

How Research Conceptualises the Student in Need of Special Education in Mathematics

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The focus of this paper is the conceptualisation of students in special educational needs in mathematics (SEM students) in the research fields of mathematics and special education. A difference between fields regarding the perspectives taken on the SEM student is obvious in the reviewed articles. Those in the special educational field were individual oriented in their view of the difficulties, whilst reviewed articles from the field of mathematics education more often discuss socio-cultural settings. The content in the selected 28 articles reveals that the overall conceptualisation of SEM student has to do with the social construct of the SEM student, as well as with students' experiences, affects, and prerequisites; with the specific training methods or interventions applied; with special areas in the subject of mathematics; with special groups of students; and with teachers' knowledge about all these factors.

Introduction

Research is grappling with the concept of students who are in need of special education in mathematics (SEM-students; Magne, 2006). Despite a sustained debate in various fields on how to help the student in need, there is no shared understanding (Heyd-Metzuyanim, 2013). Challenges involving the conceptualisation of the SEM student are similar to the differences McLeod and Adams (1989) describe in the use of the concept *affect* by mathematics educators and psychologists. Is it then possible that researchers that use the same concept mean different things, or researchers use different concepts but mean the same thing? Clarifying the concept could decrease the risk of misinterpretation and misconceptions. The present study contributes to an investigation regarding ways that the SEM-student is conceptualised in research. We build on a pedagogical foundation in the understanding of the SEM-student, since it is in the mathematics educational setting that the need occurs which is later handled by special pedagogical approaches. An effort to emphasise the student in the educational context makes the fields of mathematics education and special education sufficient research areas to explore. We analysed how research defines the SEM-student by identifying parts in the articles which *conceptualise* the student in need and explain the *cause of difficulties* and what *kind of support* is given in order to facilitate learning. The article at hand conceptualise the SEM-

student as being about the individual's *need* for special education. We draw on Silfver, Sjöberg and Bagger (2013) in the understanding of the position of need as something that may occur whether the student is a high or a low achiever, for a short or a long period, in a general or more specific area in mathematics.

A conceptual framework for categorisation

Perspectives involved in research on the student in need of support traditionally involve several fields of expertise, which are connected to a psychological, social, or pedagogical field (Emanuelsson, Persson, & Rosenqvist, 2001; Heyd-Metzuyanim, 2013; Isaksson, 2009; Magne, 2006; Nilholm, 2005; Persson, 2008; Skrtic, 1995). In addition, several levels and actors are involved when a school educates a student in need (Ahlberg, 2001, 2007; Skrtic, 1995). Nilholm (2005, 2007b) has labelled perspectives on special education as *compensatory* or *critical*, categories similar to those Persson (2008) calls *categorical* and *relational*. With both the critical and the relational perspectives, the heritage of the problem is described as located in socio-cultural settings. Solutions are then found by adapting the learning environment and the relations that surround the SEM student. A categorical or compensatory perspective in special education places the problem inside the student and can be described as a deviation from what is “normal.” Training, compensation, and correction of the individual are then necessary. Nilholm (2005, 2007a, 2007b) has furthermore described a third perspective that allows an evaluation and critique of both the compensatory and the critical perspectives used in research: the *dilemma perspective*. *Dilemma* (Nilholm, 2005, 2007b) refers to the unsolvable and contradicting problems involved in special pedagogical practice. Dilemmas can appear when the motives for supporting the student contravene the demands of society or the school system. In this paper the categorical and relational perspectives have been used in the categorisation of articles, and the dilemma perspective has been used in discussing the content of selected articles.

Methodology and methods

Magne (2006) presents research concerning the SEM student in a special issue of the Nordic mathematics education journal *NOMAD*. The present paper contributes by further reviewing ways that the SEM student is conceptualised and briefly reviews and discusses selected articles. The study focuses on two selected fields of research—namely, *special education* and *mathematics education*. Articles were selected from journals in the areas of mathematics education, special needs, and special pedagogy for the years 2006 to 2013. Journals were initially found through a journal search for the terms *special education* and *mathematics education*. We thereafter selected journals that were peer reviewed and determined their value by guidance from reported impact factors during 2012

in Scopus (Table 1). To further confirm the value, we also used the impact factor in the database Journal Citations Report (JCR). Values of 0.5 or below in JCR are considered low, and values of 1.5 or above are high. In addition to this, we added one journal, which is of importance for our text: The journal *NOMAD* is not listed in the databases but is ranked as a number one in the Database for statistikk om høgre utdanning (DBH). *NOMAD* is important because it represents the Nordic context of mathematics education. In total, 12 journals in the fields of special education (6) and mathematics education (6) were selected. Terms used for searching articles differed between the two fields since they have different focuses on the SEM student. The search term in the special educational journals was *math*, and in the mathematical journals the search words related to special needs: *dys-*, *need*, *support*, *disabilit-*, and *special*. After deselecting articles that did not mention the SEM student in the title or abstract, 28 remained for review.

Table 1. Articles found and used in journals, 2012. With impact factors.

Journal	JCR ¹	SNIP ²	Country	Issue/year	Publisher	Index category in SCOPUS	Found	Used
<i>Mathematics Education Research Journal</i>		0.760	Netherlands	3	Springer	Mathematics Social Sciences: Education	0	0
<i>Educational Studies in Mathematics</i>	0.765	1.874	Netherlands	9	Springer	Mathematics, Social Sciences	8	7
<i>NOMAD</i>			Nordic countries	4	NCM		4	4
<i>Research in Mathematics Education</i>		0.315		3	Routledge	Mathematics Social Sciences: Education	5	1
<i>JRME (Journal for Research in Mathematics Education)</i>	1.552	2.782	United States	5	Nat council teach. math.	Mathematics: Mathematics (miscellaneous) Social Sciences: Education	5	0
<i>ZDM (Zentralblatt für Didaktik der Mathematik)</i>		0.676	Germany	6–7	Springer Verlag	Mathematics, Social Sciences: Education	0	0
<i>European Journal of Special Needs Education</i>		1.104	England	4	Blackwell	Psychology: Developmental and Educational Psychology; Social Sciences: Education	5	1
<i>Journal of Special Education</i>	1.278	1.679	England	4	Sage	Medicine: Rehabilitation Social Sciences: Education	1	1
<i>International Journal of Special Education</i>		0.278	Canada	3	International J of Special Edu.	Medicine: Rehabilitation Social Sciences: Education	5	4
<i>Journal of Research in Special Educational Needs</i>		0.773	England	3	Blackwell	Social Sciences: Education	2	2
<i>Remedial and Special Education</i>	0.890	0.795	United States	6	Sage	Medicine: Public Health, Environmental and Occupational Health. Social Sciences: Education	4	4
<i>British Journal of Special Education</i>		0.792	England	4	Blackwell	Psychology: Developmental and Educational Psychology; Social Sciences: Education	4	4
						Total:	43	28

Analysis

As previously mentioned, the way research defines the SEM student is found by identifying parts in the reviewed articles which *conceptualise* the student in need and explain the *cause of difficulties* and what *kind of support* is given in order to

¹ Journal Citation Reports (JCR). Impact factor from Thompson. The value is based on cites/number of articles from the two previous years.

² Source-normalised impact per paper (SNIP). Impact factor from Scopus. The value is based on the number of citations given in the current and three past years, divided by the total number of publications in the past three years—normalisation is made between fields.

facilitate learning. Expressions about these three parts formed the basis for categorising the perspectives used. This was performed using a theoretical framework (see Table 2), drawing on the definitions of perspectives on special pedagogy developed by Nilholm (2005, 2007b) and Persson (2008). Moreover, we discussed this frame for analysing the conceptualisation with Nilholm (personal communication, October 2013). Since some articles lie near both perspectives, it is necessary to clarify boundaries. The application of these borders can be understood as a crossroad in the work of analysis. Accordingly, articles were initially sorted using the concept of the student in need. If an article discussed socio-cultural settings and affect or relations, it was placed in the relational perspective. Articles that found the student through testing and in which interventions were made with a specific child fell under the categorical perspective. If both perspectives were present in the concepts used in an article, we proceeded by looking into the context and the suggested supports and solutions.

Table 2. Frame for analysis

Perspective	Step 1: Concept used	Main cause of difficulty	Step 2: Support or solution
Relational	Describes the environment, relations between pupil's properties and context	Outside the pupil	Changes in the learning environment and relations between pupil and context
Categorical	Describes the pupil's prerequisites or properties	Within the pupil	Strengthen the pupil or compensate for deficits

Results

The results are presented in two parts. We first consider perspectives used by researchers whilst conceptualising SEM students. These perspectives are categorised through the framework described above. In addition, we discuss the review of selected articles through the dilemma perspective (Nilholm, 2005, 2007).

Perspectives on the SEM student in research

Perspectives used in research when conceptualising the SEM student are displayed in Table 3. Four crucial results appeared: (1) there is a significant difference between the field of mathematics and special education, (2) in the field of special education the categorical perspective was predominant, (3) in the mathematics educational field the emphasis on socio-cultural settings is apparent, and (4) because of the procedure for selection (we used only journals indexed under mathematics education or special education), relatively few articles were found. During 7 years and in 12 journals only 28 articles explicitly mentioned the SEM student. This is especially striking considering that the issue is frequently

debated amongst politicians, researchers, and professionals in the educational field.

Table 3. Categorisation of the reviewed articles

<i>Perspective used</i> <i>Articles indexed as</i>	Categorical	Relational
Mathematics Education	••	••••••••••
Education, Special	••••••••••••••	•

Discussing SEM students in research

What the reviewed research conceptualises as an SEM student and what is of importance for these students' learning can be summarised in six themes: (1) the social construct of the SEM student; (2) students' experiences, affects, and prerequisites; (3) the training methods or interventions employed; (4) special areas in the subject of mathematics; (5) special groups of students; and (6) teachers' knowledge about all these factors. Obviously, these themes overlap, and research often handles more than one of them. Here the themes will be discussed through the dilemma perspective. Dilemmas that concern *the social construct of the student* are apparent when students' needs and the needs of the educational system or of the school itself collide. This is displayed by Clausen-May (2007), who explored the SEM student in the context of international surveys. The need for valid measurement tools then conflicts with the student's need to gain access to tests and to be included in test taking. Although Clausen-May's conceptualisation is categorical (*children with needs*), the discussion critiques the ethos in the distributors' handling of the tests, which does not align with the ethos of the school. Another dilemma regarding the social construct of the student in research appears in that identifying the position of being in need is necessary in order to obtain support, even as this position risks marginalising and segregating individuals by identifying them as "not normal". Researchers who display these approaches do so by investigating the socio-economic or socio-cultural settings and their consequences for the SEM student (e.g., Heyd-Metzuyanim, 2013; Wei, Lenz, & Blackorby, 2013). Environment and individual are explored as a complex. This is the case when the development of a disabled identity is researched through a *commognitive approach* (Heyd-Metzuyanim, 2013).³ Identity is then dependent on how the environment brings out affective and cognitive factors within the individual. Research that scrutinises students' experiences, affects, and prerequisites often focuses on cognition, especially in the mathematics education journals in our selection. Furinghetti and Morselli (2009) investigate this through students' beliefs about the self and the subject. Malmivouri (2006) understands affect as a part of self-reflection, whilst Evans,

³ A theoretical framework developed by Anna Sfard (2009). The term *commognitive* merges *communication* and *cognitive*.

Morgan, and Tsatsaroni (2006) research emotions as a “charge attached to ideas or signifiers” (p. 209) and do not take the cognitive aspect into account, instead showing an interest in how social identity is constructed by discourse.

Diagnosis comes into play in research about the SEM student quite differently. It ranges from investigating the mathematics learning of students with a specific diagnosis (Abdelahmeed, 2007; Ahlberg, 2006) to making connections between students with different diagnoses and math achievement (Wei et al., 2013). Here the themes of *special groups of students* and *special areas within mathematics* come together. Some articles focus strictly on how the method might strengthen the individuals with deficits in general in mathematics (Barrett & Fish, 2011; Bryant, Bryant, Gersten, Scammacca, & Chavez, 2008; Ketterlin-Geller, Chard, & Hank, 2008). These studies are all considered categorical in their conceptualisation of the SEM student and are to be found within the field of special pedagogics. Students are here discussed as belonging to a group whose members are functionally similar. The method used to help or the approach investigated might concern a specific area—such as, for example, addition (Calik & Kargin, 2010), subtraction (Peltenburg, van den Heuvel-Panhuizen, & Robitzsch, 2012), or fluent computation (Burns, Kanive, & DeGrande, 2012). A dilemma in research within the themes *special groups of students* and *special areas within mathematics* is revealed only when the methods or interventions take place in inclusive settings. This is, for example, seen in research when approaches or methods are judged to fit all students in groups that include SEM students (Barrett & Fish, 2011; Bottge, Rueda, Serlin, Hung, & Kwon, 2007; Gifford & Rockliffe, 2012) or when students with diagnoses are learners in inclusive classrooms (Calik & Kargin, 2010). Individuals are then understood as having variations in abilities and belonging to a multitudinous group of learners. This can be described as a dilemma consisting of issues of categorisation and differentiation. One example of how this might play out in the conceptualisation of the SEM student is Gifford and Rockliffe’s (2012) categorical terminology about the student “with severe specific mathematics difficulties (p.2)” that nevertheless focuses on relational issues: “it would be advantageous to have a single pedagogical approach ... that was effective for children with varied difficulties. It would be even more advantageous if this approach were also effective for mainstream teaching, and could prevent mathematics difficulties” (p. 12). This dilemma is further explored in some articles about SEM students in the context of inclusion. For example, inclusive education is compared to solo lecturing (Tremblay & Laval, 2013), and Lindeskov (2006) stresses the need to understand the learners’ experience. School placement of the student might in itself determine whether the student is “special” (Calik & Kargin, 2010; Méndez, Lacasa, & Matusov, 2008). Méndez et al. (2008) have used placement as a way

of selecting informants and employ a relative expression for the SEM student—namely, *children who demonstrate disability*. This expression might be perceived as placing the problem within the individual, but the authors define the source of challenges in a way that shifts this focus: “Disability is regarded as being located in particular types of activity systems and learning cultures rather than within an individual” (p. 63). In research on the SEM student, one dilemma consists of the fact that although students have disabilities or prerequisites to take into account, this contravenes the context and the students’ experience: “difficulties experienced by children at school are best understood when the contexts in which children learn are examined along with learners’ interactions within them” (p. 64). Here some researchers highlight *teachers’ knowledge about support and the student* as cornerstones of work with SEM students (Bottge et al., 2007; Gal & Linchevski, 2010; Moscardini, 2010). Teachers’ knowledge then includes knowledge about how to identify SEM students (Al-Hroub, 2010).

Conclusion

In this study we have investigated how the SEM student has been conceptualised in selected journals in mathematics education and special education research published during the period 2006–2013. Both building the framework and identifying journals and articles of importance were challenging tasks. The impact value is a tricky measure of value in the social sciences and, moreover, depends on how young the journal is and guidelines to authors. Owing to the interdisciplinary nature of the special education field, journals may very well be indexed under *development psychology* or *education* and therefore may not have been found by the index we used. The findings show that research writings, especially in the field of special education, have a categorical vocabulary. This was not expected, and it surprised us as professionals in the field of special education, given that awareness regarding the field’s interdisciplinary challenges has been discussed by several scholars (e.g., Skrtic, 1995). There has also been a vivid debate on issues like inclusion and equity (Ahlberg, 2001; Goransson, Nilholm, & Karlsson, 2011; Nilholm & Alm, 2010; Skidmore, 2004) stemming from the Salamanca Declaration (Swedish Unesco Council, 2006). A striking fact is that very few articles explicitly discuss the conceptualisation of the SEM student. From 12 journals published during a 7-year period, we identified 28 articles using our procedure. There also seems to be ambivalence regarding the concept of the SEM student both within and between articles. The mathematical journals in general adopt a more relational perspective. In mathematics education, a social turn in research (Rodd, 2006; Lerman, 2000) might have contributed to this scenario, but it is also possible that the focus on the subject of mathematics draws research in this direction, whilst in special pedagogy the individual is in focus. We have adopted the concept *the student in need of special*

education in mathematics in order to emphasise the social aspect. The word *in* is here of great importance. The student is *in* need, not *with* needs. Ambiguity regarding the very definition of the student in need became apparent in this study but is not surprising. There exists a view of research as a collective assignment taken on by individuals, and different fields and perspectives contribute differently to the definition. We do not believe consensus in the matter is desirable since fields complement one another, and the position of being an SEM student is complex and needs to be investigated from various perspectives. But, it is necessary to be explicit and systematic about the conceptualisation in order to avoid misunderstandings and misinterpretations. Otherwise follows a potential risk of badly coordinated and performed actions both in research and practice. Hence, a mission for further research is to investigate ways to develop more sustainable definitions of the SEM student. These definitions need to take both research and practice into consideration.

References

- Abdelahmeed, H. (2007). Do Children with Down Syndrome Have Difficulty in Counting and Why? *International Journal of Special Education*, 22(2), 129–139.
- Ahlberg, A. (2001). *Lärande och delaktighet*. Lund: Studentlitteratur.
- Ahlberg, A. (2006). Children with Impairments Learning Numbers. *Nordic Studies In Mathematics Education*, 11(4), 97.
- Ahlberg, A. (2007). Specialpedagogik—ett kunskapsområde i förändring. In C. Nilholm och E. Björck- Åkesson (edt.). *Reflektioner kring specialpedagogik—sex professorer om forskningsområdet och forskningsfronterna: Vetenskapsrådets rapportserie 5:2007*.
- Al-Hroub, A. (2010). Perceptual skills and Arabic literacy patterns for mathematically gifted children with specific learning difficulties. *British Journal of Special Education*, 37(1), 25–38.
- Barrett, D. C. & Fish, W. W. (2011). Our Move: Using Chess to Improve Math Achievement for Students Who Receive Special Education Services. *International Journal of Special Education*, 26(3), 181–193.
- Bottge, B. A., Rueda, E., Serlin, R. C., Hung, Y.-H. & Kwon, J. M. (2007). Shrinking Achievement Differences with Anchored Math Problems: Challenges and Possibilities. *Journal of Special Education*, 41(1), 31–49.
- Bryant, D. P., Bryant, B. R., Gersten, R., Scammacca, N. & Chavez, M. M. (2008). Mathematics Intervention for First- and Second-Grade Students With Mathematics Difficulties: The Effects of Tier 2 Intervention Delivered as Booster Lessons. *Remedial & Special Education*, 29(1), 20–32.
- Burns, M. K., Kanive, R. & DeGrande, M. (2012). Effect of a Computer-Delivered Math Fact Intervention as a Supplemental Intervention for Math in Third and Fourth Grades. *Remedial & Special Education*, 33(3), 184–191.
- Calik, N. C., & Kargin, T. (2010). Effectiveness of the Touch Math Technique in Teaching Addition Skills to Students with Intellectual Disabilities. *International Journal of Special Education*, 25(1), 195–204.

- Clausen-May, T. (2007). International mathematics tests and pupils with special educational needs. *British Journal of Special Education*, 34(3), 154–161.
- Emanuelsson, I., Persson, B. & Rosenqvist, J. (2001). *Forskning inom det specialpedagogiska området: en kunskapsöversikt*. Stockholm: Statens skolverk.
- Evans, J., Morgan, C. & Tsatsaroni, A. (2006). Discursive Positioning and Emotion in School Mathematics Practices. *Educational Studies in Mathematics*, 63(2), 209–226.
- Furinghetti, F. & Morselli, F. (2009). Every Unsuccessful Problem Solver Is Unsuccessful in His or Her Own Way: Affective and Cognitive Factors in Proving. *Educational Studies in Mathematics*, 70(1), 71–90.
- Gal, H. & Linchevski, L. (2010). To See or Not To See: Analyzing Difficulties in Geometry from the Perspective of Visual Perception. *Educational Studies in Mathematics*, 74(2), 163–183.
- Gifford, S. & Rockliffe, F. (2012). Mathematics Difficulties: Does One Approach Fit All? *Research in Mathematics Education*, 14(1), 1–15.
- Goransson, K., Nilholm, C. & Karlsson, K. (2011). Inclusive Education in Sweden? A Critical Analysis. *International Journal of Inclusive Education*, 15(5), 541–555.
- Heyd-Metzuyanin, E. (2013). The Co-Construction of Learning Difficulties in Mathematics-Teacher-Student Interactions and Their Role in the Development of a Disabled Mathematical Identity. *Educational Studies in Mathematics*, 83(3), 341–368.
- Isaksson, J. (2009). *Spänningen mellan normalitet och avvikelse: om skolans insatser för elever i behov av särskilt stöd*. Umeå: Institutionen för socialt arbete, Umeå universitet.
- Ketterlin-Geller, L. R., Chard, D. J. & Hank, F. (2008). Making Connections in Mathematics: Conceptual Mathematics Intervention for Low-Performing Students. *Remedial & Special Education*, 29(1), 33–45.
- Lerman, S. (2000). *The Social Turn in Mathematics Education Research*. Westport, CT, USA: Greenwood press.
- Lindeskov, L. (2006). Matematikvanskeligheder i inkluderende undervisning for børn, unge og voksne. *Nordic Studies in Mathematics Education*, 11(4).
- Magne, O. (2006). Historical Aspects on Special Education in Mathematics. *Nordic Studies In Mathematics Education*, 11(4), 7–35.
- Malmivuori, M. L. (2006). Affect and Self-Regulation. *Educational Studies in Mathematics*, 63(2), 149–164.
- McLeod, D. B., & Adams, V. M. (edt.) (1989). *Affect and Mathematical Problem Solving: A New Perspective*. New York : Springer-Vlg.
- Moscardini, L. (2010). ‘I Like It Instead of Maths’: How Pupils with Moderate Learning Difficulties in Scottish Primary Special Schools Intuitively Solved Mathematical Word Problems. *British Journal of Special Education*, 37(3), 130–138.
- Méndez, L., Lacasa, P. & Matusov, E. (2008). Transcending the Zone of Learning Disability: Learning in Contexts for Everyday Life. *European Journal of Special Needs Education*, 23(1), 63–73.
- Nilholm, C. (2005). Specialpedagogik: Vilka är de grundläggande perspektiven? *Pedagogisk forskning i Sverige*,(10)2, 124–138.
- Nilholm, C. (2007a). Forskning om specialpedagogik: Landvinningar och utvecklingsvägar *Pedagogisk forskning i Sverige*,(12)2, 96–109.

- Nilholm, C. (2007b). *Perspektiv på specialpedagogik*. (2nd ed.) Lund: Studentlitteratur.
- Nilholm, C. & Alm, B. (2010). An Inclusive Classroom? A Case Study of Inclusiveness, Teacher Strategies, and Children's Experiences. *European Journal of Special Needs Education*, 25(3), 239–252.
- Peltenburg, M., van den Heuvel-Panhuizen, M. & Robitzsch, A. (2012). Special Education Students' Use of Indirect Addition in Solving Subtraction Problems up to 100-A Proof of the Didactical Potential of an Ignored Procedure. *Educational Studies in Mathematics*, 79(3), 351–369.
- Persson, B. (2008). *Elevers olikheter och specialpedagogisk kunskap*, Enskede: TPB.
- Rodd, M. (2006). Commentary: Mathematics, Emotion and Special Needs. *Educational Studies in Mathematics*, 63(2), 227–234.
- Sfard, A. (2009). Moving Between Discourses: From Learning-as-Acquisition To Learning-as-Participation. *AIP Conference Proceedings*, 1179(1), 55–58.
- Silfver, E., Sjöberg, G. & Bagger, A. (2013). Changing Our Methods and Disrupting the Power Dynamics: National Tests in Third-Grade Classrooms. 12.
- Skidmore, D. (2004). *Inclusion: The Dynamic of School Development*. Maidenhead: Open University Press.
- Skrtic, T. M. (ed.) (1995). *Disability and Democracy: Reconstructing (Special) Education for Postmodernity*. New York: Teachers College Press; 1995.
- Swedish Unesco Council (2006). *Salamanca Declaration and Salamanca +10*. Stockholm: Svenska Unescorådet.
- Tremblay, P. & Laval, U. (2013). Comparative Outcomes of Two Instructional Models for Students with Learning Disabilities: Inclusion With Co-teaching and Solo-Taught Special Education. *Journal of Research in Special Educational Needs*.
- Wei, X., Lenz, K. B. & Blackorby, J. (2013). Math Growth Trajectories of Students with Disabilities: Disability Category, Gender, Racial, and Socioeconomic Status Differences From Ages 7 to 17. *Remedial & Special Education*, 34(3), 154–165.