitable measure for establishing a threshold entry requirement for ITE.

**Keywords: Mathematics competency; primary school teacher training; assessment.**

### **Introduction**

In 2011, the National Strategy to improve and renew emphasis on numeracy among children and young people was introduced in Ireland. “The low mathematical ability among a number of students entering undergraduate initial teacher education courses at primary level and the more general weaknesses in many students’ conceptual understanding in mathematics” were cited as causes of concern and in need of address (Department of Education & Skills, p.32).

As all primary school teachers teach mathematics as an integral part of the curriculum, it was hoped that attracting students who are confident in mathematics into the profession would raise the quality of teaching and have a positive effect on all children’s performance. In order to recruit mathematically competent students, it was recommended that the minimum grade in mathematics needed to enter into initial teacher education (ITE) be raised (Quinn, 2014).

The Teaching Council undertook a public consultation process on the proposal to increase the entry requirements for primary ITE. However, the complexity of the issues involved sparked much controversy which escalated further when the Minister for Education at that time, Ruairí Quinn, implied that the low level of ITE students’ mathematical ability was largely due to the “highly feminised” nature of the teaching profession (Donnelly & O’Connor, 2014). Subsequently, the Economic and Social

Research Institute (ESRI) was commissioned to carry out research to examine what mathematics qualifications should be required for students entering ITE.

### *Threshold level for entry into ITE*

In Ireland, students aged approximately 18, sit a Leaving Certificate (LC) examination at the end of five or six years in secondary education. This LC comprises three levels; higher, ordinary and foundation, with mathematics being a compulsory subject for all students to take.

The minimum entry requirements into ITE are Grade C3 on a higher level paper in not less than three subjects and Grade D3 in three other subjects. Students must also get a minimum of a D3 at ordinary level mathematics, C3 at ordinary level English and C3 at higher level Irish.

The Central Application Office (CAO) allocates a number of points equivalent to grades obtained in the LC at higher and ordinary levels only. As can be seen from figure i below, students must achieve a minimum of five points in mathematics as opposed to 20 in English and 60 in Irish in order to enter into ITE.

Figure i: Leaving certificate grades and equivalent Central Application Office points

<i>Grade</i>	<i>Higher Level</i>	<i>Ordinary Level</i>
A1	100	60
A2	90	50
B1	85	45
B2	80	40
B3	75	35
C1	70	30
C2	65	25
C3	60	20
D1	55	15
D2	50	10
D3	45	5

Students generally take seven subjects to LC. However, points are only awarded from the best six subjects in any one year. These do not have to include subjects such as mathematics, needed to meet general minimum entry requirements. Minimum entry requirements and course requirements may be satisfied by an accumulation of subjects over more than one year. The points to enter ITE are high. For example, in 2014, students needed between 400 and 515 points depending on the ITE College chosen.

This study seeks to establish if LC results are an accurate predictor of the level of competency in primary school mathematics of students entering into ITE. Furthermore, it tries to ascertain whether there is a threshold level at LC to indicate aptitude in primary mathematics. Finally, it looks at the effect that the introduction of proposed thresholds (a pass or C3 in higher level mathematics or equivalent) might have on recruitment into ITE.

### **Methods**

It could be argued that the mathematics studied at LC is substantially different to that studied in primary school. If LC grades are to be used as the mandatory determinant to filter out students who are considered to have poor conceptual understanding in mathematics, there would need to be an assurance that this grade is consistent with and reflective of students' aptitude in primary school mathematics. To determine

students' ability in primary school mathematics, three cohorts of 1<sup>st</sup> year Church of Ireland College of Education (CICE) ITE students from 2012 – 2014 completed the Level 5, Standardised Irish Graded Mathematics Attainment Test (SIGMA-T) in their first semester (Wall & Burke, 2012). This SIGMA-T is typically administered in a child's final year in primary school.

As this standardised attainment test (SAT) is standardised to a population of children between the ages of 11 and 12, it was necessary to devise a 'pass mark' on the test that would be representative of this cohort of students. Therefore, the mean of the SAT was found and an arbitrary SAT 'pass mark' derived by subtracting one standard deviation (SD) from the mean, commonly known as grading on a curve.

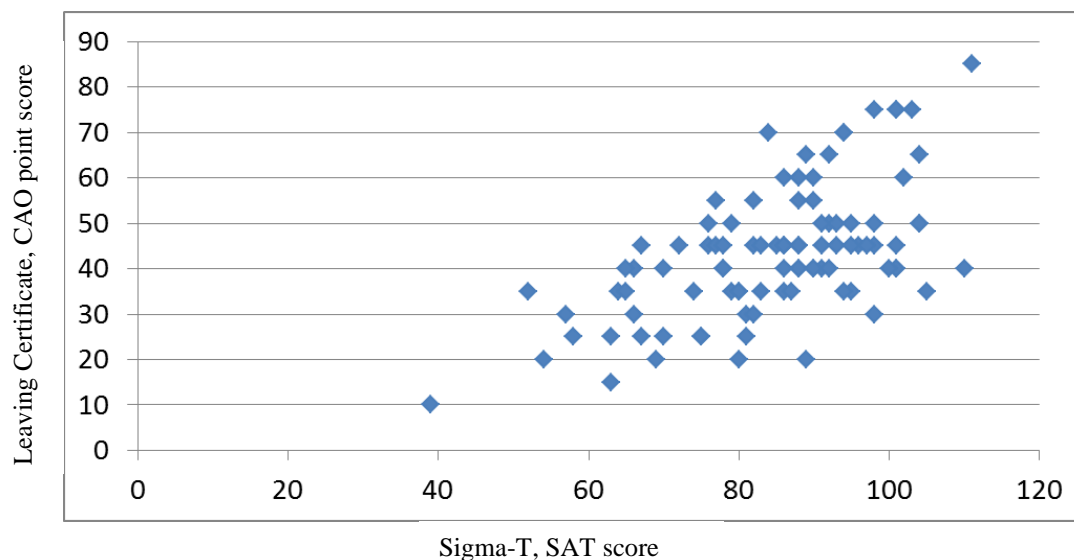
The students' LC results were converted into CAO points to allow for comparison of higher and ordinary grades. Again, the mean score and SD were obtained. The results on the SAT were compared with the students' LC results to establish whether or not there was a relationship between the two.

## Results

95 students completed the SAT over three years, 88 (92.6%) of whom were female. There were 119 questions on this SAT. Their unadjusted raw scores ranged from 39 to 111 correct answers (32.8% to 93.3%). The mean SAT score was 84.6 (71.1%) and SD, 13.9. Thus the arbitrary 'pass mark' derived from mean – 1 SD, was 70 (58.9%).

LC results ranged from D2 at ordinary level (CAO point score of 10) to B2 at higher level (CAO point score of 80). The mean CAO score was 43.4 (SD 14.5), corresponding to a B2 in ordinary level mathematics.

Figure ii: Correlation between Leaving Certificate grades and performance on the Sigma-T



As can be seen from figure ii, students' SAT scores correlated moderately to strongly with CAO point scores ( $r= 0.59$ ,  $p=0.001$ ; Pearson's's correlation).

17 (18%) students did not achieve the 'pass mark' of 70 on the SAT. Of these, all except for one had a CAO score of 40 or less, i.e. less than the threshold for a pass in LC higher level mathematics. Therefore it could be deduced that the threshold level for entry into ITE could be set at 45 CAO points.

However, this would exclude 31 other students who 'passed' the SAT but also had a CAO score of <45. This number represents 33% of the overall population or

40% of those who ‘passed’ the SAT. Furthermore, the mean SAT mark achieved by this group was 87.6, higher than the mean score of the entire cohort together, 84.6.

Only 15 (15.3%) students’ CAO score were  $\geq 60$ , the equivalent to a C3 or higher in LC mathematics.

Male students scored significantly higher SAT scores on average (94.7 vs. 83.8.  $p=0.03$ , Students t) and tended to have higher CAO scores (52.1 vs. 42.7.  $p=0.06$ ). Conversely, the students scoring the top two CAO scores and top eight SAT scores were female.

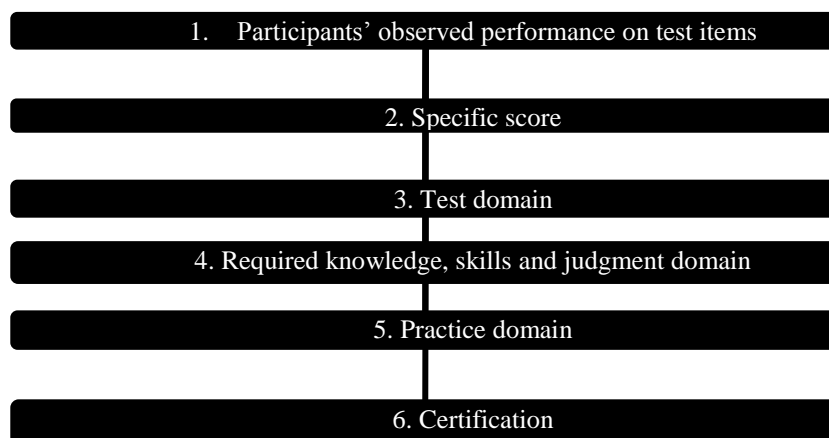
## Discussion

The proposal to raise minimum entry requirements into ITE appears to be based on an hypothesis that grade at LC level is somehow automatically equated to having the appropriate mathematics skills for teaching. On the contrary, mathematics knowledge for teaching is characterised by a number of distinct specialisms (Delaney, 2010). Subject matter knowledge is assessed at LC. During the course of teacher training, students are familiarised with both the content of the primary school mathematics curriculum and the appropriate methodologies to support and assess children’s understanding in their classrooms. Therefore, we cannot simply assume that students’ grade at LC is an indicator of their competency to teach without taking several steps to validate this conjecture.

### *Use of the LC to establish a threshold level for entry into ITE*

Using the model below, it is reasonable to argue that the mathematics grade achieved in the LC is an accurate indicator of how a student performed in the exam. However, exam performance on any one day can be enhanced or mitigated by a number of factors such as lack of sleep or level of anxiety etc. Even if a student were to take that exact same paper at a different stage, the result may be somewhat different. Neither can we deduce that this score fully reflects the student’s competency with the entire mathematics LC course as certain topics may come up that the student has prepared particularly well for or not

Figure iii: Mathematical knowledge for teaching



(Kane, 2004)

Possibly, one of the greatest unsubstantiated claims is the inference that mathematical knowledge at LC is the same knowledge that is relevant for primary school teaching. Even if it were, performance at LC does not imply that students have

the ability to use or apply this knowledge outside of the exam environment. Therefore, using the LC as the ultimate benchmark for entry into ITE is extremely questionable as an accurate measurement tool.

### ***Raising the threshold level for mathematics***

Of the 95 students who took the SAT, 17 did not ‘pass’. Of these, all except for one had a LC score of less than 45 points.

Figure iv: Establishing a threshold level for mathematics

<i>Grade</i>	<i>Higher Level</i>	<i>Ordinary Level</i>
A1	100	60
A2	90	50
B1	85	45
B2	80	40
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C1	70	30
C2	65	25
C3	60	20
D1	55	15
D2	50	10
D3	45	5

Initial analysis would appear to indicate, therefore, that the minimum entry requirement would be a pass at higher level or a B1 at ordinary level mathematics. However, it is not that simple. Should this be the entry requirement, nearly a third of all students who comfortably passed the SAT would not be eligible to obtain a place in ITE. Furthermore, the mean score on the SAT of this cohort of students (87.6) was actually higher than that of the overall mean score (84.6). This result would seem to suggest that there is a difference in mathematics competency assessed at LC level to that of competency in primary school mathematics.

### ***Impact on recruitment to ITE***

The low entry requirement for mathematics could be taken to signify the lack of regard given to proficiency in mathematics needed to teach in primary schools. Mathematics compares unfavourably with other curriculum areas. Students must achieve a minimum of 60 points in Irish at LC in comparison to 5 points in mathematics. Raising the minimum entry requirement for mathematics to be on a par with that of Irish would address this inconsistency. However, a cut-off entry grade of C3 at higher level mathematics would have excluded 85% of the current cohort from gaining access into ITE.

It would appear from initial investigation that raising entry requirements would have a devastating impact on recruitment. Conversely, the long term implications of such a change may not be as drastic. Evidence would need to be gathered to ascertain why students opt to study mathematics at ordinary level. It may be that students settle with a pass in mathematics as it is deemed to be a very difficult subject and prioritise other subjects that seem to be easier to gain valuable points in. Should higher level mathematics be a requirement for entry into ITE, students may be able to comfortably achieve this grade by giving the subject appropriate consideration.

“Research shows that young women who do the Junior Certificate and take higher level mathematics comfortably in the Junior Certificate exam, drop higher level mathematics when they do their Leaving Certificate because it is not a

requirement” (Quinn, 2014). If higher level mathematics were a requirement, would there be a decline in the number of female entrants into ITE?

Again, this is very hard to discern. In this study, the top two LC results were obtained by female students. So too were the top eight results on the SAT paper. Furthermore, the difference in mathematics competency between males and females although significant was modest.

Perhaps it would be a more realistic solution to ensure that mathematics must be one of the six subjects counted towards the overall points for entry into ITE. In this way, it would not exclude students who do not perform well at LC but may be quite confident at primary school mathematics whilst at the same time promoting the prominence of mathematics as a core curriculum subject.

### ***Opportunities for further research***

1. Is there a variance between students’ performance on the SAT who have studied the revised mathematics curriculum “Project Maths” at LC as opposed to those who have undertaken the traditional mathematics paper?
2. Is there a correlation between how the students performed in their LC and their assessed mathematics teaching competency in the classroom during school placement whilst in ITE?

### **Conclusion**

The LC appears to be an unsuitable tool for establishing an obligatory threshold in mathematics for entry into ITE. It cannot be deduced that LC results are a good indicator of the mathematical competency needed to teach in primary schools and no obvious threshold LC level was established. There is no evidence to justify the introduction of compulsory higher level mathematics for entry into ITE as a way to attract the best students who will become the most competent and confident teachers of primary mathematics.

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