Evaluation of ISL STEM Glossary Pilot – Maths.

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The importance of a numerate population, that is a population who can "apply mathematics to everyday situations", has been recognised in Ireland (National Adult Literacy Agency, 2017, p. 7). most notably by the creation of a National Strategy for Literacy and Numeracy (Department of Education and Skills 2011). In 2015, 15-year olds in Ireland performed above the Organisation for Economic Co-operation and Development (OECD) average in the Programme for International Student Assessment (PISA) tests in mathematics (OECD, 2019). Unlike literacy, however, where there was a considerable improvement between the 2012 and 2015 cycles, mathematics performance remained unchanged (OECD, 2019). Furthermore, the under-performance in the PISA tests in Ireland of specific populations, namely those from immigrant families or whose first language is not English, and those from socially-disadvantaged families, remains a cause for concern (Perkins & Shiel, 2016). While not examined in the PISA data, one population of concern for underachievement in numeracy is Deaf and Hard of Hearing (DHH) learners, who have been shown to perform below their hearing peers in maths (Marschark et al., 2015)(Marschark et al. 2015).

There are often challenges to the acquisition of numeracy skills and there are a number of student-level risk factors associated with underperformance in this area. Socio-economic disadvantage is one of the key risk factors and in Ireland and just under a third of students classed as disadvantaged were identified as lower achievers in mathematics in the PISA tests (Perkins & Shiel, 2016). Poor attendance at school, which can in turn be related to socio-economic disadvantage, also impacted on numeracy skills (Perkins & Shiel, 2016). Girls also perform poorer than boys in maths in Ireland, and there is a larger gender gap in Ireland compared with other OECD countries (Perkins & Shiel, 2016). Among the adult population in Ireland, NALA found that those adults with poor numeracy were "more likely than those with good numeracy to have parents with no qualifications, twice as likely to be early school leavers and twice as likely to have had parents who were unemployed or receive income support. They also found that numeracy skills have a strong impact on employment and earnings and those with poor numeracy skills were less likely to receive workplace training" (NALA, 2017, p.21). There are also school- and classroom-level risk factors including disadvantage status of the school, low teacher-expectations, and the disciplinary climate in maths classes (Perkins & Shiel, 2016).

The student, class and school level risk factors mentioned above can be exacerbated when coupled with an additional need such as deafness. While internationally the underperformance of deaf children in maths compared with their hearing peers has been well-documented (Powers, Gregory, & Thoutenhoofd 1998, Marschark et al. 2015, Nunes & Moreno 2002, Gottardis, Nunes, & Lunt 2011), very little is known about the performance of deaf children in numeracy in Ireland. In 2011, a study involving a very small sample (n=4) of deaf post-primary girls revealed maths performance well below average compared with

hearing peers (Owens, 2011). Owens' (2011) findings suggest that literacy difficulties may be infringing on numeracy development and she found that her students' problem solving in maths improved when they were presented with examination questions in both written English and Irish Sign Language, compared with written English alone. That said, problems arise for instruction of maths through Irish Sign Language where lexical limits in that language mean that teachers can lack the vocabulary needed to teach mathematical concepts in Irish Sign Language (Mathews, 2019).

In response to this, Sign Language communities internationally have developed glossaries for subjects such as maths and are making use of recent advances in technology and the widespread use of Information Communications Technology in education to freely disseminate this new terminology. There are several examples of such glossary projects, two of which include the Scottish Sensory Centre British Sign Language STEM Glossary and the National Technical Institute for the Deaf in Rochester Institute of Technology, New York, DeafTEC ASL STEM dictionary. Since the sign language used by each nation is unique, these resources provide a helpful framework for how an equivalent resource might be developed in Ireland, but the resources in and of themselves are not transferable to the Irish context. Instead, a glossary of signs used in Irish Sign Language was required.

Method

The purpose of this study was to evaluate the mathematics component of an Irish Sign Language STEM Glossary project managed by Dublin City University. A mixed-method experimental study design was used incorporating quantitative data from questionnaires and qualitative data from focus group semi-structured interviews. Participants were recruited to the study using purposive sampling, identifying the education sites across the country where there were likely to be ISL users. Five sites were used and recruitment information (plain language statement, informed consent form) was posted to those sites.

The questionnaire collected data on attitudes towards maths and towards talking to deaf children about maths. We also asked participants to state whether or not they had an ISL sign for a selection of 50 maths terms from the primary and post-primary curricula. The terms were selected randomly, with every nth term from a list of vocabulary included on the selection for parents and teachers. The questionnaire was answered by 78 respondents, comprising 53 parents and 25 teachers.

The evaluation of the glossary was measured using focus group interviews with teachers (n=13 teachers).

Results

Attitudes towards STEM

A range of questions were posed to assess participants' general attitudes towards maths and science. Attitudes towards maths were quite positive overall with over 78% of the sample stating that they were either very comfortable or quite comfortable dealing with maths. It

ranked considerably higher than dealing with foreign languages for example (45%). Only 6% of the sample stated that they avoided maths if at all possible. The results are summarised in Table 1 below:

How comfortable do you feel dealing with/talking about:

	Maths		**Foreign languages**		**Technology in our day to day lives**		**Careers in science, technology and engineering**	
Very comfortable	36	46.2%	11	14.3%	25	32.1%	18	24.0%
Quite comfortable	25	32.1%	24	31.2%	34	43.6%	20	26.7%
Quite uncomfortable	7	9.0%	24	31.2%	12	15.4%	17	22.7%
Very uncomfortable	5	6.4%	8	10.4%	6	7.7%	11	14.7%
I avoid it/them if at all possible	5	6.4%	10	13.0%	1	1.3%	9	12.0%

This data was supported by findings from the Likert questions asking how participants felt about maths, maths practices in the home, and deaf children learning maths (see Table 2 below). Again, 77% of participants either agreed or strongly agreed that they liked maths. There was very high agreement (93%) that maths is important in people's day-to-day lines with 74% of participants stating that they discussed maths in their home.

However, the fact that 56% of participants either agreed or strongly agreed that deaf children find maths more difficult than hearing children highlights that some obstacles are in place for this cohort. Perhaps one of the reasons participants reported that deaf children find maths more difficult than hearing children is because of the barriers to discussing maths: 62% of participants either agreed or strongly agreed that discussing maths with deaf children is more difficult than with hearing children. That said, 54% of the sample felt confident discussing maths with deaf children.

	Strongly agree		Agree		Neither agree nor disagree		Disagree		Strongly disagree	
I like maths	33	44%	25	33%	7	9%	7	9%	3	4%
Maths is important in people's day to day lives	52	70%	17	23%	3	4%	1	1%	1	1%
We discuss maths in our home	21	29%	33	45%	13	18%	6	8%	0	0%
Deaf children find maths more difficult than hearing children	19	26%	22	30%	15	20%	14	19%	4	5%
I am confident discussing maths with deaf children	17	23%	23	31%	21	28%	10	14%	3	4%

Discussing maths with deaf children is harder than with hearing children	21	29%	24	33%	16	22%	8	11%	3	4%

This confidence is not borne out by everyone in the group. A Mann-Whitney U test reveals that there was a statistically significant difference between how parents and teachers responded to this statement with teachers stating higher levels of agreement that they are confident discussing maths ($U=414$, $p=0.037$). This is likely to be in part caused by their professional qualifications in primary teaching and the daily application of maths in the classroom. Nonetheless, the lack of confidence among some parents may inhibit classroom learning being reinforced at home. Furthermore, teachers were statistically more likely to agree that they liked maths ($U=372$, $p=0.004$) than parents.

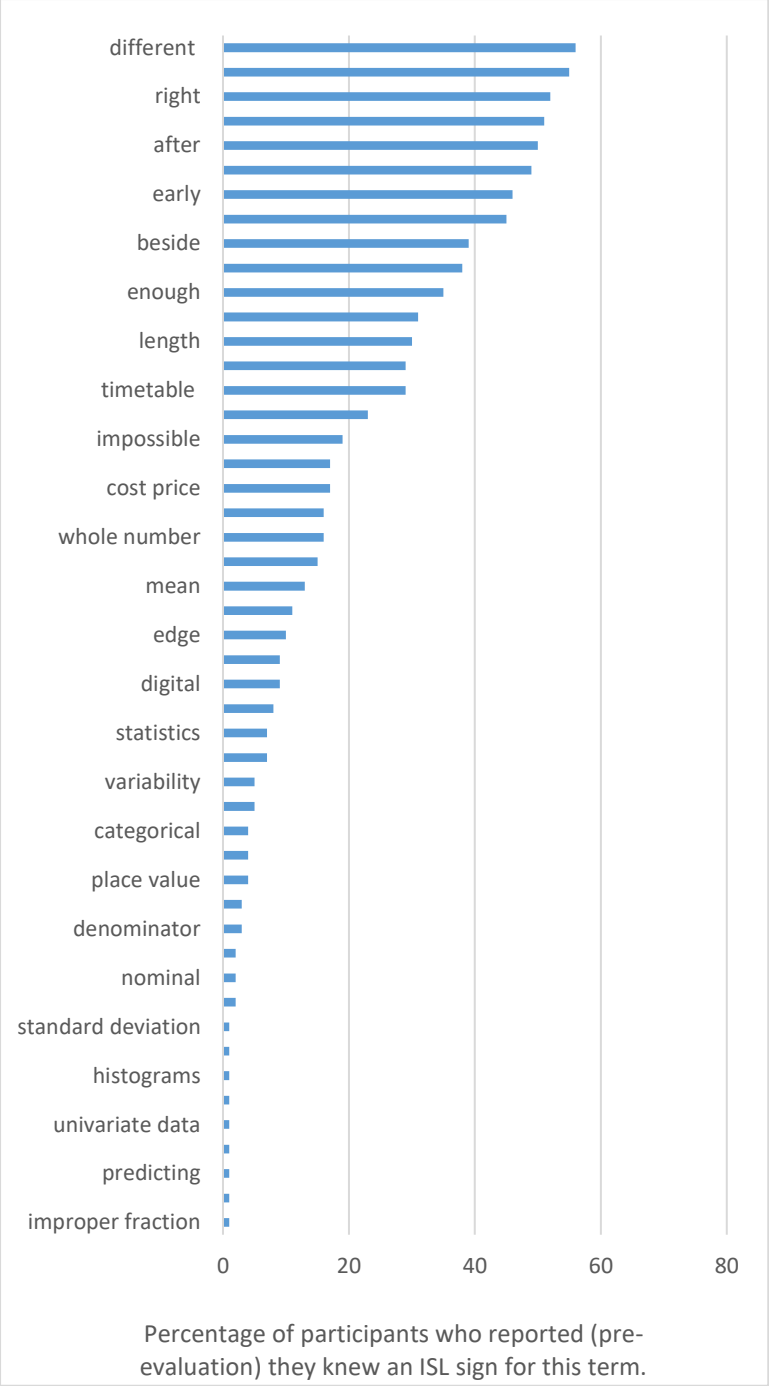

Figure 1: Participants who reported that they knew an ISL sign for the term given.

Knowledge of maths vocabulary in ISL

We asked parents and teachers before the evaluation began whether or not they had a sign for a selection of mathematical terms. Their responses are summarised in figure 1 above. Two observations can be made from these data. First and unsurprisingly, participants are much more likely to know signs from maths that have high application to everyday life. In particular, terms used to describe time (last year, minute, weekly, early) and location (right,

on top, beside) feature in the top ten most known signs. Signs relating to the more technical aspects of maths (improper fraction, predicting, ordinal) are much less frequently known.

Figure 2 below demonstrates that, across the board, teachers reported that they were more knowledgeable in ISL signs for mathematical terms. There was only one term where parents reported more than teachers that they had a sign: the term ‘mean’. This is possibly due to misunderstanding of the term where parents are reporting that they have a sign for the word ‘mean’ (as in define) as opposed to the mathematical concept of average.

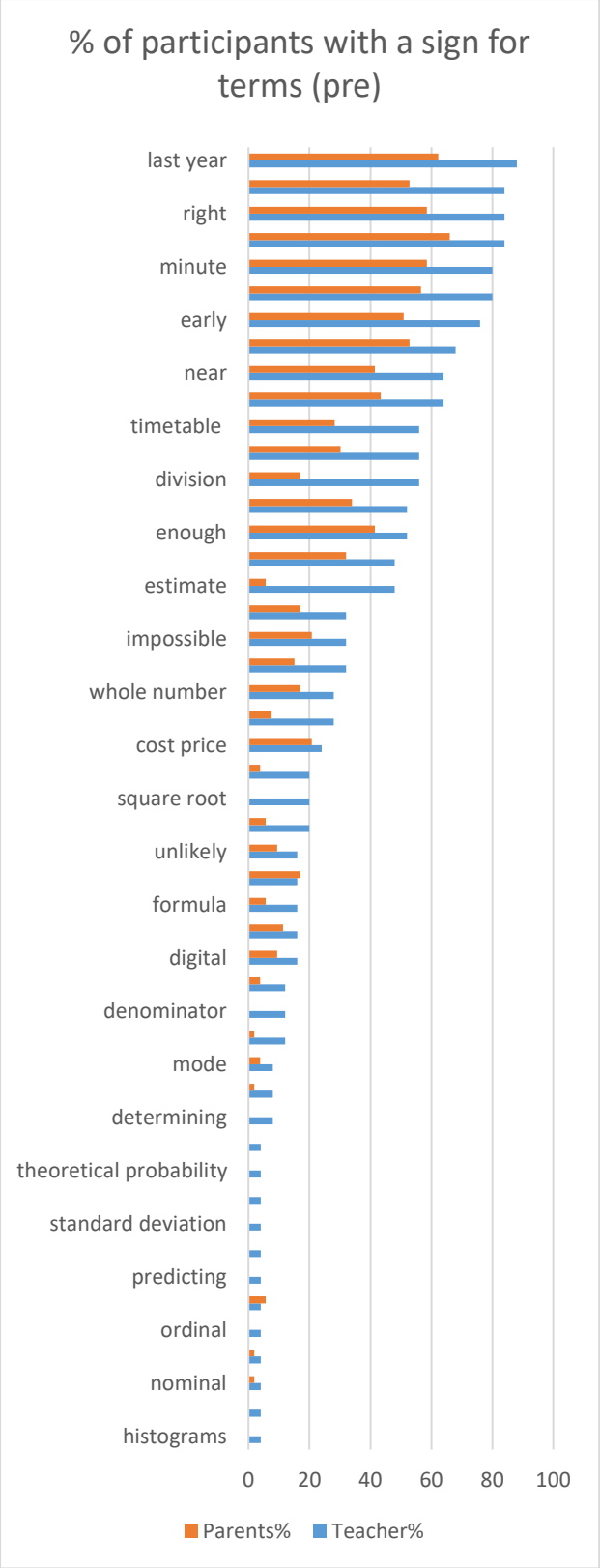

Figure 2: Percentage of each category of participant who reported (pre evaluation) that they knew an ISL sign for the term given

Discussion

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