

Who is the Student in Need of Special Education in Mathematics?

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The focus in this review is to present the conceptualisation of the student in “Special Educational needs in Mathematics” (hereafter called SEM-students) in the research fields of mathematics and special education. A difference between the fields regarding what perspective is taken on the SEM-student was obvious in the selected 13 journals. Reviewed articles from the special educational field were individual oriented whilst reviewed articles from the field of mathematics education talk about socio cultural settings. The review of the content in the selected 29 articles reveals that the conceptualisation of the SEM-student in research is about interventions, students experience, affect, prerequisites, special groups of students, special areas in mathematics and teachers knowledge about all above.

Introduction

The concept of the SEM- student is something research is grappling with (Magne, 2006). Although a sustained debate in various fields and practices on how to help the student in need of support in mathematics, there is no shared understanding on the concept (Heyd-Metzuyanim, 2013). Challenges with the conceptualisation of the SEM-student are similar to how McLeod and Adams (1989) describe differences in the use of the concept affect between mathematics educators and psychologists. Is it then possible that people who use the concept SEM-student mean different things, or use different concepts but mean the same thing when talking about the SEM-student? Clarity of concepts used regarding SEM could decrease the risk of misinterpretation and misconceptions. The present study contributes to the diminishing of these risks by clarifying how the SEM-student is conceptualised in research. This is performed with a pedagogical foundation to 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. A strive to emphasise the student in the educational context makes the fields of mathematics education and special education sufficient research areas to explore, even though there are research within the pedagogical, psychological or medical fields about the SEM- student as well, the focus in this review is the fields of mathematics education and special education. Consequently, journals and articles have been selected from these two fields in a review of the SEM-student. How research defines the SEM-student is found by identifying parts in the articles which *conceptualise* the student in need, explain the *cause of difficulties* and what *kind of support* is thought to be given in order to support learning. The research at hand focuses on the individual’s *need* of special education instead of the

individual *with* special educational needs, when defining the SEM-student. We then draw on Silfver et al (2013) where the need is something that may occur whether the student is a high or a low-achiever, for a shorter or longer period in time, in a general or more specific area in mathematics. Due to this understanding of the SEM-student we rephrase it as a *Student in need of special education in mathematics*.

Conceptual framework for categorisation

Perspectives involved in research on the student in need of support 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, there are several levels and actors involved when school educates a student in need (Ahlberg, 2001, 2007; Skrtic, 1995). Nilholm (2005, 2007b) has labelled perspectives on special education as *compensatory* or *critical* which is similar to what Persson (2008) calls *categorical* and *relational*. In both the *critical* and the *relational* perspective the heritage of the problem is placed in socio cultural settings. Solutions are then found by adapting the learning environment and relations surrounding 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 the “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 of and critique on 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 to the demands of the society or school system. In this review the categorical and relational perspective have been used in the categorisation of articles and the dilemma perspective has been used in the discussion on the review of selected articles.

Methodology and methods

In this paragraph we explain how journals and articles were selected and analysed. The method when investigating the definitions of the SEM-student in research is two-folded. Firstly perspectives in research are identified; thereafter a brief review of the content in the articles is presented and discussed in themes.

Selection of journals and articles

Magne (2006) made a presentation of the research concerning the SEM- student in 2006. This paper contributes by making further reviews on how the SEM-student is conceptualised and gives a brief review and discussion on selected articles. This is made in two selected fields of research, namely special education and mathematics learning and teaching. The selection has been journals in the area of mathematics education, special

needs or special pedagogy from the years 2006 to 2013. The purpose of the paper is primarily to investigate how Journals were found by guidance from how they were indexed in two databases: Scopus and Journal citation reports (JCR). The search words *special education* and *mathematics education* were then used. After identifying journals their value was determined with reported impact factors for the journals during 2012 (Table 1). In the JCR the value 0,5 or below is low and the value 1,5 or above high. The Journal NOMAD does not exist in the databases but is ranked as number one at *the Database for statistikk om høgre utdanning* (DBH). 13 Journals in the field of special education (7) and mathematics education (6) were selected. Terms used for searching articles that conceptualised the SEM-student have differed between the two fields. The search terms in the special educational journals has been “math” and in the mathematical journals the search words have been connected to special needs: “dys”, “need”, “support”, “disabilit” or “special”. After deselecting articles that did not mention the SEM-student in the title or abstract 29 remained for review (Table 1).

Table 1. Journals, impact factors 2012 and numbers of articles found

Journal	Impact factor JCR ¹ 2012	Impact factor Scopus SNIP ² 2012	Country	Issues/ year	Publisher	Indexed in SCOPUS as	Articles found	Articles used
Mathematics Education Research Journal		0.760	Netherlands	3	Springer	Mathematics Social Sciences: Education	0	0
Educational studies in mathematics	0.765	1.874	Netherlands	9	Springer	Mathematics, Social Sciences	8	7
NOMAD.			Nordic countries	4	NCM		4	4
Research in mathematics education		0.315		3	Routledge	Mathematics Social Sciences: Education	5	1
JRME- Journal for research in mathematics education	1.552	2.782	United states	5	Natl counce teach math	Mathematics: Mathematics (miscellaneous) Social Sciences: Education	5	0
ZDM Zentralblatt für Didaktik der Mathematik		0.676	Germany	6-7	Springer Verlag	Mathematics, Social Sciences: Education	0	0
European journal of special needs education		1.104	England	4	Blackwell Publishing	Psychology: Developmental and Educational Psychology; Social Sciences: Education	5	1
Journal of special education	1.278	1.679	England	4	Sage publications inc.	Medicine: Rehabilitation Social Sciences: Education	1	1
International Journal of special education		0.278	Canada	3	International Journal of special education	Medicine: Rehabilitation Social Sciences: Education	5	4
Journal of research in special educational needs		0.773	England	3	Blackwell publishing	Social Sciences: Education	2	2
Remedial and special education	0.890	0.795	United states	6	Sage Publications inc.	Medicine: Public Health, Environmental and Occupational Health . Social Sciences: Education	4	4
International Journal of Inclusive Education	0.363	1.016	England	10	Routledge Journals. Taylor & Francis ltd	Arts and Humanities: Arts and Humanities Social Sciences: Education	2	1
British Journal of special education		0.792	England	4	Blackwell Publishing	Psychology: Developmental and Educational Psychology; Social Sciences: Education	4	4
						Total:	45	29

1 From Journal Citation Reports, by Thomppson. Bases the value on cites/number of articles from the two years before. Ex for 2012 the years 2010 and 2012 is the base. Numbers of cites JCR social Sciences Edition contains data about more than 2 6000 journals. A value below 0,5 is considered to be low, and above 1,5 to be high within the index: education, special.

2 From SCOPUS: Source Normalized Impact per paper. Number of citations given in the present year to publications in the past three years divided by the total number of publications in the past three years –normalized between fields.

Analysis

As previously mentioned, how research defines the SEM-student is found by identifying parts in the reviewed articles which *conceptualise* the student in need, explain the *cause of difficulties* and what *kind of support* is thought to be given in order to support learning. Expressions about these three parts in the articles were the ground for our categorisation of perspectives used in the articles; this is displayed in table 2. This was performed by means of the theoretical framework drawing on the definitions of perspectives on special pedagogy made by Nilholm (2005, 2007b) and Persson (2008). First all articles have been categorised as *relational* or *categorical* in their conceptualisation. Finally the content of the talk about the SEM-student in research has been summarised in themes, which are discussed through the *dilemma perspective*. The frame for analysis has been discussed with C. Nilholm (personal communication, October 2013). Since some articles lie near both of the perspectives it is necessary to clarify borders. The application of these borders can be understood as crossroads in the work of analysis. When an article discussed socio cultural settings and affect or relations it was placed in the *Relational* perspective. When articles found the student through testing and interventions are made they fell under the *Categorical* perspective.

Table 2. Frame for analysis

Perspective	Concept used	Main cause of difficulty	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. Initially, perspectives used by researchers while conceptualising the SEM- students are displayed. These perspectives are categorised through the framework described. Discussion on the review of selected articles is in addition to this performed 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 significant 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 the predominating perspective; 3) In the mathematics educational field the emphasis on socio cultural settings is apparent; 4) Considering the procedure for selection which means that only Journals indexed as mathematics education or special education is apparent, there are few articles found. During 7 years and in 13 journals only 29 articles explicitly mentioned the SEM- student. Especially considering

this is a frequently debated issue amongst politics, researchers and professionals in the educational field.

Table 3. Categorisation of the reviewed articles

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

The talk of the SEM-student in research

What research describes as being a SEM-student is about and what is of importance for the SEM- student, can be summarized in five themes: 1) Training methods or interventions; 2) Students experience, affect, prerequisites; 3) Special groups of students; 4) Special areas in the subject; 5) Teachers knowledge about all above. For illustrating these themes some of the articles that talks more fully about the SEM- student, problems and solutions are used. This will be discussed trough the *dilemma perspective* in order to reveal how themes contradict or conflict each other.

A dilemma between students’ needs and needs in the educational system or on the school was displayed by Clausen-May (2007) who explored the SEM-student in the context of international surveys. The need of tools for measurements and the tools’ need to be valid then conflicts with the possibility for the student in need to gain access to the tests and be included in the test-taking. Although Clausen-Mays conceptualisation is categorical (*children with needs*), the discussion aims at directing critique on the ethos in the distributors way of handling the tests, which is not line with the ethos of the school. Another dilemma in research appears when the identification of the position of being in need is necessary to get support, simultaneously this position risks to marginalise and segregate individuals when identifying them as “not normal”. Researchers that display these situations do so by investigating the socio-economical or socio-cultural settings and their consequences for the SEM- student (Heyd-Metzuyanim, 2013; Humphrey, Wigelsworth, Barlow, & Squires, 2013; Wei, Lenz, & Blackorby, 2013). Sometimes environment and individual are explored as a complex. This is the case when the development of a disabled identity is researched trough a commognitive³ approach (Heyd-Metzuyanim, 2013). Identity is then dependent on how the environment brings out affective and cognitive factors within the individual. Research on the SEM- student is often about affect and cognition, especially within the mathematics education journals in the selection. Furinghetti and Morselli (2009) investigate this through students’ beliefs about self and the subject. Malmivouri (2006) understands affect as a part of self-reflection while Evans, Morgan and Tsatsaroni (2006) research emotions as a “*charge*

³ A theoretical framework developed by Anna Sfard (2009). Commognitive is a merge between communication and cognitive.

attached to ideas or signifiers” (p. 209), and do not take the cognitive aspect into account but takes interest in how social identity is constructed by discourse. Humphrey et al. (2013) instead put focus on the individual differences in connection to the schools’ differences and attainment. The authors state that: “*We found that school-level inclusivity, attainment, FSM⁴ eligibility, behaviour (in primary schools) and linguistic diversity (secondary schools) and student-level age, sex, FSM eligibility, SEN⁵ provision, SEND⁶ primary need, attendance, behaviour and positive relationships each contributed to the distribution of academic attainment*” (p. 928). Diagnosis comes into play in research about the SEM- student quite differently. It varies from investigating the mathematics learning of students with a specific diagnose (Abdelahmeed, 2007; Ahlberg, 2006) to making connections between students with different diagnosis and math achievement (Wei et al., 2013). Some articles put 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 are all considered to be categorical in their conceptualisation of the SEM- student and are to be found within the field of special pedagogics. Students are here talked about as belonging to a group of students that are functionally similar. The method used to help or investigated might concern a specific area as for example addition (Calik & Kargin, 2010), subtraction (Peltenburg, van den Heuvel-Panhuizen, & Robitzsch, 2012) or for supporting the learning of fluent computation (Burns, Kanive, & DeGrande, 2012). A dilemma in research is only shown when the methods or interventions are taken place in inclusive settings. This is for example seen in research when approaches or methods are judged to fit all students where the SEM-students are included (Barrett & Fish, 2011; Bottge, Rueda, Serlin, Hung, & Kwon, 2007; Gifford & Rockliffe, 2012) or when students with diagnosis 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. One example of how the dilemma might play out in the conceptualisation of the SEM-student is Gifford and Rockliffe (2012) who use a categorical terminology about the student like: *Children with severe specific mathematics difficulties*, but still focuses 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). Teachers’ knowledge about support and the student is identified as corner stones in the 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). The dilemma of categorisation and differentiation is further explored in some articles about SEM- students

⁴ Free School Meal

⁵ Special educational needs

⁶ Students with special educational needs and disabilities

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 be determining if 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 use 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 disability in a way that shifts the meaning of the definition of the student: "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 the students have disabilities, or prerequisite to take into account this contravenes to 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).

Conclusion

In this study we have investigated how *the student in special needs in Mathematics* is conceptualised in mathematics educational and special educational research from 2006-2013. To build the framework but also to identify journals and articles of importance were challenging. The impact value is a tricky measure on value in the social sciences and also depends on how young the journal is. Due to the interdisciplinary of the Special education field, journals may very well be indexed as Development Psychology or Education and are therefore not found by index. The findings show that writings especially in the field of special education have a categorical vocabulary. This was not expected and surprised us as professionals in the field of special education since the awareness regarding the field's interdisciplinary challenges has been discussed by several scholars, for example Skritic (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 (*Salamanca-deklarationen och handlingsram för undervisning av elever med behov av särskilt stöd*, 1997). A striking fact is that there are very few articles that talk explicitly about the SEM- student. From 7 years and in 13 Journals we encountered 29 articles with our procedure. There also seem to be ambivalence regarding the concept of SEM-student both inside and between articles. The mathematical journals in general adopt a more relational perspective. In mathematics education there has been a social turn in research (Rodd, 2006), which has contributed to this scenario, but it is also possible that the focus on the subject of mathematics draws towards this direction whilst in special pedagogy an "individual" is in focus. We suggest that the field of special education also need to take a social turn (Lerman, 2000) when defining the SEM-student. We have adopted the concept *the student in need of special*

education in mathematics in order to emphasise the social. The word *in* is here of great importance. The student is *in* special educational needs in mathematics, not *with* needs. Ambiguity regarding the very definition of the student in need is obvious in this study, but not surprising. There is a view on research as a collective assignment taken on by individuals, where different fields and perspectives contribute differently to the definition. We do not believe on consensus in the matter since fields complement each other and the position of being a SEM-student is complex. Because of this we believe that there is a strong need to define and be clear about the conceptualisation in research. The risk of misunderstandings and misinterpretations is obvious. From this follows a potential risk of badly coordinated and performed actions both in research and practice. Hence, a mission for further research is to investigate how to make more sustainable definitions of the SEM-student. These definitions need to take both research and practice into consideration.

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