MATHEMATICS DISPOSITIONS OF SECONDARY SCHOOL STUDENTS WITH SPECIAL EDUCATIONAL NEEDS

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ABSTRACT

The aim of this paper is to shed more light into the attitudes and dispositions to mathematics education of secondary school students with special educational needs (SEN) in mainstream schools. The data was collected as part of a larger project in England which looked at the relationship between students' learning outcomes (including dispositions) and the teaching they are exposed to. In this presentation we particularly draw on data from students in secondary school (from Year 7 to Year 11), focusing on those with SEN. Our emphasis in this analysis is to explore the learning outcomes, attitudes and choices regarding mathematics of those students and where appropriate, compare them with the experiences of students without SEN. Survey results along with qualitative interview data will be presented and discussed in terms of implications for practice.

BACKGROUND

Research of students' attitudes towards mathematics is well documented and has gained considerable traction over the years (Fennema & Sherman, 1976; Frost, Hyde, & Fennema, 1994; Hannula, 2002). Instruments proposed and used since then have been widely influenced by Fennema-Sherman (1976) scales that employed sets of Mathematics Attitude Scales, which included separate scales for values (e.g. 'Attitude to Success in Math'), beliefs (e.g. 'Math as a Male Domain'), 'Confidence in Learning Math', 'Math Anxiety', and disposition towards active problem solving ('Effectance Motivation'). However, critiques have argued that researchers on attitude have never actually provided clear meanings or definitions as to its actual make up. McLeod (1992) argued that often the definition is usually to be inferred from the type of instrument used since the researcher gave no explicit definitions. He argued further that this lack of conceptual clarity was linked to the borrowing of instruments and constructs from psychology, without explicit grounding for mathematics education.

Despite these controversies, studies in this area are vital as they may reveal key influences on students' choices and decision-making and hence future engagement with STEM. Previous studies had also identified a plethora of socio-cultural factors which are significant in shaping students' dispositions and choice-making in education in general, and in mathematics in particular: class, gender, nationality, ethnicity, parental and peer cultures are just the beginning of the list. In our earlier work with post-secondary students we had also contributed with instruments for measuring what we called dispositions and self-efficacy in

mathematics (Pampaka et al., 2013). Hence, students' affective dispositions (e.g. self-efficacy) may also be critical to their choices and need to be included in modelling learning outcomes (Bandura & Locke, 2003; Marat, 2005).

Research in this area has so far largely ignored factors such as SEN and disability. McCoy & Banks (2012), however, argued that attitudes towards mathematics (and reading) of students with SEN are also very important in shaping attitudes towards school. Besides, the mathematics performance of students with disabilities is lower compared to their peers without disabilities, and lower percentages of students with disabilities achieve the basic levels of performance as international evidence shows (Wei, Lenz, & Blackorby, 2012). Learning and performing in maths may vary between students with different needs. For example, Wei et al. (2012) found that whilst math achievement growth generally slows down at the early stages of secondary education for students with all types of disabilities, there are differences between certain groups: those with learning disabilities have a slower growth rate compared to those with specific learning difficulties (e.g. dyslexia), for instance. It is, thus, important to note that children with SEN should not be viewed as a homogenous group. For example, McCoy & Banks (2012) found that attitudes and experiences towards school are different depending on the SEN type: multiple disabilities e.g. learning and physical as well as learning and behavioral were more likely to 'never like school' compared to those with only physical or sensory impairments. SEN children (especially boys) were more likely to not like school compared to non-SEN.

Hence, in spite of its significance, research in SEN dispositions to mathematics is limited and less well documented. We therefore aim to answer the following research questions, herein:

- How do perceptions of attitudes towards mathematics differ between students with SEN and those of their peers?
- What do the students with SEN consider as important factors affecting their mathematics experiences in secondary school

METHODOLOGY

These results are based on a large-scale longitudinal (ESRC funded) study that explored teaching and learning secondary mathematics in the UK (www.teleprism.com). The project employed a mixed methodology including surveys with students and their teachers in all 5-year groups of secondary education in 40 schools in England, and qualitative case studies in two of these schools. The quantitative data were collected through surveys of students conducted from October 2011 to December 2012. For this paper we draw on the first two data

points (DPs, out of 3): DP1 took place at the start of academic year 2011-12 (with N= 13325), and DP2 took place at the end of that year (N=8752). Students were asked to report their mathematical attitudes, confidence at various mathematical topics, future aspirations, and their perceptions of the teaching they encounter. With students responses to these questionnaires and by using the Rasch model we created measures of mathematics dispositions and pedagogic styles (e.g. Pampaka & Wo, 2014). It should be noted that information on students' SEN was collected directly from schools, instead from students; because not all schools provided this information analysis is limited to those students for whom we had some information. Therefore the sample sizes differ from those presented above.

Qualitative data was collected through semi-structure interviews with students in two case study schools. Interviews focused on students' educational background, experiences of learning mathematics, pedagogic practices and future aspirations.

ANALYSIS AND RESULTS

Quantitative data were analyzed using Excel for descriptive plots and SPSS 20 for inferential statistics where appropriate. The interviews were analysed via NVivo 10.1.3, with an initial coding frame based on the semi-structured interview schedule. The analysis of interviews was based on principles of grounded theory approaches and constant comparison analysis techniques (Strauss & Corbin, 1990).

Results from total survey sample: The total analytical sample for this paper is 7092 students at DP1 (Tables 1 and 2).

Table 1: SEN students on register at DP1 and DP2

	DP1	DP2
Not SEN	6177 (87.1%)	5850 (87.65%)
SEN	915 (12.9%)	824 (12.35%)
Total	**7092**	**6674**

Details on the type of SEN for each student were missing for many students. Table 2 shows details of the available information, with the majority of reported cases of SEN having "moderate learning difficulties".

Table 2: Details for reported SEN cases

SEN Details	DP1 (N, %)		DP2 (N, %)	
ASD (Autistic Spectrum Disorder)	8	0.87%	8	0.97%
BESD (Behaviour, Emotional & Social Difficulties)	70	7.65%	46	5.58%
HI (Hearing Impairment)	15	1.64%	15	1.82%
MLD (Moderate Learning Difficulty)	122	13.33%	103	12.50%
OTH (Other Difficulty/Disability)	8	0.87%	8	0.97%
PD (Physical Disability)	9	0.98%	7	0.85%
PMLD (Profound & Multiple Learning Difficulty)	4	0.44%	3	0.36%
SLCN (Speech, Language and Communication Needs)	17	1.86%	14	1.70%
SPLD (Specific Learning Difficulty)	50	5.46%	35	4.25%
VI (Visual Impairment)	2	0.22%	1	0.12%
Not specified	610	66.67%	584	70.87%
Total	**915**		**824**	

The results presented here focus on the main attitudinal measures, across the two data points in one academic year, by year group (when relevant). Starting with **subject preferences** Figure 1 summarises the distribution of students in both groups based on whether they reported Maths as their favourite, least favourite or did not report maths at all (thus indifferent). As can be seen SEN students overall are more likely to report maths as their least favourite topic (even though differences regarding maths as favourite are not that clear-cut).

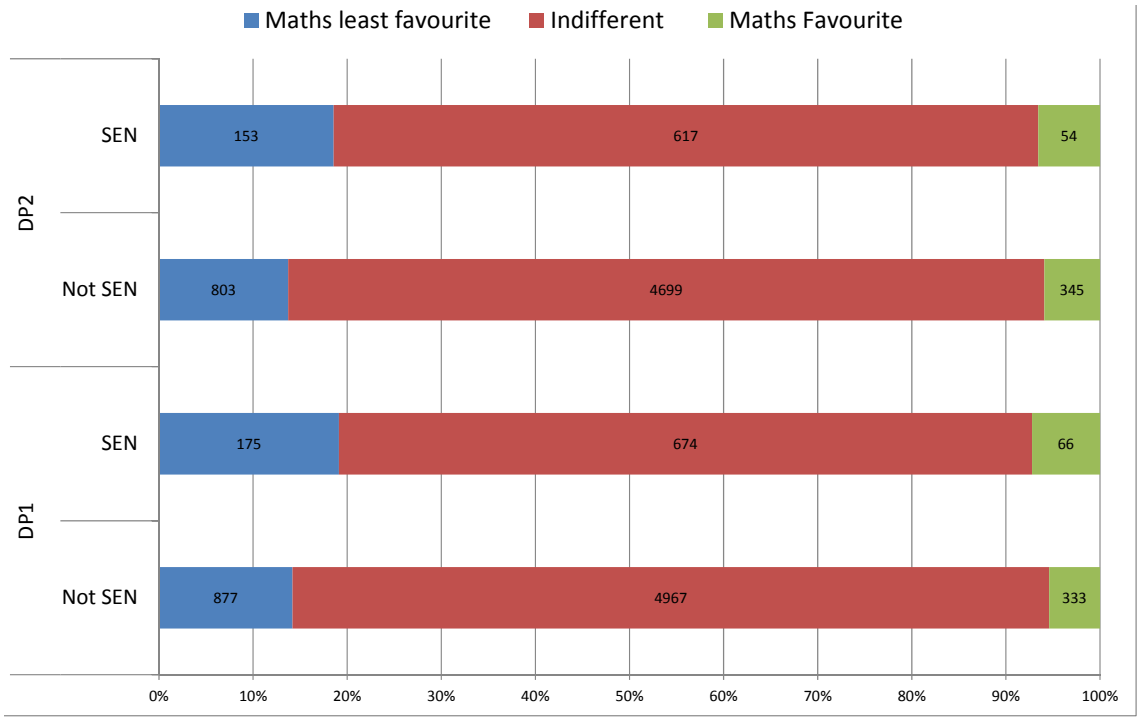

Figure 1: Students' distribution based on reported subject preference

Another interesting interaction is observed when looking at the average mathematics disposition at DP1 and DP2 (Figure 2).

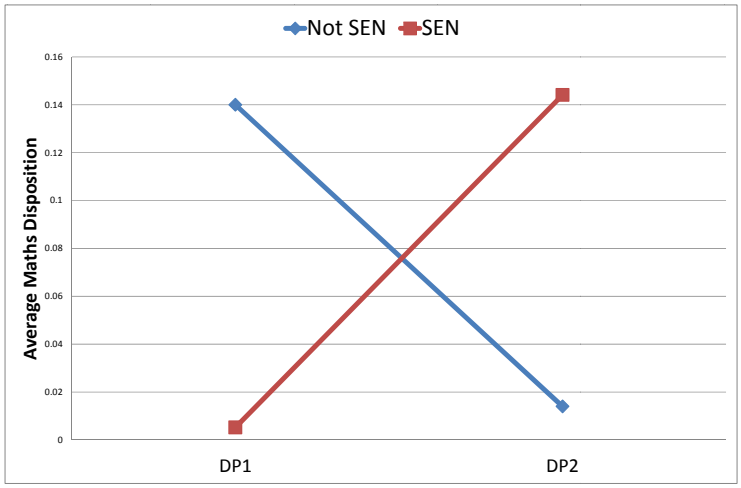

Figure 2: Students' mathematics dispositions, based on SEN vs Non-SEN

More detail on the potential cause of this 'switch' might be inferred from Figure 3, where one can note the overall drop in dispositions. Differences between the two groups of interest are not consistent. The largest observed difference with SEN students being much less disposed is at Year 9.

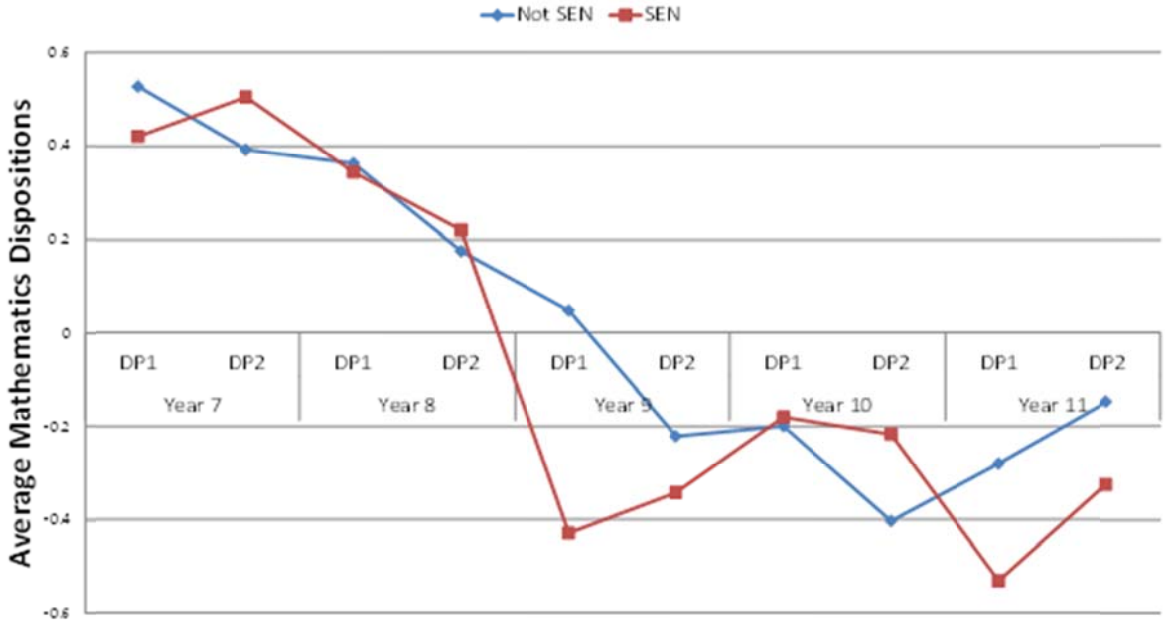

Figure 3: Students' mathematics dispositions, based on SEN vs Non-SEN, by Year group and DP

Maths identity patterns (Figure 4) are more consistent with SEN group scoring lower (apart from Year 7 DP2). The same pattern can also be observed for mathematics self-efficacy (Figure 5).

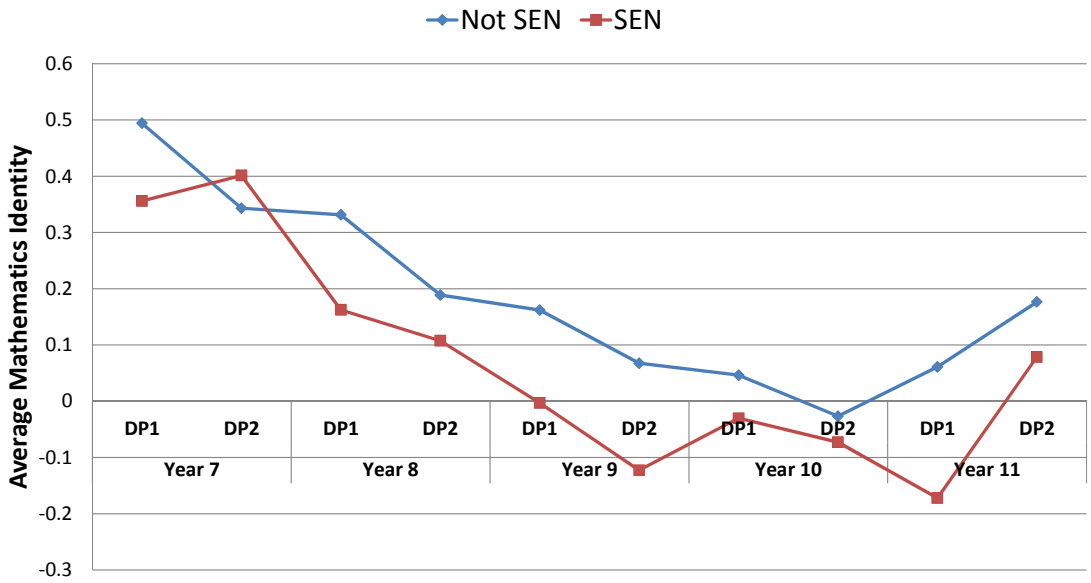

Figure 4: Students' mathematics identity, based on SEN vs Non-SEN, by Year group and DP

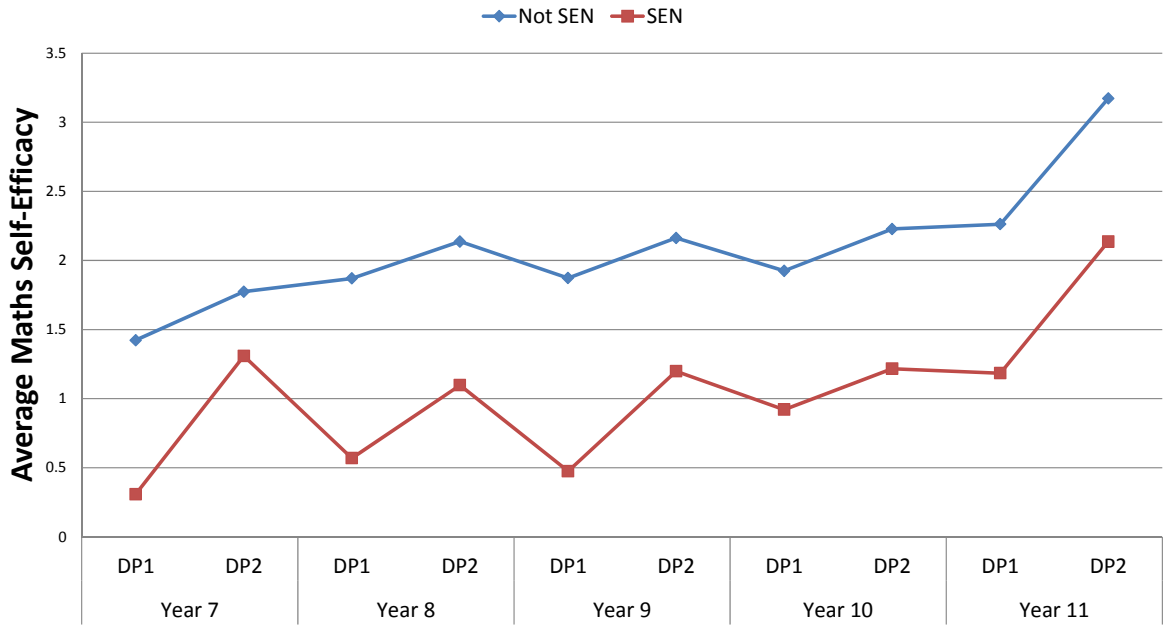

Figure 5: Students' maths self-efficacy, based on SEN vs. Non-SEN, by Year group and DP

Analysis of data from the two case studies: Data from surveys with the two schools were analysed separately. School A, according to Ofsted reports, has a 'higher than the national average' percentage of students with SEN (21.7% as found in surveys), whilst schools B is 'below the national average' (15.5%). We compared the means on the main attitudinal measures of interest (dispositions, identity and self-efficacy) for each school between SEN and Non-SEN students via independent t-tests. Interestingly we found a statistically significant difference in school A for the measure of maths disposition (t=2.26, sd=1.66,

p<0.05) with students with SEN scoring higher (m=-0.03) compared to No-SEN group (m=-0.39). This was a surprising finding as the quantitative findings from all schools show lower overall maths disposition for students with SEN. In this school identity scores were not different either. All other differences (also statistically significant) were in the expected direction (i.e. higher scores for non-SEN students).

We interviewed 10 SEN students (8 boys and 2 girls) in these two schools, with 8 students interviewed twice, with an academic year between the first (DP1) and second (DP2) interview. No information was provided by the schools about the type of students' special need. Several of these SEN students volunteered information that would provide some indication of their possible additional needs (e.g. difficulty concentrating in class, being disruptive during lessons or persistent absenteeism):

> *Student: I get in trouble sometimes.*
> *Interviewer: … why do you get in trouble?*
> *Student: I talk too much, I get detention a lot.*
> *(Y7, Boy)*
>
> *Not always I'm mostly good but I do get distracted quite a lot.*
> *(Y8, Boy)*

According to students' reports, teachers' tactics to deal with these issues varied from temporary exclusion from the classroom, to changes in seating plans, or move to a lower ability set. These actions might have negative effect on their overall dispositions:

> *Student: it stresses me when I say something and he moves me into a different classroom. …*
> (Y8, Boy)
>
> *Interviewer: Okay so what do you think made you go back up and down sets …?*
> *Student: Wasn't listening.*
> *(Y9, Boy)*
>
> *I think I was messing about a bit in class so I got moved down [ability set].*
> *(Y8, Boy)*

None of the students reported maths as their favourite subject: only one student indicated that Maths was in their 2-3 top favourite subjects, while the rest indicated maths as being their worst or 'somewhere in the middle'. Students related their dislike of maths with either the subject matter or the teacher. Maths was usually described as 'hard', 'difficult' or 'boring'. Students often said that they did not like maths because they were 'not good' at it or they 'don't get it'. They often described themselves as not confident, and when asked to describe their efficacy on specific mathematical items, they appear to have low maths self-efficacy:

Interviewer: What was your worst topic?
Student: Maths, I am not really good at maths.
Interviewer: So why didn't you like it?
Student: Because there were some things that I got confused with and some things I found hard in maths, and I am not very good at maths.
(Y7, Girl)

Yes, Maths is quite hard.
(Y7, Boy)

Interviews revealed that maths disposition was often associated with affective relationships with teachers:

When I was with Miss X I didn't like it [maths] but now I don't mind it now I'm in Miss Y.
(Y9, Boy)

Student:[better this year] Because I don't really mind the teacher.
Interviewer: You don't mind the teacher?
Student: No I didn't really like my last teacher.
(Y9, Boy)

In talking about their ideal lessons and preferred teaching styles, 'more fun', 'practical', 'interactive activities', 'hands on' and involving 'games' were the most common suggestions:

Student: Make it more fun.[…]More activities on the board and more group work.
(Y8, Boy)

We had to build stuff with straws and we had to see what was the strongest.
(Y8, Boy)

Student: make the lessons like funny. […]Like doing like practical lessons every lesson.
(Y8, Boy)

Yeah, they're a bit of a challenge and that, loads of fun. I remember in Year 7 we did the farm one, when you've got to make your own farm, that was fun ….
(Y9, Boy, School B, DP2)

Only one student in School A volunteered information about additional support received in maths in the form of group work at the start of the day. Additional support, although not directly suggested, was mentioned by many students as helpful. In combination with the finding that students felt that maths are overall 'difficult' and they often 'don't get it', suggestions for additional support are very rational:

She goes through it more and helps you.
(Y9, Boy)

Having more help if I am struggling and that would make me understand it more.
(Y7, Girl)

It's fine I like Maths now and don't struggle with it a lot because they explain it a bit more now.
(Y7, Boy)

Well, step by step is always helpful, like you don't have a full blown list to do straight away…it's like step by step, that's how I got really good at algebra, just remembering the steps and all that.
(Y9, Boy)

Students reported disliking tests as they were 'stressful', they 'forgot things' and their 'mind went blank'. For these 10 students, it is interesting to see an overall agreement in liking shapes, as opposed to algebra (and sometimes fractions) which was reported as the most difficult.

Student: I like drawing shapes, it's better than doing work.
(Y7, Girl,)

Student: I like shapes and symmetry.
Interviewer: So why do you like that?
Student: It is just more fun and it is not just writing out loads of numbers.
(Y8, Boy)

I don't mind doing shapes.
(Y9, Boy)

Student: Algebra I hate.
Interviewer: Why do you hate it?
Student: Just confusing.
(Y9, Boy)

The value of maths (usefulness and connection of maths to real life) was often underestimated by the students. Students could often see the relevance of adding, subtracting (especially in relation to money), but other topics were often deemed irrelevant:

Student: Algebra, I don't like that. […] It does my head in, it is hard and it is just boring.
Interviewer: Do you think there is anyway you would use that in the real world?
Student: Not really. […] No – why would you need algebra? Because you are never really going to change a letter to a number, are you?
(Y8, Boy)

You're not going to go around measuring a square.
(Y10, Girl)

I think I'm going to the army I don't think I'll need Maths.
(Y9, Boy)

PRELIMINARY DISCUSSION AND CONCLUSIONS

This study has shown overall differences in maths disposition and self-efficacy between students with SEN and their peers, with students with SEN achieving lower scores. Furthermore, results from the case studies have revealed the impact of school on alleviating such trends. For example, school A did not follow that pattern which was a surprising finding. A possible explanation of that could be the overall low score on mathematics disposition in School A (as can be seen in the mean scores of students without SEN across the two schools). Indeed, one of the problems of school A according to the head of maths was the overall 'lack of aspiration'. The qualitative findings from the interviews with students confirm the overall low maths dispositions of students with SEN and those without.

As children with different SEN types may experience differently their overall engagement with and attitudes to mainstream school (McCoy & Banks, 2012), children with different types of SEN may have different dispositions and attitudes to mathematics. This study found that overall, maths dispositions differ between students with SEN and those without but without a consistent pattern. Results of students' overall dispositions in schools also vary, and this is linked strongly with specific pedagogical practices used amongst other factors, as presented elsewhere (Pampaka et al., 2012). The qualitative results in this paper reveal that students with SEN may be particularly in need of more interactive, fun and connective learning, in order to feel motivated and therefore, potentially more engaged in mainstream classrooms.

Inclusive classroom environments are designed considering the needs of all learners. Whilst students without disabilities may also engage in disruptive behaviours, it appears that for students in this sample reporting levels of behavioural needs or lack of concentration more often than not reported those alongside negative disposition in mathematics learning. Different instructional practices may be more appropriate for students with SEN and they may also differ according to the type of SEN. Indeed, previous research has shown differences in the effectiveness of approaches to learning mathematics between those with SEN and their peers; for example, the use of computer technology appears to have larger effects in mathematics achievement for students with SEN (Li & Ma, 2010). Similarly, research has shown overall lower maths achievement, and slower achievement growth for students with SEN compared to that of their peers without disabilities (Wei et al., 2012).

However, the type of SEN should not be the sole indicator when planning instructional/pedagogic practices, as individual characteristics and variation are also of paramount importance. For example, Billingsley et al. (2009) in comparing three instructional

practices for teaching mathematics to students with EBD found that no single method was preferable for all students but results varied across individuals based on other variables such as age, number of years spent at school the existence of additional learning difficulties amongst others. This paper has also shown that the self-efficacy of students with SEN is overall lower compared to students with SEN. Qualitative results revealed how this is closely linked to students' mathematical dispositions. Students with SEN face additional barriers to learning.

The study of dispositions to mathematics and specific attitudes and experiences of students with SEN is necessary in order to identify specific needs in learning mathematics that teachers, schools, and policies could respond to. With the demand of mainstream inclusive education today for all students with special needs, the pedagogical practices required may take the form of additional adaptations of practices and additional support in the classroom. Whether this is the specific seating positioning, additional time on the computers, specific software and software adaptations, it is important that pedagogies should: a) follow research findings on the preferred and more effective pedagogies for all learners (see Pampaka et al., 2012) and b) take into account the specific needs of learners so as to make appropriate adaptations that with the available or additional resources enable students with special needs to be fully included in the classroom.

REFERENCES

Archer, L., Halsall, A., Hollingworth, S., & Mendick, H. (2005). *'Dropping out and drifting away': an investigation of factors affecting inner-city pupils' identifies, aspirations and post-16 routes*. London: Institute for Policy Studies in Education.

Bandura, A., & Locke, E. A. (2003). Negative Self-efficacy and goal effects revisited. *Journal of Applied Psychology, 88*(1), 87-99.

Billingsley, G., Scheuermann, B., & Webber, J. (2009). A Comparison of Three Instructional Methods for Teaching Math Skills to secondary students with emotional/behavioural disorders. . *Behavioral Disorders, 35*(1), 4-18.

Bong, M. (2001). Predictive utility of subject-, task-, and problem-specific self-efficacy judgments for immediate and delayed academic performances. *Journal of Experimental Education, 70*(2), 133-162.

Bong, M. (2004). Academic motivation in self-efficacy, task value, achievement goal orientations, and attributional beliefs. *Journal of Educational Research, 97*(6), 287-297.

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman Mathematics Attitudes Scales: Instruments Designed to Measure Attitudes toward the Learning of Mathematics by Females and Males. *Journal for Research in Mathematics Education, 7*(5), 324-326.

Frost, L. A., Hyde, J. S., & Fennema, E. (1994). Gender, mathematics performance and mathematics-related attitudes and affects: A meta-analytic synthesis. *International Journal of Educational Research, 21*, 373-385.

Hannula, M. S. (2002). Attitude towards mathematics: emotions, expectations and values. *Educational Studies in Mathematics, 49*, 25-46.

Marat, D. (2005). Assessing mathematics self-efficacy of diverse students from secondary schools in Auckland: Implications for academic achievement. *Issues in Educational Research, 15*(1), 37-68.

McCoy, S., & Banks, J. (2012). Simply academic? Why children with special educational needs don't like school. *European Journal of Special Needs Education, 27*(1), 81-97.

McLeod, D. B. (1992). Research on Affect in Mathematics Education: a Reconceptualization. In D. Grows (Ed.), *Handbook of Research on Mathematics Teaching and Learning (pp. 575-596)*. McMillan Publishing Company.

Strauss, A., & Corbin, J. (1990). *Basics of Qualitative Research. Grounded Theory Procedures and Techniques*. London: Sage.

Wei, X., Lenz, K. B., & Blackorby, J. (2012). Math Growth Trajectories of Students With Disabilities: Disability Category, Gender, Racial, and Socioeconomic Status Differences From Ages 7 to 17. *Remedial and Special Education, 34*(3), 154-165.