



AALBORG UNIVERSITY
DENMARK

Aalborg Universitet

Difficulties, Meaning and Marginalisation in Mathematics Learning as Seen Through Children's Eyes

Lange, Troels

Publication date:
2009

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Lange, T. (2009). *Difficulties, Meaning and Marginalisation in Mathematics Learning as Seen Through Children's Eyes*. Institut for Uddannelse, Læring og Filosofi, Aalborg Universitet.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Difficulties, Meaning and Marginalisation in Mathematics Learning as Seen Through Children's Eyes

Vanskeligheder, mening og
marginalisering i matematikundervisning
set fra børnehøjde

Troels Lange

Ph.D thesis in Mathematics Education
The international Doctoral School of Engineering,
Science and Medicine: Technology and Science

Department of Education, Learning and Philosophy
Aalborg University - 2009

Difficulties, Meaning and Marginalisation in Mathematics Learning as Seen through Children's Eyes

(Vanskeligheder, mening og marginalisering i matematikundervisning
set fra børnehøjde)

ISBN 978-87-91543-72-2

© 2009, Troels Lange & relevant publishers

This PhD thesis is published by:

Department of Education, Learning and Philosophy

Aalborg University

Fibigerstræde 10

DK-9220 Aalborg, Denmark

www.learning.aau.dk

learning@learning.aau.dk

Phone +45 9940 9950

Printed in Denmark 2009 (UniPrint, Aalborg University)

Content

Acknowledgements	5
Summary	7
Sammenfatning	11
Chapter 1: Preparations	15
Justification	16
Fuel, idea and aims	21
Theoretical Considerations	25
Focus and research questions.....	30
Methodological framework	32
Data production.....	33
Ethical considerations.....	35
Summary of chapter 1	36
Chapter 2: Gathering stories	37
The pilot study	38
The main study – School A.....	41
Information and consent at School A	44
Observations and interviews at School A.....	45
Other empirical material from School A.....	47
The secondary study - School B	48
Information and consent at School B.....	48

Observations and interviews at School B	49
Other empirical material from School B	49
Summary of chapter 2	49
Chapter 3: Writings	51
Paper 1: The notion of children's perspectives.....	51
Paper 2: A child's perspective on being in difficulty in mathematics	51
Paper 3: Homework and minority students in difficulties with learning mathematics: the influence of public discourse	52
Paper 4: If a quarter crashes, so it dies: children's meaning making in mathematics lessons.....	52
Paper 5: "Tell them that we like to decide for ourselves" - Children's agency in mathematics education.....	52
Paper 6: When you are bad at it, it is boring: School mathematics as an arena for children's identity work.	53
Chapter 4: Looking back and forward.....	169
Writing about the empirical material.....	169
"Answers" to the research question.....	174
SQ1: Children's meaning ascription to school mathematics.....	175
SQ2: Experiences of inclusion and marginalisation	178
SQ3: Contextualisation and theorisation	181
Conclusions and implications	185
Postscript.....	186
References	189
Appendices	199
A Letters to schools, teachers, parents, consent form	200
B Interview guides, questionnaire	206

Acknowledgements

*Le cœur a ses raisons, que la raison ne connaît pas.*¹

Blaise Pascal (1623-62)

On the title page, there is only one name but many people have contributed to this work and made it possible. I would like to express my gratitude to all and especially to the children and teachers who let me into their classrooms and shared their experiences with me. The former Skive Seminarium and CVU Midt-Vest (now part of VIA University College) financed the study together with the Danish National Graduate School of Science and Mathematics Education, NADIFO. Skive Seminarium and The Department of Education Learning and Philosophy, Aalborg University provided office facilities and helpful staff. University of Otago College of Education and School of Education, Charles Sturt University kindly welcomed me as a visiting scholar. The morning coffee tables at these institutions provided important social anchorage on a long and sometimes lonely journey. I thank colleagues, friends and my family for following me with interest, encouragement and loving thoughts. I am indebted to Paola Valero for her supervision, hospitality and friendship. Tamsin Meaney generously 'washed' my English in the spirit of my intentions and helped me catch sight of the light at the end of the tunnel in the dark hours that seem to be part of most Ph.D. projects. To her I am deeply grateful.

¹ Hjertet har sine grunde som fornuften ikke forstår. / The heart has reasons that reason cannot know.

Summary

This thesis has focused on children's perspectives on learning difficulties in mathematics. The directing question has been: What may children in difficulty with learning mathematics teach us about mathematics education? The aim was to give voice to an exposed group of children by exploring their stories about their experiences with mathematics and to understand these stories in a larger socio-political context.

A basic assumption in the project has been that low achievement in mathematics is a socially constructed mismatch between a child and their surroundings rather than a deficiency of the child. The high social and cultural valuation of mathematics has as a consequence that not fulfilling the expectations to achievements in school mathematics is seen as a problem and that puts the low achieving individual in a difficult position. By adopting the perspective of children at the edge of the social norms configured by school mathematics, I wanted to obtain valuable insight in school mathematics that is not easily accessible from other sources.

The directing question was translated into the following research question and sub-questions:

- How do children experience being in difficulties with learning mathematics?
 - What meanings do these children ascribe to mathematics and mathematics teaching and learning?

- How do these children experience processes of inclusion and marginalisation connected to mathematics teaching?
- How may these children's narratives be contextualized and theorized?

Methodologically, the study adopted a narrative approach within a socio-political perspective. The research question was addressed by a series of life world interviews with 10/11 year old school children and extended observations of their mathematics classes.

The project is inscribed in mathematics education research however not located within a well-defined subfield. Rather, it relates to the intersection of a number of subfields such as research in special needs education in mathematics, research in affect and emotion in mathematics learning, research in cultural diversity and mathematics education, and research in mathematics education from a socio-political perspective.

The thesis is structured in four chapters that construct a frame around the core consisting of six peer-reviewed papers that have been published or submitted for publication. The first chapter introduces the thesis and describes my thoughts from the inception of the project. The second chapter describes the empirical work. The third chapter contains the six papers. In the fourth chapter, I discuss the papers in relation to the research question.

The papers illustrate that children make sense of their lived experiences with mathematics teaching in a comprehensive way and from a whole life perspective. Their stories form a valid set of data, which provides interesting insights to mathematics education that are not available in any other way. Children 'at the edge', that is children whose belonging to the social field of normality was questioned, were particularly insightful.

The methodological and theoretical issues have been closely intertwined throughout the project. The idea was to research the narrative counterpart of children's lived experiences of being in difficulties in mathematics. Narratives are inherently personal and social because they communicate ideas between individuals and

draw upon the discursive resources in the environment. These theoretical considerations were methodological considerations as well because they had implications for the sort of empirical material (stories) that I needed.

Theoretically, it has increasingly made sense to think of mathematics education as a socially constructed practice because it opens up to ethnographic and sociological approaches to mathematics education research. This has enabled me to better understand how the individual is enfolded within the social in the case of children in difficulties in learning mathematics. The lived experiences are narrated into stories about identity and meaning. Narrative elements in the environment as well as children's foregrounds and backgrounds are resources out of which the stories are composed. The identity narratives are of two kinds: actual and designated. It is from the gap between actual and designated identities that learning intentions and learning endeavours arise. The actions of learning, the learning acts, then become lived experiences and are themselves narrated into stories of identity and meaning.

This model is, like any other model, a simplification of a hugely complex set of interactions. However, what this model does is to provide an understanding of how changes can be made. It suggests three places to intervene to better support children who are in difficulties with learning mathematics. These concern the type of learning activities that form the lived experiences, the valorisations in the discursive field pervading mathematics education including discourses on difficulties and immigrants and their children, and the socio-political environment that children interpret as their foreground.

Sammenfatning

Denne afhandling har fokuseret på børns perspektiver på læringsvanskeligheder i matematik. Det ledende spørgsmål har været: Hvad kan vi lære om matematikundervisning af børn der er i vanskeligheder med at lære matematik? Hensigten var at give stemme til en udsat gruppe børn ved at undersøge deres fortællinger om deres oplevelser med matematik og at forstå disse fortællinger i en større socio-politisk sammenhæng.

Det har været en grundlæggende antagelse i projektet at lave matematikpræstationer er et socialt konstrueret misforhold mellem et barn og dets omgivelser snarere end en mangel ved barnet. Den høje sociale og kulturelle vurdering af matematik har som konsekvens at det *ikke* at opfylde forventningerne til skolematematikpræstationer, anses for at være et problem, og det sætter det lavtpræsterende individ i en vanskelig position. Skolematematik konfigurerer en social norm. Ved at anlægge det perspektiv som børn på kanten af denne sociale norm har, håbede jeg at kunne opnå en værdifuld indsigt i skolematematik som ikke er let tilgængelig fra andre kilder.

Ledespørgsmålet blev oversat til følgende forskningsspørgsmål og underspørgsmål:

- Hvordan oplever børn at være i vanskeligheder med at lære matematik?
 - Hvilken mening tilskriver disse børn matematik, matematikundervisning og matematiklæring?

- Hvordan oplever disse børn inklusions og marginaliseringsprocesser i forbindelse med matematikundervisning?
- Hvordan kan disse børns fortællinger kontekstualiseres og teoretiseres?

Metodologisk anlagde studiet en narrativ tilgang indenfor et socio-politisk perspektiv. Forskningsspørgsmålet blev undersøgt med en serie livsverdeninterviews med 10-11-årige skolebørn og omfattende observationer af deres matematikundervisning.

Projektet er matematikdidaktisk forskning, men hører ikke til i et veldefineret underområde. Derimod knytter det an til et krydsfelt mellem en række underområder såsom forskning i specialundervisning i matematik, forskning i affektive og følelsesmæssige aspekter af matematikundervisning, forskning i kulturel diversitet og matematikundervisning samt forskning i matematikundervisning i et socio-kulturelt perspektiv.

Afhandlingen er struktureret i fire kapitler der skaber en ramme om en kerne bestående af seks peer-reviewede artikler der er publiceret eller indsendt til publikation. Det første kapitel introducerer afhandlingen og beskriver mine tanker fra starten af projektet. Det andet kapitel beskriver det empiriske arbejde. Tredje kapitel indeholder de seks artikler. I det fjerde kapitel diskuterer jeg artiklerne i forhold til forskningsspørgsmålet.

Artiklerne viser at børn skaber mening i deres levede erfaringer med matematik fra et perspektiv der omfatter hele deres liv. Deres fortællinger udgør et gyldigt datasæt der giver interessante indsigter i matematikundervisning som ikke kan opnås ad anden vej. Børn 'på kanten', det vil sige børn hvis tilhørsforhold til det sociale felt af normalitet var draget i tvivl, var særligt indsigtsfulde.

Metodologiske og teoretiske spørgsmål har været tæt sammenvævede gennem projektet. Ideen var at udforske det narrative modstykke til børns levede erfaringer med at være i vanskeligheder i matematik. Fortællinger er af natur både personlige og sociale fordi de kommunikerer forestillinger mellem individer, og fordi de trækker på diskursive ressourcer i omgivelserne. Disse teoretiske overvejelser

var også metodologiske idet de havde implikationer for den type empirisk materiale (fortællinger) som jeg havde brug for.

Teoretisk har det i tiltagende grad givet mening at tænke på matematikundervisning som en socialt konstrueret praksis, fordi det åbner for etnografiske og sociologiske tilgange til matematikdidaktisk forskning. Det har gjort det muligt at øge min forståelse af hvordan individet er indfældet i det sociale, i dette tilfælde børn i vanskeligheder i matematik. Levede erfaringer bliver fortalt som historier om identitet og mening. Fortællingerne komponeres ud fra narrative elementer i omgivelserne samt børns forgrunde og baggrunde. Der er to slags identitetsfortællinger: faktiske og designerede (forventede). Det er fra kløften mellem faktiske og designerede identiteter at læringsintentioner og læringsbestræbelser udgår. Læringshandlinger bliver da levede erfaringer og bliver fortalt som fortællinger om identitet og mening.

Denne model er som enhver anden model en forenkling af en uhyre kompleks mængde af vekselvirkninger. Ikke desto mindre giver modellen en forståelse af hvordan ændringer kan afstedkommes. Den peger på tre områder at intervenere på hvis man vil forbedre støtten til børn som er i vanskeligheder med at lære matematik. Disse angår de læringsaktiviteter der former de levede erfaringer, værditilskrivningerne i det diskursive felt der gennemstrømmer matematikundervisning, inklusive diskurser om vanskeligheder og immigranter og deres børn, samt de socio-politiske omgivelser som børn fortolker som deres forgrund.

Chapter 1: Preparations

This thesis describes the findings from my PhD project titled “Difficulties in learning mathematics – students’ voices”. It arose out of an interest from my ongoing work as teacher educator. The project commenced on 1st August 2004 at *The International Doctoral School of Technology and Science*, Aalborg University. My supervisor is Associate Professor Paola Valero, Department of Education, Learning and Philosophy. The study was financed by VIA University College (in the beginning by Skive Seminarium and CVU Midt-Vest) and The Danish National Graduate School of Science and Mathematics Education (NADIFO).

The thesis consists of four chapters that construct a frame around the core of the thesis consisting of six peer-reviewed papers that have been published or submitted for publication in different conference proceedings, books and journals. This first chapter introduces the thesis and describes my thoughts from the inception of the project. This chapter includes the justification of the research question and its theoretical and methodological background as it was conceived before the empirical work began. The second chapter describes the empirical work, including the observations and interviews and the adjustments the project underwent during the confrontation with the “real world”. The third chapter contains the six published, or in the process of being published, papers after initially giving full references and publication status for them. In the fourth chapter, I discuss the papers in relation to the research question. This chapter also provides a conclusion, discusses implication and suggests further research.

The structuring of a thesis as a collection of papers “wrapped” up with introductory and concluding sections has allowed me having a sense of rounding up the research experience during the time of my PhD project. On the one hand, the experience of working on several publications has been important in meeting present-day, academic publication requirements. On the other hand, the writing of three more additional wrapping chapters has allowed me a more general and coherent reflection on the material presented in the papers. However, this thesis format raises an issue of repetition. Each paper will have a shorter or longer description of the project, its theoretical framework and methodology in order to form a coherent and comprehensive text in its own right. These descriptions inevitably have commonalities and yet they are not identical because of the contexts of the papers and the different times at which they were written, thus reflecting the progress of my thinking.

This has implication in regard to what to include in the wrapping chapters. On one hand, the chapters should not repeat what is already said in the papers and on the other hand they need to be coherent and so will deal to some extent with the same matters as the papers. The choice I have made is to write the remaining part of the introduction as a partly historical account of my thinking about the project in the first half of its duration until I started the field work in the latter half of 2006. The account is based on documents written in that period such as study plans and other project descriptions. This procedure does not do away with repetitions but gives an opportunity to include background information and a fuller account of the overall project than what has been possible to do in the papers.

Justification

In this section, I deal with the question of why it is of interest to study students’ experience of being in difficulties with mathematics. When the project was formulated in early 2004, it had to be justified in relation to the field of mathematics education research, in particular to Danish research, and in relation to my employer, Skive Seminarium, and the research development program at CVU Midt-

Vest². This section describes my thoughts from when the project was conceived in 2004 until the field work started in the second half of 2006. It reflects the composite set of justifications as they were expressed in project proposals and study plans³, project descriptions and a conference paper (Lange, 2005b; 2006; 2007). At that time, I saw three main reasons to do this research. They related to the importance of low achievement in mathematics, the absence of research in special needs education in mathematics in Denmark, and the demand for knowledge in the same field.

The first reason was related to the great importance to society as well as to the life of the individual that is ascribed to school mathematics (Niss, 1996). School mathematics traditionally plays a major role in the social stratification of the students in the school system. Many students in compulsory school do not meet the expectations of mathematics achievement. The 2003 survey in the Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA 2003) found that 16 percent of 15-year-old Danish students performed at the lowest level of proficiency or below (Mejding, 2004, p. 52). Of course such figures depend on how they are defined and measured. However, the proportion is consistent with other measures. According to the Danish Ministry of Education 10-12 percent of the Danish students in primary and lower secondary school have special educational needs in mathematics, and more than 15 percent can only with difficulty solve more complex tasks in mathematics (Undervisningsministeriet, 2003, p. 70). In a longitudinal study Engström and Magne (2003) reported that the lowest-achieving 15 percent of Swedish students in year 9 performed at a level equivalent

² Skive Seminarium was a College of Education. It was part of CVU Midt-Vest that comprised a number of professional education institutions in the Mid-Western part of Jutland. It was later merged with other institutions to form VIA University College that includes most of the professional education institution in the mid part of Jutland.

³ The documents are "Ansøgning til CVU Midt-Vest om flerårsaftalemidler 2004/2005" of 1. March 2004, "Forslag til studieprogram for ph.d. project i Learning Difficulties in Mathematics" of 28 September 2004, "Provisional Study Plan" of 14 April 2005, and "Final Study Plan" of 6 March 2006.

to that of average students in year 4 to 5. These students can cope with one-step tasks posed in simple language and using trivial commonplace skills that may not even have been learnt at school. Changes in curriculum had very little effect in this respect. I attended Engström and Magne's presentation of their study at the 10th International Congress on Mathematics Education (ICME 10) in 2004. In their view, it was the school system that produced students' difficulties (Engström & Magne, 2004; Scherer, 2008).

As a school subject, mathematics has a tremendous authority. Having difficulties with mathematics is a serious issue. Success or failure in mathematics at school has a decisive influence on choice of further education and career both with regard to access and necessary self-confidence. Mathematical competencies are of importance to life as citizen and private individual, social life and everyday life (Niss & Højgård Jensen, 2002). Just like mother tongue competency, mathematics is associated with a basic literacy – and a corresponding illiteracy in case of its absence. In PISA this importance is expressed in a definition of mathematical literacy as

an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen (OECD, 2004, p. 37; Danish translation in Mejding, 2004, p. 38).

It is a serious matter for a child not to be successful in gaining functional mathematical skills. This lack of success may have consequences for both the child's perception of their own capacity to manage the challenges of schooling, and to their future education and life.

The socio-cultural significance of mathematics constitutes low achievement in mathematics as a socio-educational problem on a social level, and as a problem beyond the control of the affected children at an individual level. In this study, I take a view that mathematics education in school is a social practice or set of practices. Different participants, such as policymakers, mathematicians,

teachers, school authorities, children, parents, construct practices of mathematics education in social, historical, and cultural contexts and processes (Valero, 2002). The practices encompass forms of talking, systems of reason, expected, valued ways and norms of acting, understanding, achieving and so on.⁴

For a long time, there has also been a high valuation of mathematics, ascribing to it both great socio-economical importance as well as intellectual superiority. In our culture, “being good in math” is more or less the same as being “bright” or “intelligent”, and is often conceived almost as a genetic trait of a person. Mathematics traditionally has played a big part in the sorting and stratification of the students which is one of the functions of school. The association of intelligence with performance in mathematics, reinforced by the ostensible objectivity of assessment in the subject (Wiliam, Bartholomew, & Reay, 2004), naturalises the stratification. Low achieving children are confronted with not fulfilling an important social norm and must form their identity and their conception of mathematics education in this light.

The second reason related to the fact that research in mathematics education in Denmark was, and still is, small in volume. Research based knowledge of typical Danish mathematics teaching and learning is lacking⁵. Research in special needs education in mathematics is scarce in Denmark⁶, and research based knowledge of practice in the field is almost non-existent. However, the interest is growing in Denmark and the other the Nordic countries. Nordic Research Network on Special Needs Education in Mathematics was

⁴ To be sure, to state that mathematics education is a social construction does not mean that it is an arbitrary or accidental construction, or that it can be ‘reconstructed’ in a simple effort of will.

⁵ This complaint was for instance expressed in a report from the Danish Ministry of Education (Undervisningsministeriet, 2006). An ongoing Ph.D. study by Arne Mogensen will provide much needed data in this area.

⁶ The exceptions are Lena Lindenskov, Tine Wedege and Lene Østergaard Johansen; however, they have mainly addressed adults’ mathematics learning.

established in 2001⁷. Its biannual research conferences have attracted a growing number of participants, from around 30 in 2001 to more than 90 in 2005, and also from Denmark (Malmer, Magne, & Lunde, 2002; Engström, 2004; Linnanmäki & Gustafsson, 2009). My study lies within this research context; it is related to other research in the field of special educational needs in mathematics, and it addresses a gap and a need on a national level.

Connected to the limited amount of research was a growing demand for knowledge on special needs education in mathematics in Denmark. This was my third reason for wanting to engage in this research. This demand came 'from below' from the many participants at conferences for teachers on the subject⁸, and 'from above' by a focus on special education from political and administrative quarters⁹. In addition it was recognised that the field is poorly documented (Egelund, 2003b; 2003a; 2004). The interest in special education was motivated by a concern for efficiency and economy, but also by the inclusion agenda put forward by the Salamanca declaration (UNESCO, 1997). At the same time, political reactions to recent international surveys (PISA, Trends in International Mathematics and Science Study (TIMSS)) put improvement of mathematics education on the agenda of educational policy (e.g. Undervisningsministeriet, 2006).

Pre-service and in-service teacher training and further education of teachers and teacher educators is the most important way to communicate research and development in mathematics education to teaching practice. My study combined with my professional

⁷ The network was formally constituted in 2003; see <http://www.matematikkvansker.net/>

⁸ Most notably "Regnehuller – Konference om matematikvanskeligheder på alle alderstrin" at Frederiksberg Seminarium, February 2004 (see <http://www.regnehuller.dk>), and: "Matematikundervisning og rummelighedens paradoks - integration eller inklusion?" in Aalborg, November 2005, (see <http://matematikvanskeligheder.aau.dk/praktikker%20konference/Velkommen%20praktikkerkonference2.htm>).

⁹ One expression for this is the extensive government programme "Quality in Special Education" (Danish acronym: KVIS - see <http://www.kvis.dk/>)

occupation as pre-service and in-service teacher educator at CVU Midt-Vest¹⁰ would put me in a good position to take part in a process of informing and improving mathematics education in general and special needs education in mathematics in particular. In the next section, I describe in more detail how Magne's (2001) review of the literature on special needs education in mathematics points to the importance of the socio-political contribution to students' difficulties in mathematics education.

My three initial justifications for undertaking this research were connected to the interests both of myself but also the organisations that were funding my research. The justifications were related to the important role that mathematics had as a mechanism for social stratification, the lack of research on mathematics education in Denmark in the topic of students with special needs in mathematics, and the demand by teachers for more knowledge in this area. At the beginning stages, I anticipated that these justifications for the project were likely to bring forth new knowledge in an emerging field of research, as well as to impact on the teaching of mathematics in schools.

Fuel, idea and aims

The project's focus was on children's perspectives on being in difficulties with mathematics. Important emotional fuel for the project came from reading Marit Johnsen Høines' book (1998; 1987) on teaching mathematics to young children. I had read it with my teacher students several times over the years. Every time I read it, I was deeply moved by her description of how some of these young children were awfully forsaken because their mathematics teacher did not understand the challenges they faced in learning mathematics. I was upset when I sometimes heard of school leaders who said that he (it was usually a he) could put a mathematics textbook into the hands of any teacher and send them into a year one class to teach mathematics. I felt that teachers with a restricted

¹⁰ CVU Midt-Vest was later amalgamated into VIA University College, cf. Note 2.

understanding of what is at stake for these children learning mathematics could do considerable, far-reaching harm. I wanted the voices of these children to be heard so that school leaders could make more informed choices.

The original – and maybe naïve – idea of the project was to give voice to children. I was motivated to do this because I felt that the children in question in too many cases were subject to teaching that was insensitive to their needs. In my view, the ‘bottleneck’ to better teaching was not absence of relevant pedagogical guidelines, recommendations and teaching resources¹¹. I felt that especially children to whom school mathematical knowledge did not come easily were not well provided for by ‘traditional’ mathematics teaching that was still widespread despite curriculum documents stipulating child-centred teaching and inquiry-based learning etc. As I saw it, mathematics teaching often appeared to be conceptualised as instruction in rules and procedures, presented to students in ways that made no connection to their everyday lives and leading to routines of behaviour that could produce correct answers to closed questions posed by “experts” such as the teacher or the textbook. This was a teaching that reduced the knowledge of mathematics to its symbolic, lexical, and procedural expressions. What students thought when working with mathematics, how these thoughts were related to other knowledge they had, what the properties of the material world were, of which mathematics was an abstraction, did not play a significant role in dominant, traditional forms of mathematics teaching. Consequently, the mathematical knowledge that students acquired often could only be activated in rather narrow contexts, well known to the students, and for many students only to a limited degree. There were reasons to believe that this kind of mathematics education produced students with special educational needs and that

¹¹ From Denmark and the Nordic countries one could mention the curriculum document (Undervisningsministeriet, 2003); textbooks for teacher education in mathematics (e.g. Beck, Hansen, Jørgensen, & Petersen, 1999; Høines, 1998); and literature focused on special needs education in mathematics (e.g. Hansen, Jess, Pedersen, & Rønn, 2006; Lunde & Wahl Andersen, 2002; Malmer, 2002; Magne, 1998; 2003).

the foundation for 'their' special needs was ingrained from their first years at school (e.g. Thejsten & Hvid, 1999; Engström, 2003). I wanted to highlight this unjust individualisation and privatisation of a fault in the educational system. The production process of students with damaged parts to their identity was a facet of mathematics education that deserved attention. For these reasons, I held that the voices of children experiencing difficulties in learning mathematics were valuable in their own right, worthy of being listened to and that they represented valid experiences of school mathematics education. I hoped to stimulate pedagogical reflections, maybe even actions, among teachers and teacher educators. These would eventually result in changes being made to children's actual experiences in learning mathematics.

Thus, the basic idea of the project was to call forth and listen to the stories of children in difficulties with learning mathematics and try to understand what they said from their perspective. I wanted them to tell me, perhaps indirectly, about: the sense they made of mathematics and of mathematics teaching and learning; about their experiences of learning mathematics; of being in difficulties in learning mathematics; and of processes of inclusion and marginalization connected to mathematics teaching and learning.

Recent sociological and anthropological research in childhood generally recognises children as actors in their own life and not just objects of socialisation (James, Jenks, & Prout, 1997; Kampmann, 2000). This view of children is partly formed as a reaction to the definition of children by developmental psychology whose strong interest in (normative) developmental phases depicts children as incomplete adults and hence characterised by deficiencies. In their capacity as social actors, children have meaningful and interesting knowledge and experience worth studying in their own right (Højlund, 2002). Their experiences and stories are as significant and true as adults' are. They possess knowledge of their own life and life situation, and, as part of this, their mathematics learning. Children both have knowledge that is realized in action and knowledge in the form of reflexive consciousness.

Voices of children could inform reflections on mathematics education in two ways. First, children make their own sense and construct their own interpretations and meanings of school and school subjects and this is both informed by and also informs their own conceptions of how matters of the world are connected. Often, these will be significantly different from those of adult professionals both in respect to logic and structure. In children's stories, I would seek a narrative, experiential knowledge structure that would be different from and even cutting across that of teachers' and teacher educators' pedagogical/didactical perspective. Second, because low achieving children are generally constructed as marginalized, I anticipated that they could present 'outsider within' perspectives (Harding, 1991) about the functioning of the system, that cannot be obtained by other means.¹² If adults do not listen to children, they will be unable to ever hear these different perspectives. Statements from children 'at the edge' may be effective in inducing reflection and learning processes in professional adults (Holmgaard, 2004; Krogstrup, 1997).

However, along the way, I realised that listening and giving voice alone does not make up a research aim. From life history research, I learned that an endeavour to 'give voice' may in effect 'silence' the voices unless they are contextualized. Ivor Goodson put it this way:

A particular problem ... is posed by those genres which ... have sought to sponsor new voices – the world of 'stories', 'narratives' and 'lives'. ... As currently constructed these genres tend to lead us away from context and theorizing, away from the conceptualization of power. /... In the dialectical development of theories of contextualities, the possibility exists to link our 'stories', 'narratives' and 'lives' to wider patterns of structuration and social organization. So the focus on theories of context is, in fact, an attempt to answer the

¹² Sandra Harding argues that there is a "scientific and epistemological advantage of starting from the lives of those who have been devalued, neglected, excluded from the centre of the social order; [...] who in some cases provide 'outsider within' perspectives" (Harding (1991) quoted in Goodson, 2003, p. 5).

critique that listening to lives and narrating them valorizes the subjectivity of the powerless individual. In the act of ostensible 'giving voice', we may be 'silencing' in another way, silencing because, in fact, we teachers and researchers have given up the concern to 'theorize' context. (Goodson, 2003, p. 5)

Therefore, apart from contributing to research in mathematics education research and doing it in a field that hardly was represented in Denmark, my research aim was to bring to the fore children's experiences of being in difficulties in learning mathematics. In order to do this I had to conceptualise and theorise their narratives in a wider socio-political context of the social practices in which the difficulties were constructed.

Theoretical Considerations

My first theoretical considerations were inspired by Olof Magne's systemic conception of low achievement in mathematics and Ole Skovsmose's notion of foreground. These ideas seemed connected because they did not limit research into special needs education in mathematics just to what children bring into the classroom.

Skovsmose (2005) developed the notion of *foreground* in order to understand the hindrances and opportunities that children may meet in learning mathematics. An individual's foreground is "*the opportunities, which the social, political and cultural situation provides for the person*" (p. 6), as it is subjectively perceived by the individual. Learning mathematics is an intentional act and acts are connected with meaning. "*In order to establish meaning in education, students should be involved in meaning production, and each student's foreground is an essential resource for this production*" (p.7). Children's foregrounds, that is, their interpretation of their conditions and possibilities in life is thus of decisive importance for ascribing meaning to learning of mathematics. I see the notion of foreground related to Bourdieu's notions of habitus and disposition.

Mathematics teaching often does not involve students and their perceptions of their foregrounds in meaning production. Consequently students are often left to themselves in making sense of mathematics (Alrø & Skovsmose, 1993), and may construct meanings

that are not productive to the learning of mathematics, and thereby laying the foundations of a learning difficulty .

According to Olof Magne's review (Magne, 2001; cf. also 1998; 2002), research in special needs education in mathematics generally takes the general curriculum as the norm. Consequently, special needs education in mathematics is either based on a *content deviation model* (the low-achieving student deviates from the norm in respect to "mathematical capacity")¹³ or based on a *behaviour deviation model* (the low-achieving student deviate from the norm in respect to biology)¹⁴. Simultaneously, research with a cognitive orientation or with a deficit approach dominates the field. Only a few studies try to catch the complexity of the problem with a systemic model. Magne proposed what he called the *factor-interplay-model*¹⁵ and called more generally for *ecological systemic thinking* (2002). Low achievement in mathematics is a social construction, a human interpretation of a relation between an individual and its surroundings. The student's learning takes place in a network and numerous factors in the environment influence how and what the student learns. Defective learning is a manifestation of imbalances in the system. The mismatch may be described as a conflict between the child's ability and the

¹³ The content deviation model has the mathematical subject matter as its point of reference. Research focuses on students' difficulties to attain objectives in various areas of mathematics. Related to the model is the notion that some students can learn mathematics while others cannot. Consequently, remedy of insufficient learning would be to assign students tasks of lower level of mathematical complexity or exclude students from mathematics education (Magne, 2002).

¹⁴ In the behaviour deviation model, students' mathematical achievement is ascribed to biological conditions. Research may for instance try to elucidate relations between neuronal impairment and mathematical achievement. The idea is that a diagnosis of the brain function of the low achieving student can give teachers and therapists a solid foundation for tuition and rehabilitation of the student. Treatment consists in organic or mental therapy (Magne, 2002).

¹⁵ In the factor-interplay model "research as well as curriculum innovation and teaching practice are approached from the notion of a complex vector space where, among other factors, three main vectors are considered, namely the mathematical contents, the pupil's individuality and the social environment" (Magne, 2001, p. 12). See also (Magne, 2002; 2006)

objects of the environment. Thus, the learning disorder is not only to be attributed to the child. Rather the interplay between child and environment is where the dissonance arises and upsets the system.

Some children can cope with and fulfil the norms and expectations in school mathematics education. Some cannot and are called 'weak' or 'bad' in daily school jargon. The well performing are called 'good' or 'strong'. The social valuation of mathematics is what makes children's response to mathematics significant. On an individual level achievement in mathematics becomes an important ingredient in children's self-image (cf. Linnanmäki, 2002; 2004; Hannula, Maijala, Pehkonen, & Nurmi, 2005). A child that has to describe herself or himself as "I am bad in math" is telling an important story of identity (cf. Sfard & Prusak, 2005) with potentially heavy, short and long term implications for life (William et al., 2004). These implications will have an impact on children's perceptions of their foregrounds.

At a social level, the significance of mathematics is related to the emergence of the category of "students with difficulties in mathematics" or "students with special educational needs in mathematics" and the construction of measures such as "special (needs) education in mathematics". If mathematics was not attributed significance in the way that it is, these categories would not come into being. A child who, say, does not play the violin very well, is not categorised as having "violin difficulties", as not complying with (international) standards of "violin literacy" or attributed a "violin disability". Whatever challenge not succeeding in playing the violin may pose to the child's identity, it will not be amplified by possible social implications of the kind that relates to mathematics (Damkjær & Lange, 2006).

Thus, learning difficulties in mathematics are a social construction. The socio-cultural significance of mathematics constitutes low achievement in mathematics as a socio-educational problem on a social level and as a problem beyond the control of the affected children at an individual level. Mathematics learning has a serious impact on children's perceptions of themselves not only as mathematics learners, but also as members of school community and society in general. The learning or non-learning of mathematics is

also a construction of identity and this has an effect on students' foregrounds.

Seeing children as social actors raises the question of how children's agency links with social structure, including low achievement in mathematics. Four main ideas makes the connection. First, identities are narratives. Identities are constructed by humans and are shaped collectively rather than given. Narratives connect individual agency and the social and cultural structure in which the individual acts. We narrate ourselves and our culture; thus our identity and culture are narratives. Meaning and significance are expressed in narratives. Bruner puts it this way:

Narrative [is] both a mode of thought and an expression of a culture's world view. It is through our own narratives that we principally construct a version of ourselves in the world, and it is through its narrative that a culture provides models of identity and agency to its members. (1996, p. xiv)

Children's reflexive knowledge is available as stories, not least stories of identity. Sfard and Prusak (2005) hold that identities are narratives, that they are collectively shaped and consequently link agency and structure, and that identity narratives may be the missing link between learning and its cultural context. The most important stories are often those that imply membership in, or exclusions from, various communities. This assumption is discussed in more detail in Paper 6.

Second, children's life stories may, properly contextualized and theorized as life histories, link children's agency and low achievement as a social structure (Goodson & Sikes, 2001).

Third, a child's foreground, the interpretation of her or his conditions and possibilities in life is of decisive importance to her or his possibility to ascribe meaning to learning of mathematics and to the interpretations in which she or he inscribes mathematics and mathematics teaching (Skovsmose, 2005; Alrø, Skovsmose, & Valero, 2005).

Fourth, according to social learning theory (Wenger, 1998), learning is always rooted in a context and involves identity, meaning, community and practice, cf. Figure 1. This means that children's narratives about their learning of mathematics will reflect both their individual meaning making and the narratives of their culture about mathematics teaching and learning. Children who achieve poorly in mathematics do not fulfil an important social norm. They become acutely aware of it in a way that children who fulfil the norm do not. "Bumping" into the norm challenges their identity, the meaning they ascribe to mathematics education and questions their belonging to the learning community. They are potentially pushed to the margin of the learning community. From this position, they get a special insight into mathematics education as a social system, which is expressed in their actions and as reflexive knowledge. The latter may take the form of stories, not least stories of identity and meaning. Seen this way, as legitimate social actors, low-achieving children have something to say about mathematics education and their experience is a valuable source of knowledge about the system.

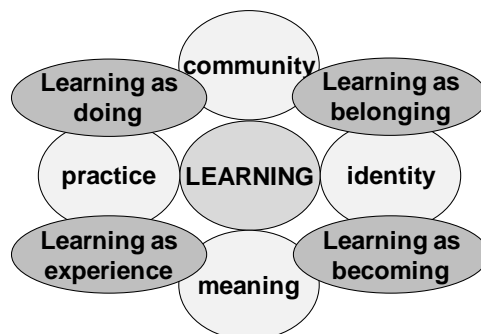


Figure 1. Components of a social theory of learning (adapted from Wenger, 1998)

The conception of learning difficulties in mathematics as a social construction does not imply that they are arbitrary or accidental, or that they can be "un-constructed" in a simple effort of will or change of vocabulary. Nor does it mean that learning difficulties in mathematics are not "real" as experiences of children, teachers, parents, and so forth. Learning difficulties in mathematics are part and parcel of the present social practices of school mathematics education. However, in line with Magne's point of view (e.g. 2001) it

is a reason to avoid essentialist or defect-oriented language that attributes the difficulties to the child. Hence, I prefer the expression “to *be in* difficulties” rather than “to *have* difficulties”.

In this perspective a child with learning difficulties in mathematics exists by virtue of mathematics teaching; despite declared intentions mathematics teaching produces its own losers.¹⁶ The impression I have from Magne’s writings and my own literature searches was that that few studies had children’s experiences as their focus and try to explore them with a narrative approach.

Focus and research questions

From the beginning of the project, the guiding question was: What may children in difficulties with learning mathematics teach us about mathematics education? – where the “us” included teachers, teacher educators and researchers in mathematics education. Consequently, the focus was on children’s perspectives on learning difficulties in mathematics. What did it mean to children to be low achieving - to demonstrate mathematics learning to a lesser extent than expected by curriculum and school tradition? I wanted to know what sense and meanings they ascribed to school mathematics, and how their self-concept, identity and social life were related to or influenced by their problems in learning mathematics. Thus, the project would not explain students’ low performance or analyse the mathematical characteristics of students’ low performance. My focus was on the relationship between children’s experience and the social construction of difficulties in learning mathematics.

The main research question was:

¹⁶ On a didactical note, I noticed Magne’s reminder that the “mechanisms” of learning are the same for all students:

“The student’s retention tends to be optimal if the learning and instruction is based upon thinking strategies and constructive activities. Thus, it is the student’s own efforts to learn that shall be ascribed the central position in mathematics education. Also the student with special educational needs in mathematics learns through his/her own efforts with the aid of social tuition” (Magne, 2001, p. 13).

RQ: How do children experience being in difficulties with learning mathematics?

However, “experience” is not a straight forward concept. How are experiences ‘detected’? Hence, in order to operationalise the question, a sub-question was added specifying “experience” to be about “meaning”:

SQ1: What meaning do these children ascribe to mathematics and mathematics teaching?

I assumed that being in difficulty with learning mathematics would raise issues of inclusion and exclusion, but I did not know whether this assumption was warranted. However, because such experiences could seriously impact on children’s identity a separate sub-question was devoted to them:

SQ2: How do these children experience processes of inclusion and exclusion related to mathematics teaching?

Later in the development of the project, I realised the need for putting children’s experiences into a context and to understand them in a theoretical perspective and added a third sub-question:

SQ3: How may these children’s narratives be contextualized and theorized?

Implicit in the formulation of this question was that I would be looking for children’s meaning ascriptions in their narratives.

The process of refining the focus of the project and the research question took some time and is discussed in more detail chapter two. The contribution of the papers to the exploration of the research question and sub-question is discussed in chapter 4.

I was interested in children whose experiences with mathematics and being in difficulties with mathematics were still in formation. As to the nature and extent of difficulties with mathematics, I was interested in children who achieved poorly in mathematics, but who still attended normal classes.

Children’s notion of mathematics, their conception of what kind of ‘game’ school mathematics was, or to use Lena Lindenskov’s (1992)

concept 'the student's own learning plan', seem to be established in early school years or even before (Høines, 1998; 1987; Fosse, 1995). For this reason, I thought about working with children in the first years of school (beginner's level, year 1 to 3). I knew that other researchers had interviewed very young children (Doverborg & Pramling Samuelsson, 2000; 1999; Andenæs, 1991) but as I had no professional experience with such young children, I was not confident to embark with this age of children. Instead I decided to work with children at the middle level (year 4-6) and ended up with children in year 4. A discussion of this process is to be found in the next chapter.

Methodological framework

Children's perspectives could only be gained from watching and listening to children themselves. Therefore, the project needed to be a qualitative research study based on interviews and classroom observations. I was inspired by literature on qualitative research (e.g. Olsen, 2002; Kvale, 2004), anthropology/ethnography¹⁷ (Ambrosius Madsen, 2003; Gulløv & Højlund, 2003; Højlund, 2002), and life history research (Goodson & Sikes, 2001; Pérez Prieto, 2000). Theoretically, Bourdieu-oriented sociology (Bourdieu & Ferguson, 1999; Prieur, 2002a; 2002b; Reed-Danahay, 2005) and socio-political approaches to research in mathematics education (e.g. Valero & Zevenbergen, 2004; Ernest, 1998) were important sources of inspiration for my thinking. The actual use of this literature appears in the papers. However, I would like to point out that the discussion in the Bourdieu literature about the need for the researcher to "objectify" themselves perhaps has been more influential than explicitly discussed in the papers in regards to sharpening my awareness of the "gaze" I was likely to have on mathematics teaching and learning because of my background as an adult, mathematics educator.

¹⁷ Ethnography may be simply defined as "*theories and methods to description of how people live and make sense and meaning in their social and cultural context.*" (Ambrosius Madsen, 2003; my translation)

I hold the basic methodological assumption that empirical data only comes into being through a perspective. Hence, there is no such thing as 'raw', 'neutral' or 'objective' data. Consequently, I try to avoid expressions such "data collection" that could indicate that data is 'out there' and the researcher just picks them up. My perspective on methodology is in line with Leone Burton (2005) in distinguishing between methodology and method, the *why* and the *how*. To Burton the idea of value-free research, including choice of theory and method, was untenable. Too often, she found, mathematics education researchers only described their research methods, the *how*, but did not justify them, the *why*. In Goodchild and English's (2005, p. xii) summary Burton's position was:

Methodology is about the underlying basis for the choices that are being made; it includes a consideration of the researcher's beliefs, attitudes and values, the research questions being explored, the answers being sought, and crucially, the nature of the key informants together with their social and cultural environments.

Hence, methodology is a theory and analysis of how research should proceed, while methods are techniques for gathering evidence. Intertwined with these, there is often epistemology, which is a theory of knowledge or a justificatory strategy. It follows that methodology in my terminology is not simply a set of procedures, but a broader conception that even touches on how procedures are connected with theory and with assumptions and ways of acting.

From the onset of the project, I did not have one single theory to guide my study or a 'big' theory that allowed me to see 'everything'. I saw it as part of my study to construct a conceptual frame that could provide such guidance and act as theoretical lenses with which to analyze and grasp the material of the study.

Data production

My main data was interviews with children in primary school. The interviews were to be of an open, loosely structured character and take place in an atmosphere of genuine interest in order to support and stimulate children in unfolding their narratives. Hence, the

interview prompts and questions were to be initiating, circular, supporting, and clarifying in order to explore the children's perspective, 'world view', learning trajectory, and meaning making related to school, teaching, learning, mathematics, leisure, friends, mates, interests, etc.; the interviewer needed to maintain a curious, open minded, and non-interpreting state of mind.

In this kind of interviewing, I was inspired by life history research (Goodson & Sikes, 2001; Goodson, 2005) and researchers with experience in conducting interviews with children (Doverborg & Pramling Samuelsson, 2000; Andenæs, 1991; Kampmann, 2000). According to Andenæs, there is no principal difference in doing qualitative interviews with children and adults; the challenges are the same, although more acute with children: "When interviewing children, you have to put even more effort and care in the contract, in establishing a common focus of the conversation, and in motivating and create optimal conditions for the interviewee." (Andenæs, 1991, p. 290; my translation) The interviews needed to be audio recorded and transcribed.

I anticipated doing my field work primarily in one school class for 2-3 months (Aug-Oct 2006). I wanted to mainly observe the mathematics lessons for this time, but also whole school days and breaks, in order to get to know the setting, make contact with the children, and become accepted. The interviews were to take place in this period. Initially, I wanted to interview approximately 8 children in pairs; 2-4 interviews of ½-1 hour by each group. According to experiences in life history research, this number of interviewees will be sufficient to provide saturated material¹⁸. Prior to the first interviews, I anticipated following the interviewees through a whole day while trying to look at the world with their eyes. I also considered other possibilities of getting narratives and perspectives from children, such as having them take pictures of important places or situations.

¹⁸ Personal communication with Ivor Goodson 13 January 2006.

I was interested in mixed groups of informants, in respect to gender and ethnicity. At a later stage of my thinking about the project, I decided to invite all the children to participate in focus group interviews in order to give them all a chance to take part in an interview, to triangulate and to support my selection of main informants.

During the observations, I also wanted to have informal conversations with the children. The conversations were to be audio recorded. When preparing the project, I considered interviewing children while they were working with mathematics (cf. Goodchild, 2005; 2001; Lindenskov, 1992). I also considered video recording classes to support my field notes and to have the opportunity to stimulate the interviewee's recollection.

I decided that the interviews would be audio recorded and transcribed. Informal conversation and focus group interviews would be summarized and only selectively transcribed.

I was concerned that observations and interviews require the interest and cooperation from one or more schools and teachers. This could imply possibilities or limitations and influence the data production.

Ethical considerations

In the research literature, ethical matters in relation to research, not least with children, are discussed in some length e.g. (Alderson & Morrow, 2004; Goodson & Sikes, 2001, ch. 6; Højlund, 2002, p. 69f; Kampmann, 2000; Morrow & Richards, 1996). My intention was to comply with the general recommendations made by these researchers. Consequently, the children and their parents were asked to give their informed consent and their anonymity protected. I intended to ensure that my research and conduct would not harm, exploit or have negative consequences for them in the future. The implementation of this general declaration of intent is discussed in the next chapter.

Summary of chapter 1

In this chapter, I have outlined my initial thoughts and inspirations for undertaking the research. As a thesis done as a series of papers, I decided to cope with repetitions in the different papers and the wrapping chapters by showing how the project developed over four and a half years. Although this does not reduce the repetition, it does show how my thoughts developed and expanded.

This chapter deals specifically with the conceptualisation of the project up until the field work began. When I applied to start my PhD study, it was clear that I had to work on an issue that was not just of interest to myself but also fulfilled the needs of the organisations, which were funding my study. I focussed on special needs education in mathematics in Denmark for three main reasons. The first of these were that mathematics has a significant role in society that is not the case for other school subjects such as physical education or for non-school subjects such as violin playing. The second reason was that there was little research in Denmark in mathematics education generally and special needs education in mathematics more specifically. The final reason was that there was a growing call from teachers for more information about special needs education in mathematics. However, I was not interested in special needs education where the child was viewed as being deficient. Rather, I felt it was more beneficial to look at how children experienced these mathematics education practices.

The consequences of my initial reflections of the project were the development of one main and three sub- research questions and a methodological framework. The next chapter describes what happened when I took these original ideas out to meet the real world of schools and children.

Chapter 2: Gathering stories

In the project I did field work in three contexts. In each, I observed mathematics lessons and interviewed children. The first was a small pilot study conducted in January 2005 at *School A*. The second lot of field work took place in 2006/07 at the same school as the pilot study, but with different children and teacher. I observed the mathematics lessons of a year 4 class on a more or less weekly basis for one school year and interviewed a number of children. The empirical data for most of the papers comes from this second lot of fieldwork. The third field work was similar to the second but took place at *School B* and was smaller in scale. It also involved a year 4 class and took place in the first half of 2007.

Both schools were ordinary Danish *folkeskoler* located in a regional city in Jutland. A *folkeskole* is a public school covering the nine compulsory years of schooling that begins when children are 6/7 years old. Although temporary grouping of children is allowed, no streaming or tracking according to “ability” - as is done in many other countries and also earlier in Denmark - is taking place at the present time. The *Folkeskole* is very much a national school. Although there are signs that the number of students in private schools is growing, most children go to a *folkeskole*. In 2007 about 85% of all children in year 1 to 6 were enrolled in a *folkeskole* and in the region where my schools were located the figure was more than 95%¹⁹.

¹⁹ This information was retrieved from www.statistikbanken.dk on 25.03.2009.

The guiding idea for my presence in the classrooms was that I wanted to be “the least adult” (Højlund, 2002; Hygum, 2006). This meant that I would usually sit among the children during whole class activities instead of attempting a panoptic view by locating myself, for instance, at the back of the class. It also meant that I referred the children to the teacher in situations where a teacher’s authority was needed such as whether they could go to the toilet during class or sorting out a conflict. When the children worked on their own or in small groups, I would usually talk to them. Either they would ask me to come and help them or I would ask them if they would tell me what they were doing in the task. In these dialogues with individual children, I would ask them questions about their thinking and avoid entering the giving-hints-without-telling-the-answer-game typical of a traditional didactical contract (Blomhøj, 1995). This role is discussed in greater detail in Paper 4.

The pilot study

In the pilot project, I “visited reality” by observing three mathematics (double) lessons ²⁰ in a year 4 class and interviewed two boys, Dennis and David, for 35 minutes during the third lesson. Data from this interview is analysed in Paper 1. The pilot project came about as an exercise from a workshop on life history research in early 2005 ²¹. In the spirit of the workshop, my aim was to focus on the ‘profession’ of being a pupil/student and I hoped with the interview to be able to throw light on how students experienced mathematics and mathematics teaching, and what meaning they ascribed these (Lange, 2005a).

I learned several things from the project. These included: the experience of contacting the school; presenting my wish to observe classes and interview children in the context of my project; and

²⁰ A lesson was 45 minutes and a double lesson 90 minutes.

²¹ The title of the workshop was: “Analysing life history interviews: Professions in challenge” with professor Staff Callewaert, Docent Héctor Pérez-Prieto and doctoral students, CVU Midt-Vest 4-5 February 2005.

negotiating an agreement with a teacher. In this case, this was facilitated by the fact that the teacher and the deputy principal were former teacher education students of mine. The process also included writing an information and consent letter to parents (see appendix A1). From the interview I learned that I was able to interview children of this age and that my interview guide served me well (see appendix B1). This project also gave me experience in handling the technicalities of recording and transcribing the interview. I also learned from writing a preliminary analysis of the interview (Lange, 2005a) organised around the themes that I found most prominent: "friends", "the computer as arena for engagement", "school" and "status". Apart from the writing experience in itself, I learned that at least in the case of Dennis and David, I was not wrong in my assumption that children experience and ascribe meaning to school mathematics education from a perspective that was much wider than mathematics itself. The meaning they ascribed to mathematics learning, or the sense they made of their actions, was derived from or subordinated to issues such as friendship; trying out their wings, so to speak, in pseudo-adult worlds of on-line computer games and social forums; leisure time; and status as school students and in the social sphere of other children. In other words, they seemed preoccupied with identity work in that they were maintaining, managing and forming their identity. Their engagement with school mathematics seemed to a large degree to be subordinated to this identity work. Finally, the analysis of the themes and a subsequent discussion with my supervisor helped clarify the relationship between the research question I could ask and the empirical material it would require. At that time the research questions under consideration were:

1. How does the phenomenon "difficulties in mathematics" look like when seen from children's height?
2. How are children marginalised in mathematics education?
3. What is the significance of the mathematics teacher's conception of the teaching task, including the significance of the learning intentions and meaning ascriptions for the

acquisition of mathematical knowledge that the teaching offers to the students?²²

The first question would give a clear focus for the empirical material – I would have to ask children. The second question was more open as to what kind of empirical material I would need, but if the question was twisted a little to refer to children’s experience of being marginalised, I could keep the empirical focus from the first question. The third question about the teacher’s conception would entail a new focus in that I would have to ask the teacher among others. Maintaining a clear empirical focus was a major concern. Consequently, I decided to leave out the last question and focus on the children’s experiences of difficulties in learning mathematics, marginalisation, and meaning. The research question was formulated in a well-formed Danish question as “*Hvordan ser matematikvanskeligheder, marginalisering og mening ud i børnehøjde?*” Unfortunately, the literal translation of “matematikvanskeligheder” into “mathematics difficulties” is not unambiguously recognised as meaning “difficulties in learning mathematics”, and “børnehøjde”, literally meaning “children’s heights”, does not have the connotations of children’s perspectives and life worlds as it has in Danish. Hence, the English translation does not flow well: “How do difficulties in learning mathematics, marginalisation and meaning look like when seen from children’s heights?” Consequently, the final version of the research question (see p. 30f) was given a phrasing that focused on children’s experiences while the first two questions above were reformulated and turned into sub-questions. The formulations using *børnehøjde*/children’s heights resurrected when the thesis found its title.

²² The Danish formulation was a complex sentence that does not translate smoothly to English: “Hvilken betydning har lærerens opfattelse af hvori undervisningsopgaven består, herunder betydningen af de læringsintentioner og de tilskrivninger af mening for tilegnelse af matematikkundskaber som undervisningen tilbyder eleverne?”

The main study – School A

In May 2006, I contacted School A again in order to organise the “real” field work. In the process, I realised that I wanted to explain my research interest in the same way to school principals, teachers, parents and not least the children. I did not want to have one understanding of the project with the children and a different one with the teacher. The information should truly reflect the project so that participants would feel that they had been well informed. Most importantly, I did not want to invite or contribute to any labelling or stigmatisation of children. Therefore, I was careful to talk about difficulties in learning mathematics as a general phenomenon that all children experienced rather than something that named a category of children. In addition, I was interested in forming my own impression of the children’s mathematical “doings” and avoid as much as possible the risk of being “enculturated” into perceptions of particular students as “being weak” or “having difficulties” that the school might hold. In order to clarify my role in relation to the teachers, I emphasised that my focus was the children’s experiences and that I would not evaluate the teachers’ teaching. In an email to the school principal after our first meeting, I described the project as follows (in my translation; for the original see appendix A2):

My interest is to explore something. The children know something that I do not know. They know how it is to be 10 to 13 years old, go to school, learn mathematics, face resistance in their learning endeavours – and I would like them to tell me about it. My interest is not to assess either the children’s mathematical knowledge, their mathematical achievements etc. nor the teacher’s teaching. My focus is the children, their experiences and thoughts.

The observations have as their focus children’s experiences of mathematics education. I am interested in children’s learning stories about mathematics. How do children experience learning mathematics? How does the school’s mathematics teaching and their mathematics learning enter into their “world view” and their conception of themselves? What patterns of meaning and significance do they form? In

the light of mathematics being an important school subject, I am especially interested in how children experience difficulties in learning mathematics.

Apart from observing, I will conduct interviews with the children in the class. The children can of course withdraw from the interviews and all reporting of observations and statements will be done anonymously.

My data from observations and interview will be used in relation to my PhD project that I am halfway through.

In a considerably abridged form, this was also the description of the project that was given to parents and children.

With the principal and three teachers, I had agreed to start observations after the school summer holiday in three classes from years 4, 5 and 6. The plan was to focus on one of the classes after a few weeks when I saw which class-teacher-context worked best for me. As it turned out shortly before the observations were going to start, for various practical and personal reasons on part of the teachers, only the mathematics teacher in the year-4 class could let me observe her classes.

My anticipation of how I would conduct the field work is discussed in the previous chapter. However, the field work conducted in this classroom deviated somewhat from the plan. In particular, I observed the class for a much longer period and interviewed more children than anticipated. There were three main reasons for this.

First, there were no obviously low achieving children in the class. The school did not provide special education measures for students in mathematics. Its resources for special education were prioritised to students with poor reading skills. Hence, while the school expressed concern for some students' reading skills and in that way labelled these students as low achieving and not-normal to the students themselves and their peers, no such labelling mechanism was in place for mathematics achievements. Furthermore, the teacher was new to the class, did not know the children, and practiced her teaching in a

way that did not produce an “achievement hierarchy” (cf. Paper 2 and 6).

The second reason was that the class had an unexpected composition in that half of the students were descendents of immigrants in that their parents had emigrated from the Middle East. In the pilot study class, there had only been a few students with immigrant background. The sheer number of students of non-native descent meant that the cultural diversity dimension was not something I could choose or not choose to take into account especially since it was well known that immigrant students generally were low achieving, and this in was particularly the case for students of Middle East descent (cf. Paper 3).

The two first reasons amalgamated into the third and perhaps decisive reason for extending the period of observation and interviewing more children. After having observed the class for 2-3 months and interviewed the children in groups and half of them in pairs I could not see how this empirical material would allow me to explore the research question in any depth. I, therefore, decided to continue the observations and do more interviews. For various practical and circumstantial reasons, these interviews took place near the end of the school year and the observations continued until then as well. Ironically, it was only after this observation period that the richness of the first sets of interviews became clear to me.

I decided to interview the children in pairs – with one notable exception as related in Paper 6. My reasons for doing this were that some children could feel uncomfortable if interviewed alone. Interviewing two children together would allow them to inspire each other and give a better child-adult balance. I had seen that happen in the pilot interview. The drawback of pair interviews was that the children might inhibit each other, or one could dominate the other. However, in the situation I thought the other issues were more important. In addition, interviewing pairs of children would allow me to hear more voices in the same amount of interviews and get a broader sample.

My idea about following a child through a whole school day before doing an interview, I gave up because of the practical implication of having to negotiate with all of the teachers for each child for a specific day in order to gain access to their classes. As well, the issue of time, taking a whole day for each child, also influenced my decision.

Information and consent at School A

In the pilot study I gave the two boys a letter for their parents (Appendix A1) that asked for their consent to let me interview their child about their experiences with mathematics. The letter explained that the interview was part of a research project, that it would be audio recorded and that their child was guaranteed anonymity. The letter invited the parents to call me if they had any questions or concerns, and stated that if they did not react I would consider it as consent. Before giving the letter to the boys, it was accepted by the school principal. The boys were given the information in the letter orally and before interviewing them I asked if they had given the letter to their parent.

In the main empirical work at School A the parents were informed by a letter given to their children to take home that was more detailed than in the pilot study (Appendix A3). It mentioned that I was interested in children's experiences in learning mathematics and specifically in their experiences of difficulties and that the children could choose not to participate even if their parents did not object. It also stated that the interviews would take place at the school and that photos, video and audio recordings were for my use only and would not be published. As in the pilot study their consent would be taken as given if they did not react. This procedure was not quite as informal as it may sound in that the teacher and I were careful to ask the children if they had given the letter to their parents.

In my first visit in the class, I introduced myself and my project, and asked if I could be present in their mathematics classes. I explained that I was interested in how it was to be ten years old, learn mathematics and sometimes find it difficult. The children were also asked to give their consent by signing a consent form (Appendix A4). It had the same information about their project and anonymity as the

letter to their parents although in a simpler wording. The consent slip stated that I had told them that they did not have to participate in the project; that they could withdraw at any time; that their parents had told them that they could participate; and that they agreed to be video and audio recorded. It was a big thing to many children to sign the consent form – some said it was the first time they signed a document. The formality of the process contributed to emphasise that the relation between them and me was negotiated and voluntary. One child withdrew from being interviewed. I did not query him for his reason. Maybe he just wanted to exercise his right.

Observations and interviews at School A

At School A, I observed 30 single or double lessons from late August to late May. After four weeks, I started to audio record the observations and 19 of them was audio recorded. Field notes were written after each observation.

Three rounds of interview were conducted:

- First round - September-October 2006: 3 group interviews comprising all children but one; video and audio recorded; these interviews lasted for 25-30 minutes; interview guide in appendix B2.
- Second round - October-December 2006: 6 interviews of children, five of them in pairs and one with a single child; audio recorded; 28-45 minutes; interview guide in appendix B4.
- Third round - May 2007:
 - 5 interviews of children in pairs; audio-recorded; 25-45 minutes; interview guide in appendix B5.
 - Interview with mathematics teacher; audio recorded; 50 minutes; interview guide in appendix B6.

The 11 interviews of children in round two and three comprised 14 of 20 students of which 7 of them were interviewed twice. Table 1 lists the individual children and the interviews in which they participated.

Table 1. Children's participation in interview rounds.

	1st (Group)	2nd (Pair)	3rd (Pair)	Interviews
Gustav	-	-	-	0
Emma	+	-	-	1
Hamid	+	-	-	1
Helene	+	-	-	1
Jacob	+	-	-	1
Philip	+	-	-	1
Bahia	+	+	-	2
Ghazala	+	+	-	2
Kamal	+	+	-	2
Kasper	+	+	-	2
Ishak	+	-	+	2
Simon	+	-	+	2
Zahra	+	-	+	2
Frederik	+	+	+	3
Hussein	+	+	+	3
Isabella	+	+	+	3
Kalila	+	+	+	3
Maha	+	+	+	3
Maria	+	+	+	3
Sahra	+	+	+	3
Children	19	11	10	

In Table 2 the children are stripped of their individuality and reduced to members of different categories. The table shows the number of children in the three rounds of interviews and their distribution on gender and ethnic descent²³. For example, the first row labelled “Children” shows that there were 20 children in the class of which 19 participated in first round (group interviews), 11 in the second round (pair/single interviews) and 10 in the third round

²³ Some children’s parents had different ethnic/immigrant background, e.g. “Danish” mother and “Middle East” father. Here they are categorised as the children seemed to do among themselves, cf. Paper 3.

(pair interviews). One child did not participate in any interview. The following three columns show that 14 children participated in at least one interview in round 2 and 3, seven of them only in one of them (and hence two interviews in all), and the remaining seven children in all both and hence all three rounds. The following sets of rows split these numbers on gender, ethnicity, and gender-ethnicity. The figures show that there are more interviews with girls and children of Middle East descent than with boys and children with ethnic Danish background and that more children in these two categories are interviewed in all three rounds.

Table 2. Number of children in various categories in each round of interviews and kumulated numbers.

	Total	1st	2nd	3rd	2nd or 3rd	2 int.	3 int.
Children	20	19	11	10	14	7	7
Girls	10	10	7	6	8	3	5
Boys	10	9	4	4	6	4	2
Danish	10	9	4	4	5	2	3
Middle East	10	10	7	6	10	5	5
Girls – Danish	4	4	2	2	2	0	2
Girls – Middle East	6	6	5	4	6	3	3
Boys – Danish	6	5	2	2	3	2	1
Boys – Middle East	4	4	2	2	3	2	1

Other empirical material from School A

I collected other material from School A:

- In the group interviews I asked the children which subjects they liked the best and the least. In the first interview the question was just asked and in order to focus this part of the interview I handed out a simple questionnaire to the two following groups asking they children to indicate by smiley faces how the liked the different school subjects (Appendix B3).
- I took pictures of the children’s “family trees” that they made in their English lessons. On a piece of paper with a drawing of a big tree, they drew pictures and wrote names of their family members.

- I photocopied the children's answers to two tests that the teacher gave in October and May, and I marked them from the copies for my own information.

Mostly, this material has served as sources for reflection when writing the papers. The information from the questionnaire was used in Paper 5.

The secondary study - School B

The reasons for doing observations and interviews at another school were mixed. On one hand, I was worried about getting useful data after I learned that two of the three teachers at School A had withdrawn. On the other hand, engaging with another school and teacher would require me to produce another set of data with the entailed implications for my workload. However, after a positive meeting with a teacher from School B – that I was referred to through a colleague who knew a teacher who knew this teacher and that she might be interested in participating – I let go of my hesitations. This teacher taught mathematics in a year 4 and a year 6 class. At this point, I wanted to focus on year 4 children so we decided on this class. The teacher was early in her teaching career and was interested in more openness about teaching and in having feed-back on her teaching. I was happy to give something in return for having access to her classroom so after each observation, we discussed the lesson over a cup of coffee.

Information and consent at School B

In order to inform the parents and have their consent, I participated in a parent/teacher meeting. I presented my project and explained how I would like to interact with their children. The parents were given a letter with the same information about the project as the letter to the parents at School A (Appendix A5). This time the consent form requested a positive consent to the participation of their child. The principal at School B required that I asked for positive consent in order to avoid complaints from parents saying that they had not seen the information letter. The teacher was helpful in gathering all the

consent forms and making the necessary reminders. The children were introduced to the project in much the same way as at School A and was given a similar consent form to sign (Appendix A6).

Observations and interviews at School B

I observed 13 lessons from December 2006 until May 2007 in the same way as I had done in School A. There were 19 children in the class, 9 boys 10 girls, all of Danish descent. Field notes from each observation were written based on memory, notes taken during the lesson, whereof seven were supported by an audio recording of the lesson.

In May 2007, I interviewed six children in pairs, two pairs of girls and one pair of boys, all of them low achieving (interview guide in appendix B5). This school gave special education to children who were low achievers in mathematics. These children would typically spend the mathematics lessons with the special education teacher in another room. The children I asked to interview were chosen in consultation with the teacher. In one pair of girls that I interviewed, one girl had special education in mathematics that year and the other had received the previous year. The other pair of girls the teacher had advised to attend the homework cafe where they could receive help, and the teacher also considered the two boys to be low achieving in learning mathematics. The teacher was also interviewed using the same interview as at School A (see appendix B6).

Other empirical material from School B

I got copies of the answers that the interviewed children gave to a test that the teacher gave to the children in May 2007. The test was a website generated "Maths Facts Practice" sheet asking for 100 seemingly assorted facts from the multiplication table.

Summary of chapter 2

This chapter sets out the background to the collection of observations and interviews in the three research sites. It provides details about how the research questions changed as a consequence of the pilot study interview. The collection of data at the main site also resulted in changes, but in this case, it was changes to the amount of

interviews and observations done and the duration of time, over which they were gathered. These changes were made because the original interviews initially were not considered rich enough to answer the research question. The chapter also describes how a second site was used for the gathering of interviews and observations after the possibilities of originally watching three classes and then following the most promising were reduced to only being able to observe one class.

Chapter 3: Writings

This chapter contains the six peer-reviewed published or submitted papers, that arose from the observations and interviews, in chronological order of writing. With the exception of paper 6, they are reprinted as close as possible to their published/submitted format including the original page numbers if any; however they are scaled to fit the paper size of the thesis (B5). Instead of consecutive page numbers, each paper is provided with a header, [Paper n], where n indicates the number of the paper. The papers are listed below with a full reference and in some cases information about their relation to other papers.

Paper 1: The notion of children's perspectives

Lange, T. (2007). The notion of children's perspectives. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education*, (pp. 268-277). Department of Education, University of Cyprus: European Society for Research in Mathematics Education.

Paper 2: A child's perspective on being in difficulty in mathematics

Lange, T. (2008). A child's perspective on being in difficulty in mathematics. *The Philosophy of Mathematics Education Journal*, (23) <http://people.exeter.ac.uk/PErnest/pome23/index.htm>

A few minor grammar and spelling errors in the article have been corrected before reprinting the article. A similar version is published

as a paper for the 4th Nordic Research Conference on Special Needs Education in Mathematics (Lange, 2009).

Paper 3: Homework and minority students in difficulties with learning mathematics: the influence of public discourse

Lange, T. (2008). Homework and minority students in difficulties with learning mathematics: the influence of public discourse. *Nordic Studies in Mathematics Education*, 13 (4), 51-68

The paper is a revised and extended version of a paper presented at the 11th International Congress of Mathematics Education, ICME-11, in July 2008 in Topic Study Group 7: Activities and programs for students with special needs (Lange, 2008).

Paper 4: If a quarter crashes, so it dies: children's meaning making in mathematics lessons

Lange, T. & Meaney, T. (in press). If a quarter crashes, so it dies: Children's meaning making in mathematics lessons. Manuscript submitted for publication in B. Sriraman, C. Bergsten, S. Goodchild, C. Michelsen, G. Palsdottir, O. Steinthorsdottir, & L. Haapasalo (Eds.), *The sourcebook on Nordic research in mathematics education*. Information Age Publishing.

An earlier version of the paper was submitted to the 30th Annual Conference of the Mathematics Education Research Group of Australasia, MERGA30, in July 2007 and presented as a short communication at the conference. It was later completely rewritten and considerably extended to form the book chapter. The paper has been submitted for publication, but the editors have not yet come back to us with their feedback. The paper is written jointly in a close collaboration including a series of discussions around the theoretical framework and analysis of the two pieces of data. A co-author statement is in appendix C1.

Paper 5: "Tell them that we like to decide for ourselves" - Children's agency in mathematics education

Lange, T. (in press). "Tell them that we like to decide for ourselves" - Children's agency in mathematics education. To appear in

Proceedings of the Sixth Congress of the European Society for Research in Mathematics Education.

The paper was presented at the Sixth Conference of European Research in Mathematics Education, CERME6, in January 2009 and accepted for publication.

Paper 6: When you are bad at it, it is boring: School mathematics as an arena for children's identity work.

Lange, T. (2009). When you are bad at it, it is boring: School mathematics as an arena for children's identity work. Manuscript submitted for publication in *Journal of Research in Mathematics Education Special Issue on Equity*

THE NOTION OF CHILDREN'S PERSPECTIVES

Troels Lange

Aalborg University, Denmark

In this paper, I discuss methodological concerns relating to the notion of children's perspectives. My starting points are that children are social actors with their own ways of constructing meaning and interpreting their world, and second, that meaning is what children ascribe to their actions in the field of school mathematics learning. Meaning in this sense of the word is taken as a key notion in constituting and exploring children's perspectives. Insights into this meaning can be gained from adopting a life story approach to research that invites children to tell from their perspective. The paper ends with a methodological self-reflection.

INTRODUCTION

The inclusion agenda officially manifested in the Salamanca Statement (UNESCO, 1994) invites schools - and mathematics education - to move the focus from the shortcomings of individual students to the structures, attitudes, social and pedagogical practices that hinder students' participation in the school and learning community (Booth, Ainscow, Baltzer, & Tetler, 2004). This agenda calls for a systemic reconceptualisation of low achievement in mathematics (and other school subjects) and of defective learning as a manifestation of imbalances in the system (see Lange, forthcoming). According to Magne (2001), most research in special needs education in mathematics, however, assumes either a content deviation model or a behaviour deviation model. In either case, the low achieving student is seen as deviating from a norm, that of the standard curriculum. Only a few studies deal with the complexity of the problem by considering the multiple factors involved in the creation of learning difficulties. Furthermore, children's subjectivity and experience of being in trouble with mathematics is seldom taken as a key source of insight.

Recent sociological and anthropological research in childhood generally recognizes children as actors in their own lives and not just objects of socialization (James, Jenks, & Prout, 1997; Kampmann, 2000). In their capacity as social actors, children have meaningful and interesting knowledge and experience. Their experiences and stories are as significant and valuable as those of adults are.

Children's or *students' perspectives* and other linguistic variations have become common terms in recent mathematics education research literature (e.g. Young-Loveridge, Sharma, Taylor, & Hawera Ngarewa, 2005). However, the notion is mostly used in an everyday sense and generally not treated as a theoretical construct. This is surprising given that ethnographic research has a long tradition for studying what the world is like for people who are different from the researcher. Discussions of methodological issues and pitfalls in this enterprise are an integral part of the tradition (Reed-Danahay, 2005), but that does not seem to be the case in mathematics

education research. Almost twenty years ago, Eisenhart (1988) pointed to the ethnographic research tradition as a valuable source of inspiration for mathematics education research because it requires researchers to scrutinise their own views and assumptions and investigate instead of taking for granted the intersubjective meanings that might constitute schools, classrooms, teaching practices, the arrangements in time and space etc.

An ethnographic, whole life approach, capable of capturing the complexity of affective issues in mathematics education, is also what McLeod (1994) called for in a review on research on affect:

They [Ivey, 1994; Ivey & Williams, 1994; Walen, 1994; Villiams & Baxter, 1993] suggest a new approach to affective issues – one that emphasizes the student as an individual with a comprehensive belief system, or world view. ... They suggest that students' affective reactions to mathematics occur within a larger framework of how students make sense of their world in general. ... Thus the students' views of mathematics can't be considered in isolation but must be analyzed in the context of an integrated approach that considers all the beliefs and motivating forces that influence the student. (McLeod, 1994, p. 644)

These approaches to methodology resonate with my current research work. In my ongoing PhD project, I focus on children's perspectives on learning difficulties in mathematics and explore how mathematics and learning it is positioned in children's life and world view; in McLeod's words, 'within the larger framework of how students make sense of their world in general'.

My notion of *children's perspectives* so far (see Lange, forthcoming), comprises *children's voices*, *experiences* and *meaning ascriptions* as constituents, and an aspiration of *contextualizing* and *theorizing* these. In this paper, I want to explore the notion further and consider how this affects methodology in regard to my PhD research. My argument shall be that the core of children's perspectives is the meaning they ascribe to the actions that they undertake when learning (or not learning) school mathematics. The argument rest on a paradigmatic choice that claims that meaning of tasks takes priority over the meaning of concepts (see Skovsmose, 2005b). Further, children's perspective being an analytical construct raises the question of the perspective in which I, the researcher, look at children's perspectives; I discuss this briefly in the end of the paper.

CHILDREN'S PERSPECTIVES

The etymological root of perspective, *spicere* from Latin, means *to look*. Central to the different meanings of *perspective* is the arrangement of objects (physical or mental) to represent their relative interrelations when 'seen' from a certain *point of view*. *Perspective* presupposes and indirectly acknowledges that there are different ways of looking at the same phenomena. Each of the different actors at school, teachers, students, parents, school leaders and authorities have their perspective on

school matters and develops knowledge from their different perspectives. This may be illustrated with an example of teachers' perspective. Højlund (2002, p. 155ff) found that in her interviews teachers stereotype children as asocial and egoistic, and generally characterise them by insufficiencies: they lack respect, manners, social sense and discipline. This picture of children is obviously neither complete nor neutral, but is derived from teachers' perspective. The function of teachers is to teach, and this determines their professional relations to children whom they see as students and as part of a class. Their definition is functional and relational and as such contains its own logic and rationality. Compared to the teacher, a child 'looks' at school matters from a different *point of view*, that is in a different perspective that may contain phenomena invisible in a teacher's perspective or differently interrelated.

A child's perspective is how the child 'looks' at 'the world'. As seeing is not a one-to-one imprint of 'the world' on the retina, but an active interpretation of the sensory impulses on part of the brain, a child's perspective is an active making sense of and ascribing meaning to – in this case – mathematics learning. That is, not only the cognitive or conceptual meaning the child ascribes to mathematical concepts but more important the meaning of teaching and learning of school mathematics in the child's life and worldview, and the meaning the child ascribes to actual and potential learning acts or other acts in the school mathematics field. Schools are socio-political settings. Hence, in order to grasp children's meaning ascriptions I need a theoretical framework that links them to the socio-political context of mathematics learning. Such a framework is the object of the next section.

Foreground and background

Ole Skovsmose connects meaning, (mathematics) learning and action by a cluster of interrelated notions: foreground, background, dispositions, intentions, meaning, action and reflection (Skovsmose, 1994; 2005a; 2005b). The main features in the network of notions are described briefly in the next few paragraphs.

The notion of *foreground* refers to

a person's interpretation of his or her learning possibilities and 'life' opportunities, in relation to what the socio-political context seems to make acceptable for and available to the person. Thus the foreground is not any simple factual given to the person; rather, it is a personally interpreted experience of future possibilities within the social and political frame within which the person acts. (Alrø, Skovsmose, & Valero, in press)

Similarly, the *background* of a person is

the person's previous experiences given his or her involvement with the cultural and socio-political context. ... [W]e consider background to be a dynamic construction in which the person is constantly giving meaning to previous experiences, some of which may have a structural character given by the person's positioning in social structures. (Alrø et al., in press)

Taken together foreground and background make up the person's *dispositions*, which "embody propensities that become manifest in actions, choices, priorities, perspectives, and practices" (Skovsmose, 2005a, p. 7). A person's dispositions are not always homogeneous and in fact can be contradictory as the person may conceptualise different foregrounds and backgrounds at different times and situations.

In order to understand a person's actions we need to consider his or her *intentions*. Hence, intentionality is taken to be a defining element of action, thereby separating action from mere activity. Intentions emerge from a person's dispositions, that is his or her background and foreground. Some forms of learning are seen as *action*, and so we can speak of intentional learning acts. Students can be invited into situations where they can be involved in processes of learning as action, but it cannot be forced upon them. In school, not all forms of learning are intentional learning acts; learning also results from forced activity, and unconscious learning is occurring. (Skovsmose, 2005a)

Meaning is an integrated aspect of acting, and something that is produced and constructed. Disposition, foreground and background, are resources for the production of meaning. All sorts of intentions emerge in children's actions in school mathematics teaching and learning situations and a variety of meanings are constructed. A child might want to please the teacher, sit next to the right person, finish tasks in time, avoid homework, be happy to solve the task, and want to play football. If children are not invited to engage in meaningful learning acts the field is not void of intentions and meanings, but left open to all sorts of other meaning productions, for instance 'underground intentions' (Alrø & Skovsmose, 2004). Thus, a child's interpretation of his or her previous experiences, of learning possibilities and 'life' opportunities, their availability and acceptability in the given socio-political context, are key resources of meaning production and hence key aspects of the child's perspective.

Looking with children

One may look *at* or look *with* children, or at least try to put oneself in their place, try to see with their eyes. Understanding children's perspectives, the logic of their meaning constructions, means looking into their foregrounds and backgrounds as major sources of information. Talking with children in interviews aimed at exploring how they make sense of and ascribe meaning to mathematics and mathematics education seems to be a way of looking with them. In this, I have two main sources of inspiration. First, life history research (Goodson & Sikes, 2001; Goodson, 2005) in which the (adult) informant ideally only is given the prompt: "Tell me about your life". The interviewer interrupts as little as possible and only with clarifying questions, maintaining a curious, open minded, and non-interpreting state of mind, thus letting the informant's story unfold as 'uncontaminated' as possible by the interviewer's perspective. My informants are 10 to 12 years old; hence, the second source of inspiration is researchers with experience in conducting interviews with

children. Doverborg and Pramling Samuelsson (2000) have interviewed children from the age of three about their thoughts. Andenæs (1991) has conducted “way-of-life-interviews” with 4-5 year old children by interviewing them on locations relevant to the themes of the interview, for example their home. Researchers have found it fruitful to support the interviewing of young children with drawings, pictures, film, or stories (Kampmann, 2000). This research suggests that it is quite possible to interview children about their thoughts and meaning making and have them tell their stories. According to Andenæs there is no principal difference in doing qualitative interviews with children and adults; the challenges are the same although more acute with children: “When interviewing children, you have to put even more effort and care in the contract, in establishing a common focus of the conversation, and in motivating and create optimal conditions for the interviewee.” (Andenæs, 1991, p. 290; my translation)

It follows that the interviews should have an open, loosely structured character and take place in an atmosphere of genuine interest in order to support and stimulate children in unfolding their stories. The interview prompts and questions should be initiating, circular, supporting, and clarifying, and explore the children’s ‘world view’, learning trajectories, and connections, patterns and meaning making related to school, teaching, learning, mathematics, leisure, friends, mates, interests, etc.

An Example

Children have insights and points of view, which the other actors of the school system do not have. Quite often, their perspective is significantly different from that of adult professionals. It may for example contain a logic that differs from a rational, didactical perspective. The following extracts from an interview with two boys provide an example.

David and Dennis are 10 and 11 years old, friends and in fourth grade. At the time of the interview, the children in this grade were grouped in their mathematics classes according to level of achievement as perceived by the teachers. David is not quite aware of this criterion, but Dennis is. The extract begins with their reflections on this and continues with the story of why they are in the same group and how they managed to obtain that. [1]

- | | | |
|-------|--------|---------------------------------------------------------------------------------------------------------|
| 1 | David | actually, I think that the groups are given out [i.e. formed] from those who are best, I don’t know ... |
| 2 | Dennis | they are |
| 3 | David | I think it is Ann [teacher], she takes the best, I think ... |
| 4 | Dennis | that is why I have gone up; started to be in the other [group] |
| (...) | | |
| 5 | Dennis | we used to have been together always |
| 6 | David | yeah |
| 7 | Dennis | and then I was going to go down |
| 8 | David | (?) |

- 9 Dennis and then I made me good again because we were just chatting occasionally ...
- 10 Int and then you made – do you say that you made yourself good again?
- 11 Dennis yes, then I did my ...
- 12 Int how did you do it?
- 13 David then he did his best not to go down
- 14 Dennis then I did it again - not to go - stay there in that group, and then I went up in his [group] again
- 15 Int well, okay, how, what did you do to go to that group again?
- 16 David tried to do himself better
- 17 Dennis (?) mathematics and everything

In my interpretation, Dennis displays a strong disposition for autonomy or being in control. For instance, he explains earlier in the interview that it was his choice to repeat a class: “Once, I was fighting a lot in school, but that was because they tease me every day and therefore I did not bother to go in that class and then I repeated a class and came into his [David’s] class” In the extract, he is completely aware of the ground rules of the game, that is the criterion for forming the groups (2). He is the one who decides in which group he will be. Originally he was placed in the low set (4, 7) but then he made himself better (9, 14, 17). David supports and supplements his story (13, 16). The reason they give is friendship: they have always been together (5, 6) and want to be so; their friendship is expressed in David’s confirmation, support and taking over (6, 13, 16). It is background and foreground because it was a valuable previous experience that they want to continue into the future. They also tell a story of identity, which reflects their interpretation or perception of the socio-political context, their background: they belong to the *best* group (1-3) which consist of the *good* and *better* (9, 16). These categories are explicitly embedded in a hierarchical order expressed as *up* and *down* (4, 7, 13, 14); you are *up* if you are *best*. Alternatively, the grouping might have been conceived as a means to facilitate learning of mathematics, and thus reflecting intentions of learning mathematics on part of the children, but that possibility seems absent from their considerations.

A little later in the interview, I tried to investigate their relation to this hierarchy:

- 18 Int is it cool to be in the best group, or
- 19 David Yes, it ...
- 20 Dennis I don’t think so!
- 21 David I think it is cool because I know ...
- 22 Dennis I don’t think so!
- 23 David that I am one of the best
- 24 Int mm
- 25 Dennis I don’t think it is cool, rather cool
- 26 Int why don’t you think so?

27 Dennis because then you get more homework than they [the other group] do

Being good at mathematics has a high social valuation, and this is reflected in the children's background in two different ways. David appreciates the social status of being in the best group (19, 20) and thinks that he rightly deserves it (23). Dennis on the other hand, strongly denies that it is cool to be with the best (20, 22, 25) because he dislikes the consequence of more homework (27). This may be seen as another example of his strong valuation of autonomy in that homework may interfere with or even infringe on the social life in his free time. This interpretation is supported in a later part of the interview, where Dennis explains why practicing the multiplication tables is (the only?) good mathematics homework: you can do the tables in your head while you ride your bike from your home to your friend's home. However, the social status of belonging to the top end of the hierarchy that he expressed earlier (4, 7, 14) is a mixed blessing to him. In the conflict between social status and autonomy, Dennis seems to make a conscious compromise: he works hard enough to maintain the status mathematics provide (and stay with David as well) but no more. The social valuation of mathematics is subjectively interpreted as background and foreground, and come into play in the different dispositions of David and Dennis to engage in learning mathematics. Whereas David's need for recognition goes hand in hand with the social valuation of mathematics and adds positively to his disposition for learning mathematics, Dennis' disposition shows a conflict between status and autonomy which impacts on his engagement with learning mathematics.

The example suggests that these two children interweave the meaning of mathematics education into a fabric of friendship, belonging, expression and construction of identity, and the social practice of everyday life. In the extracts as well as in the rest of the interview, learning intentions and meaning constructions have their basis in their lives as children, their background and foreground, and are seemingly not related to mathematics as such. Their perspectives are very different from that of the curriculum. However, it would be possible for the teacher to use this information when trying to engage students in meaningful mathematics education.

SEEING PERSPECTIVES FROM PERSPECTIVES

Children are not a homogeneous group, children's foregrounds and backgrounds are different, their interpretations of the socio-political context are fluctuating, discontinuous and contradictory, their intentions and meaning constructions likewise. Hence, there is not one child perspective; *the* child perspective does not exist.

As well, a child's perspective is not a 'thing', an empirical entity that one may for example take a picture of; it is an analytical construction of the researcher. Informants do not have privileged access to the truth about their own world. The researcher's analytical account is of another order than that of the children's experiential knowledge.

However, children's perspectives as objects of the researcher's gaze, are seen from what perspective? I cannot reflect on my perspective without stepping out of it and look at it from a different point of view. The question then becomes more introspective as I consider the perspective from which I look at the perspective from which I look at children's perspectives. (This chain of perspectives on perspectives continues – we have a principally infinite regress.)

Giving voice or silencing

My PhD project may be seen as an attempt to “give voice” to an exposed group, children in difficulties with learning mathematics. However, in an endeavour of this type, one may silence in effect the voices if they are not linked to a theoretical understanding of their social and cultural context. Goodson writes:

A particular problem ... is posed by those genres which ... have sought to sponsor new voices – the world of ‘stories’, ‘narratives’ and ‘lives’. ... [A]s currently constructed these genres tend to lead us away from context and theorizing, away from the conceptualization of power.

... In the dialectical development of theories of contextualities, the possibility exists to link our ‘stories’, ‘narratives’ and ‘lives’ to wider patterns of structuration and social organization. So the focus on theories of context is, in fact, an attempt to answer the critique that listening to lives and narrating them valorizes the subjectivity of the powerless individual. In the act of ostensible ‘giving voice’, we may be ‘silencing’ in another way, silencing because, in fact, we teachers and researchers have given up the concern to ‘theorize’ context. (Goodson, 2003, p. 5)

The background-foreground ‘model’ incorporates a research interest, that of emphasizing the socio-political nature of mathematics education and learning. Hence, this choice of perspective on children's perspectives serves my attempt to avoid silencing the voices of children, because it allows theorising children's meaning constructions and agency, their perspectives, in a wider socio-political context.

That is my – present – perspective on children's perspectives.

ACKNOWLEDGEMENTS

I want to thank Diana Stentoft Rees, Helle Alrø, Ole Skovsmose, Tamsin Meaney and the reviewers for critical comments and helpful suggestions to the paper.

NOTES

1 In Denmark, children are not streamed in primary and lower secondary school. Recent legislation has allowed the formation of groups across classes and year groups for limited periods of time.

The interview was conducted in an early phase of the project when I was trying out interviewing children, and not intended to become part of my empirical material. Hence, the informants do not belong to my primary target group, children being in difficulties with mathematics. I have translated the extracts and normalized the language a little though still trying to maintain the characteristics of children's language.

In the transcript “...” marks interruption, “(...)” omission, and “(?)” short unintelligible passages.

REFERENCES

- Alrø, H. and Skovsmose, O.: 2004, *Dialogue and learning in mathematics education: Intention, reflection, critique*, Boston, Kluwer Academic Publishers
- Alrø, H., Skovsmose, O., & Valero, P.: in press, 'Inter-viewing foregrounds', in M.César & K. Kumpulainen (eds.), *Social interactions in multicultural settings*, EARLI Books.
- Andenæs, A.: 1991, 'Fra undersøkelseobjekt til medforsker? Livsformsintervju med 4-5-åringer', *Nordisk psykologi* 43 (4), 274-292.
- Booth, T., Ainscow, M., Baltzer, K., and Tetler, S.: 2004, *Inkluderingshåndbogen*, Kbh., Danmarks Pædagogiske Universitet
- Doverborg, E. and Pramling Samuelsson, I.: 2000, *Att förstå barns tankar: Metodik för barnintervjuer*, 3. ed., Stockholm, Liber
- Eisenhart, M. A.: 1988, 'The ethnographic research tradition and mathematics education research', *Journal for Research in Mathematics Education* 19 (2), 99-114.
- Goodson, I. F.: 2003, *Professional knowledge, professional lives. Studies in education and change*, Maidenhead, Open University Press
- Goodson, I. F.: 2005, 'Lærende liv', in R.Ådlandsvik (ed.), *Læring gjennom livsløpet*, [Oslo], Universitetsforlaget, pp. 77-100.
- Goodson, I. F. and Sikes, P. J.: 2001, *Life history research in educational settings*, Buckingham, Open University
- Højlund, S.: 2002, *Barndomskonstruktioner. På feltarbejde i skole, SFO og på sygehus*, [Kbh.], Gyldendal Uddannelse
- James, A., Jenks, C., and Prout, A.: 1997, *Theorizing childhood*, Cambridge, Polity Press

- Kampmann, J.: 2000, 'Børn som informanter og børneperspektiv', in P.Schultz Jørgensen & J. Kampmann (eds.), *Børn som informanter*, Kbh. Børnerådet, pp. 23-53.
- Lange, T.: forthcoming, 'Students' perspectives on learning difficulties in mathematics' in L. Ø. Johansen (ed.), *Proceedings of the 3rd Nordic Research Conference on Special Needs Education in Mathematics*,
- Magne, O.: 2001, *Literature on special educational needs in mathematics. A bibliography with some comments*, Malmö, Department of Educational and Psychological Research, School of Education, Malmö University
- McLeod, D. B.: 1994, 'Research on affect and mathematics learning in JRME: 1970 to the present', *Journal for Research in Mathematics Education* 25, 637-647.
- Reed-Danahay, D.: 2005, *Locating Bourdieu*, Bloomington, Indiana University Press
- Skovsmose, O.: 1994, *Towards a philosophy of critical mathematics education*, Dordrecht, Kluwer Academic Publishers
- Skovsmose, O.: 2005a, 'Foreground and politics of learning obstacles', *For the Learning of Mathematics* 25 (1), 4-10.
- Skovsmose, O.: 2005b, 'Meaning in mathematics education', in J.Kilpatrick, C. Hoyles, & O. Skovsmose (eds.), *Meaning in mathematics education*, New York , Springer Science, pp. 83-100.
- UNESCO: 1994, *The Salamanca statement and framework for action on special needs education*.
http://www.unesco.org/education/information/nfsunesco/pdf/SALAMA_E.PDF
[On-line]. Retrieved 10-5-2006
- Young-Loveridge, J., Sharma, S., Taylor, M., & Hawera Ngarewa: 2005, *Students' perspective on the nature of mathematics. Findings from the New Zealand Numeracy Development Projects 2005* [On-line]. Available: http://www.nzmaths.co.nz/Numeracy/References/Comp05/comp05_young-loveridge_etal.pdf. Retrieved 17-8-2006

A CHILD'S PERSPECTIVE ON BEING IN DIFFICULTY IN MATHEMATICS

Troels Lange

Aalborg University & VIA University College
trla@viauc.dk

This paper is part of a study that explores learning difficulties in mathematics from the children's point of view. An interview with a group of ten to eleven year old students is analysed with respect to their making sense of and ascribing meaning to their learning or non-learning of school mathematics. The analysis uses a three level procedure for analysing interviews adopted from (Kvale, 1984) that is coherent with the methodology and conducive to sensitivity towards the notion of children's perspectives as an analytical construct. The students' sense making seamlessly integrated into coherent wholes their immediate experiences in their mathematics classroom with the prospect of their future lives. It was also found that children in difficulties with learning mathematics can be reflective about the norms and expectations at play in school mathematics.

Framing children's perspectives

In a previous paper (Lange, 2007), I explored methodological aspects of researching learning difficulties in mathematics from children's point of view. In this paper, I report on research following these methodological considerations. It is shown young children can be interviewed about their experiences with school mathematics and their making sense of and ascribing meaning to school mathematics. A three level interpretation procedure inspired by (Kvale, 1984) is conducive to the construction of children's perspectives. Finally, as anticipated in (Lange, 2007), children "at the edge", e.g. performing poorly in mathematics, can be quite reflective about the norms and expectations at play in school mathematics.

In (Lange, 2007) learning difficulties in mathematics were seen as a social construction within the social practice of school mathematics education (Valero, 2002) and therefore closely related to the socio-cultural significance attributed to mathematics in Western societies. Consequently, the learning or non-learning of mathematics seriously affected children's perceptions of themselves and therefore their construction of identity.

Children should be recognised, not just as objects of socialisation, but also as actors in their life with their own ways of constructing meaning and interpreting their world (James, Jenks, & Prout, 1997). As agents, children are co-constructors of the social practice of school mathematics teaching and learning because of their own sense-making, meaning ascription and identity formation. The recognition of children's agency makes their construction of identity and meaning a unique and valuable source of knowledge on mathematics education and learning difficulties in mathematics (Lange, 2007).

It was anticipated that children's identities and ascription of meaning to mathematics education would be expressed in narrative form. As narratives are made up from "stories floating around" (Sfard & Prusak, 2005), they connect individual agency and the social and cultural structure. Hence, children's narratives about their learning or non-learning of school mathematics would reflect their individual meaning making and agency, as well as the social and cultural structure embedding the practices of mathematics teaching and learning.

The notion of children's perspectives was claimed to be a theoretical construct of the researcher as opposed to a natural given (Lange, 2008). It was defined as meaning constructions: *the meaning that*

children ascribe to their actions in the field of school mathematics learning. This definition referred to Skovsmose's conception of students' foreground and background as resources for their meaning constructions (Skovsmose, 2005a; Skovsmose, 2005b; Skovsmose, 1994). Foreground and background of a child are the child's interpretation of the socio-political context. As children exert agency in interpreting the socio-political context and in ascribing meaning to mathematics education, children's perspectives express children's agency as well as embody the socio-political context.

Given that identity and meaning were considered narratives, it was imperative that research methods should be adopted that invited children to tell narratives. Hence, with reference to life history research (Goodson & Sikes, 2001) interviewing children seemed to be a method coherent with the aims of the research. The style of interviewing can be categorised as semi-structured life world interviews, the form of research interview defined as "an interview whose purpose is to obtain descriptions of the life world of the interviewee with respect to interpretation the meaning of the described phenomena" (Kvale, 1996, p. 5f).

In the next section, the study is described and the framework for analysing interview data introduced. In the second section, excerpts from a group interview are analysed. The final section concludes the analysis and reflects upon what can be said about difficulties in learning mathematics.

Researching children's perspectives

The research reported on in this paper is part of a larger study. The empirical material consists of interviews with children aged 10 or 11 years and observations of their mathematics classes. The children were students in a Year 4 class in a Danish *Folkeskole* (public primary and lower secondary school). I explained my presence in their classroom by saying that I would like to learn from them what it was like to be in Year-4, learn mathematics and sometimes find it difficult, something in which they were experts.

The mathematics lessons were observed for almost a whole school year on a more or less weekly basis. Three rounds of interviews were conducted. In the first all students but one were interviewed in groups of six or seven students. In the second approximately half of the students were interviewed in pairs or alone. Half of the students were also interviewed in pairs in the third round. Some students took part in both second and third round. The interviews lasted from 30 to 45 minutes and were audio recorded; the group interviews were video recorded as well.

In this paper, I interpret key excerpts from the first group interview, which took place six weeks into the school year (September 2006). Following Kvale (1984), the excerpts are interpreted on three levels. The first level is a summary that the interviewees would recognise as a fair rendering of their statements in a language accessible to them and within their horizon of understanding. The second level of interpretation may transcend the interviewee's understanding but remains within a common-sense context of understanding. It can include general knowledge about the interviewee's statements, address the form of the statement, the way it is expressed, and read "between the lines". At the third level of interpretation, statements are interpreted within a theoretical framework or perspective. The interpretation is likely to transcend the interviewee's self-understanding and a common-sense understanding. Here, the theoretical frame is the notion of *children's perspectives* as described above. Thus, I will be looking for how the children make sense of their experiences with school mathematics learning and what meaning they ascribe to school mathematics in their life world.

To some extent, the extracts and interpretations focus on one student, Kalila, while letting the other students in the group interviewed provide the context. The first reason for this is that the paper is exploring the possibilities provided through a particular methodology and conceiving of *child perspective* as a theoretical notion. Looking at one child in one interview context would constitute a simple case for trying out the methodology. The second reason is that observations and other interviews pointed to Kalila as a student who was particularly articulate. In the context of the group

interview, Kalila could be seen as acting as a spokesperson for the students in the group in that she often reiterated and extended what the other students were saying. Sometimes they actively endorsed her statements, but generally, they neither contradicted nor challenged her. Hence, there are no reasons to think that her perspective was very particular or idiosyncratic. Even if her perspective was not coinciding with all of the other students, it outlined the sort of landscape within which students' perspectives are to be constructed.

Transcripts and translation

The extracts are quoted in some length, and the original Danish transcript is translated in English. There is a difference between the researcher's voice in a summary of an interview and the interviewee's own voice (although filtered through a transcription). Goodson and Sikes (2001; ch. 3) discuss how in some cases the difference can be dramatic as to the impression the reader gets of the interviewees and their stories. As children of the age in question express themselves differently from adults, linguistically, grammatically and from a different perspective, it is important in the present context to render their ways of expressing themselves as a starting point of the interpretation.

The Danish transcript is provided so that readers familiar with Scandinavian languages have an opportunity to read the material that is analysed. The transcript is close to the wording of the recordings. A translation in written English that conveys the subtleties of (a transcript of) children's spoken Danish is not always possible. When having to compromise, a rather literal translation has been chosen at the expense of what might be considered good English.

Background

There were twenty students in the class with equal numbers of boys and girls. The children also distinguished themselves as *Arabs* or *Danes*. In this terminology, half of them were referred to as Arabs and the other half as Danes. All of the children were born in Denmark and spoke the same regional dialect of Danish. The difference was that the "Arabs" were descendents of parents emigrated from the Middle East. For the group interviews, an even distribution of girls and boys as well as of children of Danish and non-Danish descent was sought.

When I began my observations in the beginning of the school year, the class had just become Year-4, moved from *green corridor* of the beginner's level (Year 0 to 3) to their new classroom in *blue corridor* of the middle level (Year 4 to 6). From being the older among the youngest students, they were now the younger ones in the middle group of students. Moving into the middle level also meant having new teachers, most importantly a new Danish teacher and a new mathematics teacher. The Danish teacher was also class teacher and took the classes in English and Religious Knowledge. The mathematics teacher took the classes in music and science. These changes seemed to cause some unrest in the class dynamics and made the children unsettled in varying degrees. Kalila, for example, had many conflicts with her class mates and the mathematics teacher in the first months.

The mathematics teacher began the year by focusing on the multiplication tables. For each of the tables, she let the children produce a set of cards with all the "questions" and "answers" belonging to a table, e.g. the questions 3·1, 3·2, ..., 3·10 and the answers 3, 6, ..., 30. The student played games with the cards, and they could take them home to assist them in practising the tables. The teacher let each student choose one table, sometimes more, for homework and checked their knowledge of the table afterwards. These activities took place in the weeks preceding the interview.

Constructing Kalila's perspective

This section deals with four excerpts from a 30-minute group interview with Kalila, Bahia, Isabella, Simon, Ishak, and Hussein. Each excerpt relates to the dialogue following one of the main questions that structured the interview. The dialogues are analysed according to the three levels of interpretation. At the first two levels, the children's understanding is summarised and a common-sense interpretation is suggested. The third level focuses on Kalila's contributions letting the other students' contributions

serve as background with the aim of constructing Kalila's perspective, i.e. her ascription of meaning to her experiences with school mathematics education.

In the transcript comma (,) is used to ease the reading by marking a new beginning of a sentence and repetitions; brackets around words () means that the transcript is uncertain; underscore (_) signals that a few words are unintelligible; hyphen (-) signals a pause; text in sharp brackets [] gives the reader information that would be evident in the actual context of the interview. In the full transcript, the statements were numbered consecutively. In the interpretation, these numbers are referred to in brackets.

Can you tell me about something you have learned in mathematics?

The dialogue reproduced in the transcript began 12:40 minutes into the interview and lasted 4:20 minutes. Not all what was said in the period related to the question; this part has been omitted.

Transcript 1. Extract from 12:40-17:00 mm:ss of group interview 1

351	Troels	Kan I fortælle mig om noget I har lært i matematik?	Can you tell me about something you have learned in mathematics?
354	Simon	Plus	Plus
355	Hussein	Vi har lært at regne plus minus	We have learned to do plus minus
356	Ishak	Tabeller	Tables
357	Hussein	Tabeller og minus og gange og dividere	Tables and minus and times and divide
358	Kalila	Altså ved du hvad (der) er godt i fjerde klasse? Det er at (hun) [læreren] giver nogen tabel for og så siger hun _ fem gange tre og så skal man jo sige det	Do you know what is good in year 4? It is that (she) [the teacher] sets some table[s] [for homework] and then she says _ five times three and then you must say it
359	Isabella	Ja det kan jeg også godt lide	Yes I like that too
360	Kalila	_ Og det sådan, det lærer man jo sådan lidt mere	_ And that like, that you learn like a little more
361-365	<i>Hussein bekræfter og Isabella og Kalila genbekræfter at de kan lide at lære tabeller</i>		<i>Hussein confirms and Isabella and Kalila reconfirm that they like learning tables.</i>
366	Troels	Hvorfor, hvad er det sjove ved det?	Why, what is the fun about it?
...			
369	Kalila	Det er sådan at nogle, altså hun siger for eksempel sådan at vi følger med i tavle og så siger [læreren til] mig ... "Tre gange tre?" Og så, og så er det sjovt. Ja	It is like that somebody, like she says for example that we follow what's happening in [the] board and then says [the teacher to] me ... "Three times three?" And then, and then it is fun. Yes
...			
380	Kalila	Ved du hvad jeg godt (kan lide)? Hun sætter krydser hvis man kan. Til sidst for eksempel i går "Kalila du kan jo ni-tabellen" for eksempel. _ "Så skal du lige have [et kryds]"	Do you know what I (like)? She puts crosses if you know. At the end for example yesterday "Kalila you know the nine [times] table" for example. _ "Then you must have [a cross]"
381	Troels	Hvad er det gode ved at hun sætter krydser?	What is the good about that she's putting crosses?
382	Kalila	Det er at så ved man jo hvad man kan. Hvis hun nu sætter krydser bare "ja det kan du godt" så kan man jo altid sige "Jeg kan fem seks syv otte ni ti" og videre videre videre også sådan når man ikke	It is that then you know what you can. If she just puts the crosses "yes you know that" then you can always say "I know five six seven eight nine ten" and on on on also when you do

		kan dem	not know them
383	Isabella	<i>forklarer at læreren noterer ved at sætte enten en bagudvendt skråstreg [/] eller en fremadvendt skråstreg [/]. "Så ved hun det"</i>	<i>explains that the teacher keeps track by putting either a back slash [/] or a forward slash [/] respectively. "Then she knows it"</i>
384	Troels	Ok	Ok
385	Kalila	Altså så ved hun det. Så er hun sikker på når, først hvis man ikke kan det så sætter hun en prik. Hvis man kan det sådan midt imellem så sætter hun en streg. Hvis det er helt korrekt så et kryds. Det er sådan man lærer meget	Like then she knows it. Then she is sure when, first if you do not know it then she puts a dot. If you know it like in the middle then she puts a line. If it is completely correct then a cross. That is how you learn much
389-396	Simon	<i>kan lide at lære tabeller, men kun lidt. Ishak kan lide det fordi "det er ligesom syvtabellen. Syv fjorten, enogtyve og så videre". Isabella er enig i dette</i>	<i>Simon only likes learning the tables a little. Ishak likes it because "it is like the seven times table. Seven fourteen twenty one and so on". Isabella agrees to this</i>
397	Kalila	Det der er godt ved det er at man får en uddannelse	What is good about it is that you get an education
398	Troels	Er det godt at få en uddannelse?	Is it good to get an education?
399	Kalila	Ja det er rigtig godt fordi	Yes that is really good 'cos
400	Isabella	Det tror jeg	I think so
401	Kalila	Ligesom mig jeg vil godt være en designer	Like me I would like to be a designer

Summary of the students' understanding (1)

The students have learned plus, minus, times, divide and the times tables. Apart from Simon, they really like the way they work with the times tables: tables are set for homework and then the teacher ask them multiplication questions that they have to answer. The teacher makes notes about how well they know the tables. Kalila thinks this tells you what you know and that she learns well this way. That is good because then you get an education and may become a designer.

Common-sense interpretation (1)

Simon, Hussein and Ishak's answers to my question about *what* they had learned in mathematics dealt with mathematical topics (354-357). Kalila focused on *how* they worked with the multiplication tables. She highlighted that the teacher set tables for homework (358), that she tested the students' table knowledge in class (358, 369), and that she kept a record (380), the details of which Kalila and Isabella reported in minute detail (383, 385). It was important that the teacher was serious in the recording (385) because the teacher's record guaranteed to Kalila and Isabella that they knew the tables (381-5). The students liked this kind of teaching (358, 361-5, 389-96). For Kalila it was because it facilitated her learning (360, 385) and gave her an education (397) that pointed towards a future of her choice (398-401). She described her experience as being fun (369). What seemed to be fun was being asked questions from a times table you had practiced and being able to answer - and if not, to find it manageable to practice more for next lesson (369).

Kalila's perspective (1)

The question now is what may be said about Kalila's perspective on learning mathematics. How did she make sense of and what meaning did she ascribe to learning mathematics?

The students mentioned the four basic operations and the multiplications tables as examples of what they had learned. They did not mention examples of what is often called *practical applications* of mathematics, like converting a recipe for one number of persons to another number; working on this and similar problems had also been a substantial part of their lessons. Thus, the students ascribe the meaning to mathematics that the subject primarily comprises the basic rules and the times tables. This

meaning ascription could be a making sense of their mathematics education or picked up from the popular conception of school mathematics. If the latter was the case, it can be inferred that their mathematics education either had not sought to challenge this conception or had been unsuccessful in doing so.

To Kalila (and Isabella) the authority to judge her learning seemed to reside solely with the teacher. The ticks in the teacher's notes physically manifested that Kalila knew a table. It was not Kalila's subjective experience. This indicates that to Kalila learning the multiplication tables – and in a wider sense also mathematics – was not a way of systematising number relationships, but a question of getting it right, that is come up with the expected answer. The reasons for why this answer was expected or the logical connections in which it was embedded were not part of the business.

Thus, Kalila and the other students did not seem to ascribe the sort of meaning to mathematics that the curriculum talked about (Undervisningsministeriet, 2003). In this light, it was not accidental that Kalila answered a question about *what* with an answer about *how*. The key word in the *how* is fun. The experience of fun seems to link two dimensions of time. In the “horizontal” dimension of time, the immediate moment, the here-and-now, fun was derived from the liking of being able to comply with the requirements and expectations of the moment. “When the teacher ask a times question, I can answer”.

In what could correspondingly be called the “vertical” time perspective, the past, the present and the future, Kalila linked *fun* to *like*, *learn*, *education*, and *job* of own choice. The emotional experience of the moment (fun, like) informs and is formed by a future perspective (education, job). Becoming a designer takes education, which takes mathematics, which takes multiplication tables, which takes teacher's ticks. This chain linking the school mathematics practice to her foreground (Skovsmose, 2005a; Skovsmose, 1994) constituted her perspective.

How is it when mathematics is easy and how is it when mathematics is difficult?

The next dialogue followed immediately after the first and was rather short.

Transcript 2. Extract from 17:00-17:41 mm:ss of group interview 1

- | | | | |
|-----|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 443 | Troels | Hvordan er det når matematik er let og hvordan er det når matematik er svært? | How is it when mathematics is easy and how is it when mathematics is difficult? |
| 444 | Bahia | ... Matematik når det er nemt så kan man lave, hvis man får et ark så kan man lave det på to eller 10 minutter. Hvis det er svært så sidder man og tænker og så begynder man mere at regne. Og hvis man slet ikke kan det så begynder man bare med at kede sig eller også så springer man over det. | ... Mathematics when it is easy then you can do, if you get a [work] sheet then you can do it in two or ten minutes. If it is difficult then you sit and think and then you begin more to calculate. And if you cannot at all then you just begin to be bored or you skip it |
| 445 | Kalila | Hvis det er svært og man virkelig ikke kan det så gider man ikke det. Og man har prøvet at regne det, ik å, og man ikke kan. Så sidder man sådan [albuen på bordet og hagen på hånden] Så sidder man og snakker og render rundt og. Måske render man ikke lige rundt men så skal man lige | If it is difficult and you really cannot then you don't feel like it. And you have tried to do it, haven't you, and you cannot. Then you sit like this [elbow on table and chin in the hand] Then you sit and talk and run around and. Perhaps you not exactly run around but then you just have to |
| ... | | | |
| 448 | Isabella | Spidse sin blyant | Sharpen you pencil |

Summary of the students' understanding (2)

Bahia says that when mathematics is easy you can do a work sheet in a few minutes. When it is difficult, you have to think and calculate. When you do not know how to do it, you get bored or skip it. Kalila adds that when you cannot you do not feel like doing mathematics and then you start doing things you are not supposed to do.

Common-sense interpretation (2)

Bahia gave a clear answer to the question. Doing mathematics is (often) doing work sheets. These are either easy and quickly done, or they are difficult and requires thinking and calculation, or they are impossible to do and you get bored and skip them (444). This link between not being able to do what mathematics teaching requires of you and being bored, was elaborated on by Kalila. She stressed the experience of not succeeding despite trying hard, and how this undermined her will and stamina. She clearly perceived how this unpleasant situation raised unrest that was reacted out in bodily expressions like talking and running around (445) – or just doing something different as Isabella's suggestion of sharpening her pencil (448).

Kalila's perspective (2)

Bahia expressed a common understanding among students that mathematics tasks should be quickly solvable (Schoenfeld, 1989). If this is not the case, then something is wrong either with the students' ability or with the tasks. Kalila did not object and probably held the same view.

In the analysis of the previous extract it was shown how the experience of *being able to* started the chain of *fun – like – learn – education – job*. In the present extract, the opposite experience of *not being able to* is merged by Kalila into a cluster of *cannot, being bored, dislike (not feeling like), and bodily unrest*. Whereas the chain of *fun – like – learn – education – job* above links the experience of the moment with the future, its counterpart only mostly deals with the here-and-now experience. Its logical continuation, *not learn – no education – no job* is not expressed. However, a closer look indicates that it nonetheless could be active.

Kalila described her feelings of dislike and of being bored when she could not do the mathematics that was set for her however hard she tried. She also described how this caused her to talk and walk around. I take this as a sign of stress. Consequently, it is suggested that failing causes stress. Now, what is stress? When the body is threatened, it becomes alerted, it wants to fight or flee. If none of these opportunities are available, the adrenalin cannot be transformed into appropriate action, and the result is stress. Hence, if Kalila's bodily unrest is taken as a sign of stress, this indicates that her body was in an alerted state with no available possibility of relevant action, which means that she was threatened. She had fought, tried hard without succeeding. She did not feel like doing more, she entered a state of dislike, her energy seeped out of her. She could not flee. She was caught in a no-way-out situation. If this analysis is accepted, it follows that not succeeding with mathematics is threatening. A plausible reason could be that then the continuation of *cannot, being bored, dislike with not learn – no education – no job* even if unsaid is active in her foreground. A future job of her liking depends on succeeding in mathematics. Not succeeding equals the opposite. In her perspective on mathematics, her future was at stake.

Why do you think the adults have decided that children should learn mathematics?

The dialogue following this question was rather focused as may be seen from the small number of omitted lines in the transcript.

Transcript 3. Extract from 18:58-22:00 mm:ss of group interview 1

476	Troels	Jeg kunne tænke mig at spørge jer om ... hvorfor tror I de voksne har bestemt at børn skal lære matematik i skolen?	I would like to ask you ... why do you think the adults have decided that children should learn mathematics in school?
-----	--------	---------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------

...			
478	Kalila	Hvis man arbejder i en slikbutik	If you work in a sweet shop
...			
484	Hussein	Man kan ikke få en uddannelse hvis man ikke lærer matematik og sådan noget. Fordi hvis man skal arbejde ... i et træ_ og man laver et bord og det ikke er lige langt på begge sider så vil det være et problem fordi man ikke kunne regne. Og man kan ikke få en uddannelse hvis man ikke kan læse og skrive ... og hvis man ikke kan regne og noget som helst så kan man ikke få en uddannelse	You cannot get an education if you do not learn mathematics and such. 'Cos if you should work ... in a wood_ and you make a table and it is not the same length on both sides then it would be a problem because you could not calculate. And you cannot get an education if you cannot read and write ... and if you cannot calculate and nothing then you cannot get an education
...			
491	Bahia	Hvis jeg nu arbejdede i en butik og du købte den der lille, et ur for en krone og du så kom og gav mig en hund, en hundredekroneseddel. Hvad skal man så give tilbage og man ikke kan matematik så ved man jo ikke noget. Så derfor skal man jo ikke bare plusse det hele. Så ved jeg det. Så er det nemlig nioghalvfems kroner. Så skal jeg give dig tilbage.	If I work in a shop and you bought that little, a watch for one krone and you then gave me a hundred kroner note. What should you then give back and you cannot do mathematics then you do not know anything. So therefore you should not just plus all of it. So I know. It is ninety nine kroner you see. So I shall give you change
492	Isabella	Tror du, et ur koster ikke en krone	Do you think, a watch is not one krone
493		<i>Prisen på et ur diskuteres i baggrunden mens Kalila taler:</i>	<i>The price of a watch is discussed in the background while Kalila is talking:</i>
494	Kalila	Og det er ligesom i benzin_ Jeg ved ikke _ . Det har jeg bare hørt at der er nogen som kom til at sætte benzin ned til to og et eller andet halløjsa _ . Og så har de mistet, så har de mistet et eller andet med femten hundrede	In is like in petrol_ I don't know _ I have just heard that there is someone who happened to put petrol down to two and something _ . And then they have lost, then they have lost something like fifteen hundred
495	Troels	ok. Så det var fordi de ikke kunne regne de kom til at?	Ok. So it was because they could not calculate that they happened to?
496	Kalila	Naj det er ikke derfor. De kunne jo godt regne. De kom til det	No that is not why. They could calculate. They happened to do it
497	Troels	De kom til at sætte prisen for langt ned?	They put the price too far down?
498	Kalila	Ja	Yes
...			
503	Troels	Hvorfor tror du at børn skal lære matematik i skolen Simon?	Why do you think that children should learn mathematics in school Simon?
504	Simon	For så ved man hvor meget benzin man skal hælde på en crosser	'Cos then you know how much petrol to put on a <i>crosser</i> [motocross bike]
...			
520	Ishak	Hvis man nu arbejder i en butik og der er en der køber mange ting og det koster hundrede kroner og så en han snyder ham med halvtreds så ved han ved han det _	If you work in a shop and someone buys many things and it costs hundred kroner and then one he cheats him with a fifty then he knows it _

...			
527	Troels	Hvorfor tror du [Isabella] at børn skal lære matematik i skolen?	Why do you [Isabella] think that children should learn mathematics in school?
...			
529	Isabella	Ellers kan de jo ikke regne og så kan de ikke få en uddannelse	Otherwise they cannot calculate and then they cannot get an education
530	Troels	Ellers kan de ikke regne og så kan de ikke få en uddannelse?	Otherwise they cannot calculate and then they cannot get an education?
531	Isabella	Ja man skal jo kunne få en uddannelse før man kan det	Yes you should be able to get an education before you know it

Summary of the students' understanding (3)

You must learn mathematics in order to get an education and a job. In order to work in a shop you must be able to calculate so that you can give the correct change, and you must know the notes to avoid being cheated.

Common-sense interpretation (3)

The students give three types of reasons for why they must learn mathematics at school that relate to either education, job or leisure time activities. Some of their reasons are explicitly or implicitly justified or contextualised by a mathematical topic, either money or measurements. The reasons and the mathematical topics are summarised and organised in table 1.

Table 1. Reasons given for school mathematics and topics used for exemplifying

Reason Math topic	Education	Job	Leisure
Money		Kalila: shop assistant in sweet shop, petrol station (478, 494-8) Bahia: shop assistant, give change (491) Ishak: shop assistant, not cheated with money (520) Isabella: price of watch (492)	
Measurement (length, volume)		Hussein: wood industry (484)	Simon: petrol on motocross bike (504)
Unspecified	Hussein (484) and Isabella (529): no education without being able to calculate	Isabella: education necessary to get a job? (531) Kalila: in order to become a designer (397-401 in transcript 1)	

The main reasons were having a job and getting an education. Working in a shop and having to deal with money transactions was the dominant job example. No mention was made of education preceding becoming a job assistant or being a shop owner. Money was the most often mentioned mathematical topic, measurements being the other. However, the examples seem to have more to do with recognising that numbers are related to certain phenomena than actually involving mathematical operations. Hussein knew that numbers gave the lengths of the sides of tables. Simon knew the same went for volume of petrol. Isabella knew what number of kroner could be a reasonable price for a watch. Ishak knew the difference between a fifty kroner note and a hundred kroner note. Kalila knew that two kroner per litre was a low price for petrol, she thought that fifteen hundred kroner was a big loss, and she knew that the small litre price was connected to the total loss. Only Bahia's example about giving the right amount of change involved a mathematical operation.

Hussein, Isabella, and Kalila saw mathematics as necessary for getting an education. Kalila and Isabella (perhaps) saw education as necessary for getting a job either as such (Isabella) or a specific job (Kalila). None of them expressed ideas about why or how mathematics was necessary.

Kalila's perspective (3)

The students largely gave reasons for learning mathematics at school related to their future, that is to their foregrounds. They thought that mathematics, in line with reading and writing, was necessary to get an education and a job. Apart from this gate keeping function, the role of mathematics in relation to education and jobs following education was unspecified. They saw clear connections between numbers, basic mathematical operations, and money-handling jobs. Possibly, the children's backgrounds also are at play. The students, who gave money examples, Kalila, Bahia, and Ishak, are all descendents of emigrants from the Middle East. These immigrants often run shops, so these children have shop keeping as part of their environmental reference. Kalila's father was a shopkeeper.

In the analysis of the former transcript a negative cluster was found consisting of *cannot, being bored, dislike, and bodily unrest*. The hypothesised extension of this cluster into a chain with *not learn, no education, no job* is clearly stated in this transcript when the ability to calculate and use numbers in everyday and workplace situations – on par with reading and writing – are seen as prerequisites for getting an education and/or a job.

What is the most important thing you have learned in mathematics?

This question was the last in the interview. The students were getting tired and their concentration was waning. The two sets of statements prompted by the question are given in the transcript.

Transcript 4. Extract from 24:41-28:34 mm:ss of group interview 1

596	Troels	Hvad I synes har været mest interessant eller mest spændende eller mest vigtigt [af alt det I har lært i matematik mens I har gået i skole]	What do you think has been the most interesting or the most exciting or the most important [of all that you have learned in mathematics while you have gone to school]
...			
600	Hussein	Det mest spændende det var dengang vi lærte om gange og minus og plus og dividere.	The most exciting was when we learned about times and minus and plus and divide
602	Kalila	Når man kan så er det jo rigtig rigtig sjovt i matematik ik'å'. Hvis man kan alt, gange fem hundrede og fem så er man jo hurtig ik'. Så er det jo sjovt hvis man kan, hvis man nu får et kopiark	When you know then it is really really fun in mathematics isn't it? If you know everything, times five hundred and five then you are quick aren't you? Then it is fun you see if you can, if you get a copy [work] sheet
603	Troels	Så det er sjovt at være god til det	So it is fun to be good at it
604	Isabella	Ja	Yes
605	Kalila	Ja når man er god så er det også sjovt at lave det. Men når man ikke kan så er det kedeligt når man ikke laver det	Yes when you are good then it is also fun to do it. But when you cannot then it is boring when you don't do it
606	Isabella	Hvis man er dårlig til det så er det kedeligt	If you are bad at it then it is boring
607	Kalila	_ når man ikke ved det	_ when you do not know
...			
628	Bahia	... jeg vil lige sige noget. Det der er godt ved matematik det er når man kan det	... I want to say something. What is good about mathematics it is when you know it
629	Troels	... Hvordan kommer man til at kunne	... How do you get to know it?

		det?	
630	Kalila	Det er når man hører efter i timerne	It is when you listen in the lessons
631	Simon	Og øver sig	And practice
632	Bahia	Hvis man kan tabellerne så kan man alt i matematik faktisk.	If you know the tables then you know how to do everything in mathematics actually

Summary of the students' understanding (4)

To learn how to calculate with times, minus, plus and divide has been the most exciting to Hussein. Kalila, Isabella and Bahia think mathematics is fun when you are good at it and know how to do it. If you are bad at maths and do not know how to do it, then it is boring. You learn mathematics by listening in the lessons and practice, especially the times tables.

Common-sense interpretation (4)

Hussein said that the most *exciting* was to learn the four basic rules (601). Kalila, supported by Isabella, said that mathematics was *fun* when you *know* and are *quick* and *good* at it (602-5). When you *cannot*, you are *bad* at it, and it is *boring* and (605-7). So while Hussein reacted to my *what* question by talking about mathematical topics and the accompanying emotion, Kalila (and Isabella) only talked about *how*, i.e. their experiences with learning mathematics. They phrased them in terms of competence/ability (can/cannot or know/not know), emotion (fun/boring) and identity (good/bad at maths). Bahia's succinct statement "What is good about mathematics it is when you know it" (628) is similar to Kalila's and Isabella's in the absence of mathematical content as reasons to their perception of mathematics.

Kalila's perspective (4)

The dialogue repeated and extended the chains discussed in the previous sections. To the chain *fun – like – learn – education – job* is added *excited, know, quick* and *good at maths*. Its negative counterpart *cannot – bored – dislike – unrest – not learn – no education – no job* is supplemented with *boring* and *bad at maths*. With her statement "What is good about mathematics it is when you know it", Bahia seemed to say that school mathematics is about competence as such and not about competence in something, mathematical topics for instance, and possible benefits from such competence. Contrary to her, Hussein gave mathematical subject matter, the basic rules, as sources of his excitement. He indicated no clues to why he found them exciting, and the order in which he listed them was different from the ones that would reflect their mathematical connections (plus - minus, times - divide or plus – times, minus – divide). So, maybe Hussein ascribed the same meaning to school mathematics as Bahia, namely that school mathematics is about competence or mastery of what is considered to be school mathematics. The circularity of this perception begs the question why school mathematics is worthwhile. An answer may be found in Kalila's (and Isabella's) statement. She went a step further than Bahia in pointing to a double meaning of *good*. Kalila seemed to say, "What is good about mathematics is when you know it because then you are good at mathematics", or even more condensed "What is good about mathematics is when you are good at mathematics". As seen in the analysis above, Kalila and the other students were well aware of the function of school mathematics as gatekeeper to her foreground of education and job. Being good at school mathematics promised passing through the gate.

The importance ascribed to the teacher's ticks as a guarantee of Kalila's learning was highlighted in the analysis of transcript 1. This "learning theory" is elaborated in the present transcript when she explained that she would get to know mathematics if she listened in the lessons. In saying so, she paraphrased what the teacher often said. The implication of *listening* was remembering and following the instructions given, like practicing the multiplication tables. Her understanding, the sense she made, seemed to be that the teacher – on behalf of mathematics – has the authority to judge what is right or wrong. You become good at mathematics by getting it right. You get it right by listening to the teacher and doing what you are told. In this coherent understanding of mathematics learning students are ascribed a rather passive role and little space is left for them as active participants.

Relating Kalila's perspective on being in difficulties with mathematics

In this section, I will reflect upon the methodological ideas in this paper, that is interviewing a group of ten to eleven year old students, analysing the interview using the three level interpretation process, and constructing a child's perspective. Finally, I discuss what may be learnt from children in difficulties with learning school mathematics.

The interview with the students was a semi-structured life world interview (Kvale, 1996) with the purpose of obtaining descriptions of the children's experiences with school mathematics learning that would allow interpretations of the meaning that the children ascribed this part of their life. At an interview "technical" level this meant that each main question was followed up by questions or reactions aimed at inviting and supporting the children to tell more, explore the issue further, or test my understanding of what they had said. The transcripts and the analysis show that it was possible to conduct this form of interview with ten to eleven year old students. The dialog let them form and express their point of view about their experiences with learning school mathematics.

The interview was analysed using a rather strict, almost pedantic, interpretation procedure in three levels. This was meant to discipline the interpretation process and make it transparent. The discipline was needed in order to avoid an unknowing conflation of my adult, mathematics teacher, researcher perspective, that is my meaning ascriptions and sense making with those of the children. In the phrasing of the ethnographic research tradition it was an attempt to objectify myself as researcher (see for instance Eisenhart, 1988; Reed-Danahay, 2005; Prieur, 2002).

At the first level of interpretation, the interview showed that the students made sense of their school mathematics in a way that connected multiple dimensions. Summarising their understanding, the students had learned about plus, minus, times, divide and the times tables in mathematics. They felt they learned well when they had times tables of their own choice set for homework, and then had the teacher ask questions from the tables. It was important that the teacher made careful notes of their table knowledge because that testified to them that they had learned mathematics. The way they learned mathematics was by listening in the lessons and through practice. They found mathematics easy when work sheets could be done in a few minutes and difficult if they had to think. When they knew how to do it, they felt good at mathematics and that it was fun. If they could not, they felt it was boring and did not like doing mathematics. They thought that they must learn mathematics in order to get an education and a job.

As seen from the summary, the students' sense making addressed a comprehensive range of questions on what school mathematics is about, what productive ways of teaching are, how they learn, what signs tell them that they are learning, what it is like to learn mathematics, and why they should learn mathematics. Their sense making apparently seamlessly connected their immediate experiences in the classroom with the prospect of their future life into a coherent whole.

The second level of interpretation, added to the children's understanding by pointing to that especially Kalila, sometimes supported by Isabella, addressed the emotional experience of learning mathematics. Also, these two students were particularly observant of the teacher's note practices.

At the third and theoretical level of interpretation Kalila's perspective on school mathematics was constructed. This interpretation presumed that the notion of a child's perspective is an analytical construct. It is not a given, not even in an archaeological sense of dug out bits and pieces from pottery or a dinosaur skeleton that I have put together in an as-sensible-as-possible way because that would assume that an original whole once existed and thus also a right way to put the pieces together. It is my making sense of the interview from the assumption that sense and meaning of school mathematics are not imprinted on a passive child, but the child's active attempt to come to terms with her

experiences with school mathematics and integrate them into a coherent identity and meaningful life world.

What about difficulties – a perspective from a child at the edge

I envisaged that children, who performed poorly in mathematics, could be quite reflective about the norms and expectations at play in school mathematics (Lange, 2007). Because of the high social valorisation of mathematics, school mathematics constitutes an important social norm to students. Children who do not meet the expectations put to them by school mathematics could be expected to become acutely aware of the existence and nature of the norm in a way that children who fulfil the expectations do not. Having their belonging to a highly charged normality like school mathematics questioned would spur their reflective activity concerning their identity and sense making of school mathematics.

Judged from my observations and talks with her in the classes, Kalila struggled with learning mathematics. She did not find it easy and was happy when she succeeded, as was the case with the multiplication tables. Being able to learn mathematics as it was presented to her, was not a given. She could not rest confidently in a feeling of being a sufficiently good mathematics learner.

Kalila was not positioned as disadvantaged in the classroom (Valero, 2007). The school did not categorise her as having special educational needs in mathematics; in fact, the school rarely provided special needs teaching or assistance in mathematics as it did in reading. The new mathematics teacher only later in the school year recognised Kalila as low performing, and – to my eyes – she conducted her teaching without any public ranking of the children according to her perception of their mathematical performances. Still, Kalila was sensitively aware of the consequences of not succeeding with mathematics. In the interview, she was the first to draw attention to the link between learning mathematics and her dreams for her future. A number of times, she was the one who talked about *how* learning mathematics was *experienced*. So even without specific public labelling, Kalila could be seen to consider herself as being “at the edge”. Possibly this precarious position contributed to her being especially reflective and articulate.

Referring to Mellin-Olsen’s distinction between instrumental and social rationales for learning mathematics (Mellin-Olsen, 1987), Kalila’s perspective seemed to include only instrumental rationales and be disconnected from topic related reasons or social rationales for her learning of school mathematics – with money as a possible exception. Kalila and the other students displayed instrumental rationales for learning when they saw school mathematics learning as prerequisite for education and job later in life. The immediate experience of succeeding with the expectations presented by school mathematics, whether times tables to master or work sheets to complete quickly, seemed only to be related to the future, the “vertical” time perspective. To succeed was an experience of being good at mathematics and was felt to be fun; not succeeding was being bad at mathematics and felt to be boring. No other meaning seemed to be ascribed here-and-now, in the “horizontal” time perspective. School mathematics apparently was about being good at school mathematics. This perspective was coherent with Kalila’s “learning theory” – with no inherent meaning ascribed, how could she conceive of learning mathematics in any other way than listening and doing what she was told.

Her perspective “from the edge” highlights that much more than cognitive issues may be at play for children who struggle with learning mathematics. For Kalila a future of her choice was at stake.

Her instrumental rationales for learning school mathematics realistically reflect the socio-political context of schooling and valorisation of mathematics. However, the absence of social rationales is probably not conducive to her learning because it leaves her with no here-and-now meaning and no way of conceiving how her life world, her active imagination and thinking could contribute to her learning of school mathematics, and the other way round. One might speculate if children “at the edge” are especially prone to develop only instrumental rationales and hence that emphasising the importance of mathematics is not helpful to such students. If this is the case, then it is even more

important for students “at the edge” that mathematics education counterbalance the strong socio-political incentives to instrumental rationales by encouraging and facilitating the formation of social rationales for learning school mathematics.

Acknowledgement

I want to thank Naomi Ingram, Tamsin Meaney, and Paola Valero for comments and suggestions for improving earlier versions of this paper and for linguistic assistance.

References

- Eisenhart, M. A. (1988). The ethnographic research tradition and mathematics education research. *Journal for Research in Mathematics Education*, 19 (2), 99-114
- Goodson, I. F. & Sikes, P. J. (2001). *Life history research in educational settings*. Buckingham: Open University.
- James, A., Jenks, C., & Prout, A. (1997). *Theorizing childhood*. Cambridge: Polity Press.
- Kvale, S. (1984). Om tolkning af kvalitative forskningsinterviews. *Tidskrift för Nordisk Förening för Pedagogisk Forskning*, 4 (3/4), 55-66
- Kvale, S. (1996). *InterViews. An introduction to qualitative research interviewing*. Thousand Oaks - London - New Delhi: Sage Publications.
- Lange, T. (2007). Students' perspectives on learning difficulties in mathematics. In L. Ø. Johansen (Ed.), *Proceedings of the 3rd Nordic Research Conference on Special Needs Education in Mathematics*, (pp. 171-182). Aalborg: Adgangskursus, Aalborg Universitet.
- Lange, T. (2008). The notion of children's perspectives. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education*, (pp. 268-277). Department of Education University of Cyprus.
- Mellin-Olsen, S. (1987). *The politics of mathematics education*. Dordrecht: D. Reidel.
- Prieur, A. (2002). At sætte sig i en andens sted. En diskussion af nærhed, afstand og feltarbejde. In M.H.Jacobsen, S. Kristiansen, & A. Prieur (Eds.), *Liv, fortælling, tekst. Strejftog i kvalitativ sociologi* (pp. 135-155). Aalborg: Aalborg Universitetsforlag.
- Reed-Danahay, D. (2005). *Locating Bourdieu*. Bloomington: Indiana University Press.
- Schoenfeld, A. H. (1989). Explorations of students' mathematical beliefs and behavior. *Journal for Research in Mathematics Education*, 20 (1), 338-355
- Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher*, 34 (4), 14-22 25 Oct. 2005
- Skovsmose, O. (1994). *Towards a philosophy of critical mathematics education*. Dordrecht: Kluwer Academic Publishers.
- Skovsmose, O. (2005a). Foreground and politics of learning obstacles. *For the Learning of Mathematics*, 25 (1), 4-10
- Skovsmose, O. (2005b). Meaning in mathematics education. In J.Kilpatrick, C. Hoyles, & O. Skovsmose (Eds.), *Meaning in mathematics education* (pp. 83-100). New York: Springer Science.
- Undervisningsministeriet (2003). *Fælles mål - matematik*. [Kbh.]: Undervisningsministeriet, Område for Grundskolen.
- Valero, P. (2002). Reform, democracy, and mathematics education. Towards a socio-political frame for understanding change in the organization of secondary school mathematics. Copenhagen: Department of Curriculum Research, The Danish University of Education,
- Valero, P. (2007). A socio-political look at equity in the school organization of mathematics education. *ZDM Mathematics Education*, 39, 225-233

Homework and minority students in difficulty with learning mathematics

The influence of public discourse

TROELS LANGE

In this paper, I contrast an immigrant 10 years old girl's perception of her home support and her mathematics teacher's rather different perception. I show how the girl tries to align her perception of her home support with middle class Danish family values, and how the public discourse about immigrants apparently frames the teacher's perception of the resources that are available or not available to the girl. The analysis becomes an example of how mathematics teaching and learning are embedded in a wider socio-political field. It suggests that sometimes resources could be available that schools do not see because students are constructed as disadvantaged.

In recent years, immigrant¹ students' school performances have become subject of concern among politicians, administrators, school authorities etc., as evidenced by the follow up report *Where immigrant students succeed* (OECD, 2006) on the PISA 2003 survey (OECD, 2004), that investigated immigrant students specifically. In many of the participating countries, the average performances of immigrant students were found to be lower, often much lower, than native students. In the case of Denmark, the report showed that immigrant students performed poorly academically. Similar to many other countries, the differences in performance between immigrant and native students could only partly be explained by differences in the socio-economic background of the students including the educational background of their parents. Part of the differences were seen to be related to the students' immigrant status such as whether the

Troels Lange

Aalborg University, Denmark

language spoken at home was the language of instruction, and the age at the time of immigration (for first generation immigrants).

Taken as a group, minority students in Denmark can be seen as under-achievers (Holmen, 2008). The explanation for this underachievement accepted by politicians and bureaucrats determines how it is dealt with. In 2007, a national survey attributed this lower performance in large part to communication patterns and cultural capital of the immigrant families (Rockwool Fondens Forskningsenhed, 2007a). Consequently, the educational policy can be seen as drawing upon a notion of deficiency of the immigrant students and their families with respect to linguistic mastery of Danish and integration in Danish culture (Holmen, 2008).

National PISA surveys, *PISA København–2004* (Egelund & Rangvid, 2005) and *PISA Etnisk 2005* (Egelund, Jensen & Tranæs, 2007) detailed the picture of the school performances of immigrant students of non-Western origin. It was found that the average performance of immigrant students in reading, mathematics, and science was alarmingly poor, worse than expected, and much lower than the average of their fellow native students. Again, the difference could not be fully explained by the generally lower socio-economic circumstances and educational background of the immigrant population compared to the native population. The latter report found that neither could the differences be related to school conditions. No clear difference was found between immigrant and native students' feelings of belonging to the school, their perception of the relation between students' and teachers, and the disciplinary climate. Neither did clear differences arise from the school leaders' assessment of the degree to which the teaching was hampered by student or teacher behaviour, lack of teaching materials and qualified teachers. Rather, according to the report, the explanation was to be found largely in the students' home culture. A newsletter summarising the results of the report to the public illustrates the tone of the message:

The picture is quite clear: It is of little use to look at the schools if you shall find explanations to the relatively weak reading skills among young bilingual [students. See note 1]. [...] [The survey] shows that it is decisive which other language [than Danish] a bilingual student speaks at home. Those who speak Arabic with their parents have a tremendous tendency to lack reading skills [...] The situation is completely different if you speak Punjabi or Urdu [...]

(Rockwool Fondens Forskningsenhed, 2007a, p. 5; my translation)

The home language was seen to be bound up with the family culture understood as types of behaviour and communication. It was found that family support for homework was five times higher in native Danish

families than in immigrant families. Similarly, the levels "social communication" was found to be three times higher and "cultural communication" ten times higher in native Danish families². The parents' income, taken to signify their level of integration in the labour market, also had a great impact on the immigrant students' school performances (Rockwool Fondens Forskningsenhed, 2007a).

The report was given wide attention in the media. The minister of education was "worried", repeated what measures had already been taken by the government addressing the issues, and promised his support to the local authorities (Rockwool Fondens Forskningsenhed, 2007a). The educational spokesperson of the Social Democratic Party (the leading opposition party at the time) concluded that the necessary actions had to start with the parents in the children's homes. Without crossing the threshold of private life, it would not be possible to deal effectively with the problem. The parents had to have a job and become integrated in the Danish society via the labour market. The children had to be "integrated" in the family, the meaning of which was explained as follows:

What does it mean that children are integrated in the family. It is *homes where children are talked to* and not *at*³. It is homes where the parents support the children in their schoolwork with homework. It is homes where you are interested in what each other does and ask after big and small things that have happened during the day, and what you have experienced and thought. And it is homes where the family go on trips together, visit museums, talk about the events of the day on television, the new movies etc. On all the circumstances there is a marked difference in bilingual families and in Danish families.

(Rockwool Fondens Forskningsenhed, 2007a, p. 14;
my translation, italics in original).

A well-respected principal at an inner Copenhagen school with a high proportion of immigrant students agreed to the importance of the communication in the families:

[T]he biggest gap between the Danish and the ethnic children's achievements is in science and that is no surprise, because it is here that it "works through" that there is no conversation culture in most of the ethnic homes.

[...] We must work harder to get the necessary close contact with the families so that we can get the parents to understand how important it is that both mum and dad talk to their children, take interest

in their schooling, attend the meetings at the school, ask about the children's well-being etc.

[...] This survey confirms my contention of the great importance of the dining table! Here it is seen that it is the very way you talk in typical Danish families and in typical ethnic families, that is the "cultural communication", which is ten times higher in a Danish than a in an ethnic family, and here I think, that that is connected with the dining table you gather around every evening versus the individual eating at the coffee table in the ethnic families.

(Rockwool Fondens Forskningsenhed, 2007a, p. 17;
my translation, quotation marks in original)

In these two quotations, it is seen that the idea that immigrant students low school performance was to be explained with reference to presumably cultural features specific of immigrant families was readily accepted. It seemed to resonate strongly with existing presumptions and lent itself easily to further elaboration.

Homework

Mathematics education is a complex social practice (Valero, 2002) of which homework is a part. Homework is a central "meeting place" for school and home. School and home culture, values, norms, expectations, and resources meet with the student/child (student at school, child at home) as the meeting ground. Homework could therefore be seen as a strategy that has the possibility of bridging school practices and family practices in an attempt to both influencing children's school performance and enriching the family involvement and capacity to support children's school life (Anthony & Walshaw, 2007; Civil, Diez-Palomar, Menéndez & Acosta-Irqui, 2008).

However, there are problematic issues with homework as a pedagogical practice. One is whether it helps students' learning. Quantitative studies report little effect of homework on students' achievement in elementary school (Inglis, 2005). Nonetheless homework is recommended with the purpose of fostering "positive attitudes, habits, and character traits; permit appropriate parent involvement; and reinforce learning of simple skills introduced in class" (Marzano & Pickering, 2007; Grade Level section). As the quote illustrates, talk about homework is often embedded in a moralistic language, which takes certain values as given, in this case what is seen as *positive* and *appropriate*. It hides the fact that assigning of homework is also exertion of teacher power over students, a way of controlling students' behaviour in and out of school time, and

a way of asserting school norms and values. In fact, some students think of homework as appropriating their free time (Lange, 2008).

Equity is another problematic issue. Homework interacts in complex ways with the students' dispositions and their social environment. As pointed out by Merttens (1999) the outcome can be quite different from the intended depending on how particular forms of homework interact with the actual contexts in which children manage their homework:

How [homework] is done is more important than that it is done, because the how will make the difference between supporting children's learning and facilitating the collaboration of their parents, or it becoming yet another element in an education system in which the benefits are differentially available, according to socio-economic class, gender or ethnicity.

(Merttens, 1999, p. 79 cited in Anthony & Walshaw, 2007, p. 168)

A third problematic aspect is that homework assignments affect the relationship between children and their parents. Bratton, Civil and Quintos (2005) found this relationship was affected even more when the parents were not fluent in the majority language as shown by the case of Mexican immigrant in USA. Abreu (2005) has shown how some immigrant children have to separate the 'schools way' of doing maths (algorithms) from their parents' way, and Abreu and Cline (2007) argue that children from low socio-economic background develop awareness of the different social valorisations of school culture and their home culture with its mathematical practices.

The issue of whether homework contributes to effectively bridge the gap between school and home is far from easy to resolve. However, the research studies examined above suggest that homework is not a neutral player in school practices. More often than not, it has the potential of evidencing the differential resources that students have at home, and thereby contributing to the construction of some students as disadvantaged. Valero (2007) discussed how advantaged and disadvantaged positions for participation in mathematics education practices are constructed in the school organisation where homework is seen to be an important component. In this paper, I give another example of how mathematics education practices construct disadvantaged positions for some students with particular characteristics. I show how Kalila⁴, a 10 years old second-generation immigrant girl, tries to align her perception of her home support with middle class Danish family values, and how the public discourse about immigrants apparently frames the teacher's perception of the resources that are available or not available to the girl. The analysis becomes an example of how mathematics teaching and learning

is embedded in a wider socio-political field. On one hand, the analysis illustrates that the family resources called upon by homework are very differentially available to children with different backgrounds. On the other hand, it suggests that sometimes resources could be available that schools do not see because students are constructed as disadvantaged.

Methodology

This paper is part of a larger study aimed at exploring students' perspectives on mathematics learning in general and in particular from their experiences of being in difficulties with learning mathematics (Lange, 2007). The empirical material produced in this study is interviews with children aged 10 or 11 years and observations of their mathematics classes. The children were students in a year 4 class in a Danish *folkeskole*, i.e. a public school. There were twenty students in the class with equal numbers of boys and girls as well as an equal number of what the children referred to as *Arabs* or *Danes*. All were born in Denmark and spoke the same local variant of Danish. However, the *Arabs* were descendants of parents emigrated from the Middle East and hence second generation immigrants in official terms (cf. note 1). In the local community, immigrants were a minority. About a quarter of the students at the school had immigrant background. With its even distribution of native Danish and immigrant children, the composition of this particular class was unusual.

The mathematics lessons of the class were observed for almost a complete school year on a more or less weekly basis. Three rounds of interviews were conducted. In the first round, all students but one were interviewed in groups of six or seven students. In the second, approximately half of the students were interviewed in pairs or alone. Half of the students were also interviewed in pairs in the third round. Some students took part in both the second and third round. The interviews lasted from 30 to 45 minutes and were audio recorded; the group interviews were video recorded as well. The students' mathematics' teacher was interviewed in the third round of interviews.

The interviews were semi-structured qualitative research interviews that aimed to explore and understand the experiences and *life world* of students in relation to school mathematics teaching and learning (Kvale, 1996; Goodson, 2005; Goodson & Sikes, 2001). Students that in my judgement, after having seen them in the classroom, could be low performing in school mathematics were generally the ones asked to participate in the pair and single interviews. I assumed that interviewing low

performing students could produce interesting and valuable insights into school mathematics education (see Lange, 2007).

In this paper, I interpret excerpts from three interviews: a single interview with Kalila in the second round; a paired interview with her and another second-generation immigrant girl in the third round; and the interview with the mathematics teacher, also in the third round. Observations and other interviews inform the choice of excerpts and interpretations but are not analysed in this context.

In presenting transcripts, two choices have been made. The first was to quote in some length, and the second to give the original Danish transcript together with a translation into English. The reason for the first choice concerns the difference between the researcher's voice in a summary and the interviewee's own voice (although filtered through a transcription). Goodson and Sikes (2001; ch. 3) discuss this issue and exemplify that in some cases the difference can be dramatic as to the impression the reader gets of the interviewees and their stories. As the interest in this research is on children's perspectives on mathematics education, and as children of the age in question express themselves differently from adults, linguistically, grammatically and from a different perspective, it is important to render their ways of expressing themselves as a starting point of the interpretation.

The Danish transcript is given because that is what is analysed. The transcript is as close as possible to the wording of the recordings. As a translation that conveys the subtleties of a transcript of children's spoken Danish into what could be a transcript of children's spoken English is neither simple nor always possible, a rather literal translation has been chosen at the expense of what might be considered good English by native speakers of one of the versions of this language.

Homework support

In many of the mathematics classes I observed, the teacher would assign the students to work on a number of problems and their homework would be what they did not finish in the lesson. According to my experience as teacher educator, this practice is very common in Danish classrooms and not specific to this particular teacher. All the same, it constructed homework as a sort of punishment for not being on task, quick, able, knowing what to do, listening to instruction, etc.

In the following, I first present how Kalila perceives the support she gets at home for her homework, and how the teacher perceives it, and continue with Kalila's perception of how her big sister helps her. The argument will be that the help Kalila receives from her sister seems

appropriate. Second, I will present how the teacher perceives the language knowledge of the immigrant children and explain this with reference to patterns of communication in immigrant families. I will show how the teacher's perception echoes explanations "floating around" in the public discourse presented above. Third I will discuss how both Kalila and the teacher can be seen as aligning with the conception of normality in the majority Danish culture.

In the first interview with Kalila, I asked her if somebody helped her with her homework. The transcript⁵ gives the dialogue and shows the style of interviewing.

Transcript 1. Interview with Kalila November 2006 (36:04–36:50)

	Original Danish transcript	Translated English transcript
1 Troels	Er der nogen der hjælper dig når du laver lektier?	Is there somebody that helps you when you do your homework?
2 Kalila	Det er min far	It is my dad
3 Troels	Det gør din far. Ok. Gør han det hver dag eller engang imellem?	Your dad does. Ok. Does he do that every day or sometimes?
4 Kalila	Altså det er også min storesøster	That is, it is also my big sister
5 Troels	Også din storesøster, ja	Also your big sister, yes
6 Kalila	Mest min storesøster	Mostly my big sister
7 Troels	Mest din storesøster, ja	Mostly your big sister, yes
8 Kalila	Fordi min far han er sådan mest i forretningen (ja, ja). Man kan godt sige det er min storesøster	Because my dad he is like mostly in the shop (yes yes). You can pretty well say it is my big sister
9 Troels	Ja ok. Hvornår gør din far det?	Yes ok. When does your dad do it?
10 Kalila	Altså det er når - for nogle gange der sådan sådan stopper inde i forretningen (ja) - så så når han er hjemme tidligt eller træt og sådan noget så hjælper han mig	Well that is when - 'cause sometimes then like like [he] finishes in the shop (yes) - then then when he is at home early or tired or like that then he helps me
11 Troels	Ja ok. Ellers er det mest din storesøster der hjælper dig?	Yes ok. Otherwise it is mostly your big sister that helps you?
12 Kalila	Ja	Yes

Homework and minority students in difficulty with learning mathematics

- | | | | |
|----|--------|--------------------------------------------------------------------------|-----------------------------------------------------------------|
| 13 | Troels | Ja ok. Siger du hun går i 10. klasse? | Yes ok. Do you say that she is in Year-10? |
| 14 | Kalila | Jeg tror det er tiende eller gymnasiet (ok) det kan jeg altså ikke huske | I think it is ten or the gymnasium (ok) I really don't remember |

The transcript shows that Kalila's big sister helps her with her homework (4–12; here and in the following, numbers in brackets refer to line numbers in the transcript). Her sister is in year-10 or the gymnasium (upper secondary school) (13–14). Sometimes her father helps her (2, 10). In her family Kalila was the fourth of six children; her sister was the eldest of the siblings and being in her tenth school year she was probably 16–17 years old.

Kalila's story about who is helping her with her homework developed from "it is my dad" (2) to "also my big sister" (4) to "mostly my big sister" (6) and ended with "you can pretty well say it is my big sister" (8) – with the addition that her father occasionally helped her (10). A discussion of how this may be aligning with perceptions of the type of help she was supposed to get at home occurs in the final section of the paper.

In the interview with the mathematics teacher, I asked her to group the students in three groups according to their mathematical competence. Five of the seven children in the group with the least competence were minority children. The teacher saw a clear connection to family support in that four of the five minority children in her view had little support to their school work. Kalila and another student had no support: "There is no backing, there is nothing at all". The two other children had only little support: "If there is anybody that helps then it is often a big sister".

The teacher's general opinion seemed to be that parents should help their children with their homework and that big sisters were not appropriate helpers. She was apparently unaware that Kalila's big sister was helping her. At 16 to 17 years old, the sister was a young adult and contrary to Kalila's parents, she had gone to school in Denmark and could be supposed to know the school culture and the social practices of mathematics education in the Danish *folkeskole* much better than her parents did.

In a later interview with Kalila and Maha, also an immigrant student, big sister help with homework was confirmed as normal practice. The girls contributed details about the form of help they received. The interview took place about the same time as the interview with the teacher quoted above.

Transcript 2. Interview with Kalila and Maha May 2007 (15:18–16:39)

- 15 Troels Er der nogen der hjælper dig Is there somebody that helps
med lektier der hjemme? you with your homework at
home?
- 16 Kalila Ja Yes
- 17 Maha Min storesøster My big sister
- 18 Troels Din storesøster ja Your big sister yes
- 19 Kalila Altså ved mig er der, er det ikke You see by me there is, is it not
hun laver det for mig men she makes it for me but [she
does not do it for me]
- 20 Maha Nej. Hvis der nu er noget jeg No. If there is something I
ikke kan, altså den der (en cannot, that [a problem in the
opgave i deres lærebog) den textbook] that I did not quite
forstod jeg ikke helt (nej ok) så understand (no ok) then my big
forklarer min storesøster det sister explains it (well ok)
(nå ok)
- 21 Kalila Altså for eksempel hvis nu For example now if we take for
tager vi for eksempel, hvis det example, if it was for example
var for eksempel to plus to for two plus two (yes ok) yes and
eksempel (ja ok) ja og så [siger] then she [says] what is two plus
hun hvad er to plus to. Og der two. And there are many prob-
er mange regnestykker af dem lems [of that sort?](mm). Aren't
(mm). Ikke _ fem plus fem. Og there _ five plus five. And then
så prøver hun at forklare mig she tries to explain it to me so
det så tager hun et stykke papir. she takes a piece of paper. "You
"Du har to, og du plusser to have two, and you plus two
mere" altså sådan to tre more" that is two three
- 22 Maha "Hvad er et plus et?" "What is one plus one?"
- 23 Kalila Ja. Og så hvad er, hvis du skal Yes. And then what is, if you
sige et plus et, det ved jeg ikke. shall say one plus one, I don't
hvis jeg nu vidste det, det er to. know that. If I knew, it is two.
"Så gør det to gange". "Et plus et" "Then do it two times". "One
det er to". "Et plus et det er to". plus one that is two". "One plus
Så giver det jo fire. Så laver hun, one that is two". So that makes
så hjælper hun mig, med mig four. Then she makes, then she
med det første og så _ andre og helps me, with me with the
så har jeg forstået det first and then _ the others and
then I have understood it

24	Troels	Så jeres storesøster de er sådan, de gør ligesom et lærer ville gøre lyder det til. Er det rigtigt?	So your big sisters they are like, they do like a teacher would do, it sounds. Is that right?
25	Maha	Ja	Yes
26	Kalila	Jaah (trækker lidt på det?)	Yeah [hesitating a little?]
27	Troels	Ja mm ja	Yes mm yes
28	Maha	Altså _ altså "To plus to hvad er det?" "Det er fire." "Så skal du bare skrive det ned"	You see _ you see "two plus two what is that?" "It is four." "Then you just write it down"

An elder sister helps both Kalila and Maha with their homework (15–19) when they need it (20). The sisters explain the problems in the textbook (20) and ask them questions to make them understand (21–23) so that they can do the tasks by themselves (23).

To these two girls, big sister help was an established way of dealing with their homework. Their description indicated that their sisters attempted to activate knowledge relevant to the situation (21–23, 28) and thus took on a teacher-like approach (24–26). The sisters seemed to have reflected on their role as helper. Kalila had considered the kind of help she had from her sister. This can be seen when, on her own initiative, Kalila pointed out that her sister did not do her homework (19) but instead asked her questions to support her understanding (21, 23, 28). Thus, the support the girls got from their sisters seemed relevant, sensible and considered, and not different from the support native Danish parents could be expected or hoped to give to their children⁶.

Influence of public discourse

As seen above, the teacher felt that Kalila received no support from her home. This raises the question about why the teacher did not recognise the resources actually present for Kalila in her family even if she did not think of big sisters as proper homework supporters. In this respect, the teacher's general view on immigrant students is informative.

In the interview, the teacher said that the bilingual children's knowledge of words and concepts was much less than the Danish children's knowledge. She saw this as a consequence of communication patterns in the families.

And that is logical indeed because these words - generally I do not at all think that bilingual parents talk with their children as Danish parents do. They don't get talked - they get talked *at*, but I don't think they get talked *to*. That you sit down and say, "this is a blue

car and the car says broom". I don't think – it is my feeling that it does not happen at all. (Interview with teacher, May 2007)

In other words, the teacher assumed that the communication between children and parents in immigrant families was less dialogic and more directive compared to native Danish families. She further assumed that this led to immigrant children being less competent in academic Danish than native students were. Hence, the teacher endorsed the same explanation for immigrant students' school performance as the report described in the introductory section (Rockwool Fondens Forskningsenhed, 2007a). The core of her argument (children getting *talked at* versus *talked to*) was the same phrasing as used by the spokesperson of the Social Democratic Party. Thus, the teacher's perception was not her personal idiosyncratic construction of an explanation for her experiences as a teacher of immigrant students. Rather, her assertion can be interpreted as a voicing of the dominant public discourse at the time. The image of immigrant families as deficient does not support an awareness of other possible resources (Alrø, Skovsmose & Valero, 2008), and this might explain why the teacher did not recognise them in the case of Kalila.

In the Danish PISA-reports the immigrant students are reported – on average – to get less help from their parents and to draw on a wider range of other resources, such as, siblings, friends, homework cafes, libraries, to support their homework compared to the native students (Egelund et al., 2007; Egelund & Rangvid, 2005). Kalila and Maha exemplified this. As often seen in immigrant families of non-Western origin there were more children in their families than usual in native Danish families. Being among the younger children in their family, they had older siblings that had gone to Danish primary, lower secondary, and perhaps upper secondary school. In the interview, the teacher described Maha's big sister as a "bright and really intelligent" student. Thus, it would seem that they were well qualified for helping their younger siblings because of their knowledge of Danish and familiarity with the implicated norms and values of the Danish *folkeskole*. Compared to their parents, these sisters were likely to be better with academic Danish and insights into the social practices of Danish school mathematics. Hence, letting big sisters provide homework support for younger siblings could be seen as a sensible and responsible disposition for immigrant families in supporting their children's schooling. In addition to this general argument, the concrete help provided by the sisters of Kalila and Maha seemed to be in accord with that provided at school.

Normality and difficulties

The dominant discourse explaining non-Western immigrant students' academic performances by deficiencies in their families and normalising parental support for homework seemed to affect Kalila as well as the teacher. To the teacher the discourse corresponded to and allowed the expression of her frustrating experiences with immigrant students. It also seemed to make her overlook resources actually available to some students like the apparently competent sisters of Kalila and Maha.

For Kalila, the public discourse could have resulted in non-recognition of the support her family provided for her. The discourse required parents to help their children with their homework, and the absence of such help was taken as an expression of lacking interest in their children's school attendance. Kalila told a story about her father helping her when generally it was her sister. A possible interpretation is that Kalila had perceived the Danish majority definition of proper homework support and that she tried to position herself and her family as normal in this respect. She seemed to align her perception of homework support with the dominant discourse in spite of the fact that this did not recognise and valorise her actual support. Instead, it constructed her parents as inadequate because they did not personally help her with homework. If this interpretation is valid, it is an example of homework as a meeting place between school and home, in this case a meeting of conflicting norms about how families should operate. Placed at the intersection of school and home, Kalila bears the burden of having the support her family provides for her devalued by the dominant discourse.

My observations suggested that it was not easy for Kalila to learn school mathematics. She struggled and only achieved limited success. It seems reasonable to contend that recognition of her home support may have been useful in providing her with extra support. This would be the argument from an inclusion perspective, which implies moving the focus from shortcomings of individual students to structures, attitudes, social and pedagogical practices that hinder students' participation in the school and learning community (Booth, Ainscow, Baltzer & Tetler, 2004). A recent evaluation of the education of bilingual students in the Danish *folkeskole* recommended schools to reorganise and develop their practices to better include immigrant students (Danmarks Evalueringsinstitut, 2007). Other researchers criticised the *PISA Etnisk* report for tacitly assuming that the school is a culturally and socially neutral space. The demands made on families are culturally dependent and require a certain normality to fulfil. The school as an institution tends to recognise "white" middle class children's experiences and overlook the experiences of immigrant children (Gilliam & Gitz-Johansen, 2007).

Becoming aware of the mechanisms by which immigrant students are constructed as disadvantaged could open up the development of practices that better facilitated immigrant students' learning of mathematics. As homework is contested in respect of learning outcome and hits students very differently, a serious reconsideration of homework as a pedagogical practice seems to be justified. However, reconstructing discourses about immigrants and homework is the responsibility of governments, politicians, school authorities, and the public and not the sole responsibility of individual teachers.

Afterword

Four months after the release of the *PISA Etnisk* report an erratum was announced. It had turned out that the conclusion about the communication in immigrant families was incorrect. Instead, the general picture was that Danish immigrant youth talked a little more with their parents than in an average OECD family, yet still less than in average native Danish families do. Hence the main explanation for the immigrant students' lower school performances now was the immigrant parents' on average weaker position as to education, income and labour market status (Rockwool Fondens Forskningsenhed, 2007b).

Acknowledgement

This is a revised and extended version of a paper presented in Topic study group 7 at ICME 11 in Mexico, July 2008.

I wish to thank an anonymous reviewer for helpful comments, Tamsin Meaney for 'washing' my English, and Paola Valero for comments and discussion of previous versions of the paper.

References

- Abreu, G. de (2005). Cultural identities in the multiethnic mathematical classroom. In M. Bosch (Ed.), *Proceedings of the Fourth Congress of the European Society for Research in Mathematics Education*, (pp. 1131–1140).
- Abreu, G. de & Cline, T. (2007). Social valorization of mathematical practices: the implications for learners in multicultural schools. In N.S.Nasir & P. Cobb (Eds.), *Improving access to mathematics: diversity and equity in the classroom* (pp. 118–131). New York: Teachers College Press.

- Alrø, H., Skovsmose, O. & Valero, P. (2008). Inter-viewing foregrounds: students' motives for learning in a multicultural setting. In M. César & K. Kumpulainen (Eds.), *Social interactions in multicultural settings*. Rotterdam: Sense Publishers.
- Anthony, G. & Walshaw, M. (2007). *Effective pedagogy in pāngarau/ mathematics: best evidence synthesis iteration (BES)*. Wellington: New Zealand Ministry of Education. Retrieved January 14, 2009 from <http://www.educationcounts.govt.nz/publications/series/2515/5951>
- Booth, T., Ainscow, M., Baltzer, K. & Tetler, S. (2004). *Inkluderingshåndbogen*. København: Danmarks Pædagogiske Universitet.
- Bratton, J., Civil, M. & Quintos, B. (2005). Engaging with parents on a critical dialogue about mathematics education. In M. Bosch (Ed.), *Proceedings of the Fourth Congress of the European Society for Research in Mathematics Education* (pp. 1182–1192). Retrieved January 14, 2009 from http://ermeweb.free.fr/CERME4/CERME4_WG10.pdf
- Civil, M., Díez-Palomar, J., Menéndez, J. M. & Acosta-Iriqui, J. (2008). Parents' interactions with their children when doing mathematics. *Adults Learning Mathematics: An International Journal*, 3(2a), 41–58.
- Danmarks Evalueringsinstitut (2007). *Undervisning af tosprogede elever i folkeskolen*. København: Danmarks Evalueringsinstitut. Retrieved January 14, 2009 from <http://www.eva.dk/projekter/2006/tosprogede-elever-i-folkeskolen>
- Danmarks Statistik (2007). *Indvandrere i Danmark 2007*. København: Danmarks Statistik. Retrieved January 14, 2009 from www.dst.dk/ebog/indvandereidk
- Egelund, N., Jensen, P. & Tranæs, T. (2007). *PISA Etnisk 2005: kompetencer hos danske og etniske elever i 9. klasser i Danmark 2005*. København: Rockwool Fondens Forskningsenhed.
- Egelund, N. & Rangvid, B. S. (2005). *PISA-København 2004*. København: PISA-konsortiet og Københavns Kommune. AKF forlaget.
- Gilliam, L. & Gitz-Johansen, T. (2007). PISA etnisk – spiller skolen ingen rolle? *Dansk pædagogisk tidsskrift*, 2007 (3), 74–77.
- Goodson, I. F. (2005). Lærende liv. In R. Ådlandsvik (Ed.), *Læring gjennom livsløpet* (pp. 77–100). Oslo: Universitetsforlaget.
- Goodson, I. F. & Sikes, P. J. (2001). *Life history research in educational settings*. Buckingham: Open University.
- Holmen, A. (2008). Dansk som andetsprog i den flerkulturelle skole. In J. Bundsgaard (Ed.), *Positioner i danskfagets didaktik*. (CURSIV nr. 2 2008) (pp. 59–76). Institut for Curriculumforskning, Danmarks Pædagogiske Universitetsskole ved Aarhus Universitet. Retrieved January 14, 2009 from <http://www.dpu.dk/site.aspx?p=12829>

- Inglis, S. (2005). *A two-way street: homework in a social context*. Centre for Education, Auckland College of Education. Retrieved October 29, 2007 from http://www.education.auckland.ac.nz/uoa/fms/default/education/docs/word/research/foed_paper/issue15/ACE_Paper_8_Issue_15.doc
- Kvale, S. (1996). *InterViews. An introduction to qualitative research interviewing*. Thousand Oaks: Sage Publications.
- Lange, T. (2007). Students' perspectives on learning difficulties in mathematics. In L. Ø. Johansen (Ed.), *Proceedings of the 3rd Nordic Research Conference on Special Needs Education in Mathematics* (pp. 171–182). Adgangskursus, Aalborg Universitet.
- Lange, T. (2008). The notion of children's perspectives. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education* (pp. 268–277). Department of Education, University of Cyprus: European Society for Research in Mathematics Education.
- Lange, T. & Meaney, T. (2008). *I actually started to scream: doing school mathematics homework*. Manuscript submitted for publication.
- Marzano, R. J. & Pickering, D. J. (2007). The case for and against homework. *Educational Leadership*, 64(6), 74–79. Retrieved October 29, 2007 from <http://www.marzanoandassociates.com/pdf/homework.pdf>
- Merttens, R. (1999). Family numeracy. In I. Thompson (Ed.), *Issues in teaching numeracy in primary schools* (pp. 78–90). Buckingham: Open University Press.
- OECD (2004). *Learning for tomorrow's world. First results from PISA 2003*. Paris: OECD.
- OECD (2006). *Where immigrant students succeed – a comparative review of performance and engagement in PISA 2003*. Paris: OECD.
- Rockwool Fondens Forskningsenhed (2007a). *Nyt fra Rockwool Fondens Forskningsenhed maj 2007*. København: Rockwool Fondens Forskningsenhed. Retrieved January 14, 2009 from <http://www.rff.dk/da/publikationer/nyhedsbreve/2007>
- Rockwool Fondens Forskningsenhed (2007b). *Nyt fra Rockwool Fondens Forskningsenhed september 2007*. København: Rockwool Fondens Forskningsenhed. Retrieved January 14, 2009 from <http://www.rff.dk/da/publikationer/nyhedsbreve/2007>
- Shumow, L. (2003). The task matters: parental assistance to children doing different homework assignments. *The School Community Journal*, 13(2), 7–23.
- Valero, P. (2002). *Reform, democracy, and mathematics education. Towards a socio-political frame for understanding change in the organization of secondary school mathematics*. Copenhagen: Department of Curriculum Research, The Danish University of Education.

Valero, P. (2007). A socio-political look at equity in the school organization of mathematics education. *ZDM. The International Journal on Mathematics Education*, 39, 225–233.

Notes

- 1 The OECD terminology is used the paper. "*Native students* or non-immigrant students: Students with at least one parent born in the country of assessment. [...] *Immigrant students*: This group includes both first-generation students and second-generation students [...] *First-generation students*: Students born outside of the country of assessment whose parents are also foreign-born. *Second-generation students*: Students born in the country of assessment with foreign-born parents" (OECD, 2006, p. 14; my italics).

This terminology correspond to that of the Danish Statistical Bureau (Danmarks Statistik, 2007). In Danish educational settings, the standard term is *bilingual children*, which is defined in the Danish folkeskole Act as "children who have another mother tongue than Danish, and who only learn Danish by contact with the surrounding society, possibly through education of the school," (FL § 4a, stk. 2, my translation)

- 2 Social and cultural communication was measured by indices formed from the students answers to the questions "How often does your parents: a. Discuss how you are at school? b. Sit and eat a main meal together with you? c. Take time to talk to you?" and "a. Discuss political or social issues with you? b. Discuss book, films, or television programs with you? c. Listen to classical music with you? (Egelund et al., 2007, p. 73; my translation)
- 3 The difference between the Danish expressions, "tale med" and "tale til", translated here to "talk to" and "talk at", is that the first implicates dialogue whereas the second signals directive monologue.
- 4 Names are pseudonyms.
- 5 In the transcript small sounds or comments by the listening person are indicated by (), hyphens (-) signal pauses, commas that the speaker starts again on a sentence, underscore (_) inaudible words, and three dots (...) shows where bits of dialogue has been left out.
- 6 I am not aware of research about how Danish parents interact with their children in respect to homework in mathematics. In my interviews, there are a few indications ranging from a mother practicing multiplication tables with her daughter in a pleasant atmosphere, to recurring conflict-ridden situations with a father 'helping' his daughter in a rather directive way (Lange & Meaney, 2008). The US parents in a study by Shumow (2003) tended to be quite directive in their help with arithmetic homework.

Troels Lange

Troels Lange is a senior lecturer in mathematics at VIA College of Education and a Ph.D. student at Aalborg University. His research interest are children's perspectives on mathematics teaching and learning, especially on learning difficulties in mathematics.

Department of Education, Learning and Philosophy
Aalborg University
Fibigerstræde 10
9220 Aalborg
Denmark
tl@learning.aau.dk

Sammendrag

I artiklen modstilles en 10-årig piges opfattelse af den støtte hun får fra sit hjem og hendes matematiklæreren noget anderledes opfattelse. Pigen tilhører en minoritet i Danmark idet hendes forældre er indvandret fra Mellemøsten. I artiklen vises dels hvordan pigen prøver af tilpasse sin opfattelse af sit hjemms støtte til den indfødte danske majoritets normalitetsforestillinger, og dels hvordan den offentlige diskurs om immigranter tilsyneladende former lærerens opfattelse af de ressourcer pigens familie råder over. Analysen er et eksempel på hvorledes matematikundervisning er indlejret i et socio-politisk felt. Den antyder at der kan være ressourcer til stede i minoritetsbørns familier som skolen ikke har øje for, fordi den offentlige diskurs konstruerer minoritets elever som underprivilegerede.

IF A QUARTER CRASHES, SO IT DIES: CHILDREN'S MEANING MAKING IN MATHEMATICS LESSONS

Troels Lange, Aalborg University and Tamsin Meaney, Charles Sturt University

In this chapter, we present extracts from two classrooms in Denmark and New Zealand and discuss how the children made sense of mathematics activities. From a premise that children were constantly involved in meaning making, we explore how the ways, which mathematics activities were constituted, influenced the meaning that children ascribed to them. We widen the discussion to look at whether information about children's backgrounds obscures or enlightens our understanding, as researchers, of this meaning making process. In understanding the children's ascription of meaning to mathematical activities, we conclude that what is important is how children enact their agency, as a consequence of interpreting past, present and future activities.

INTRODUCTION

Over the last century, research has highlighted a variety of contributions to the process of gaining mathematically valuable learning. In this chapter, we use classroom excerpts from two countries to consider how children's interpretations of mathematical activities affect their meaning ascription. We speculate on how knowing more about the backgrounds of the children can alter our impressions as researchers about the meaning making process. Our suggestion is that, like classroom norms, children's background is one of a myriad of conflicting influences on whether they gain mathematically useful learning from participating in classroom activity. In order to understand how meaning is ascribed to mathematical activity and whether it is likely to lead to the gaining of valuable mathematical understanding, we instead need to look at how children enact their agency.

Efforts to improve students' mathematical learning in classrooms have been of concern since mathematics education research began. For example, Hamilton (1924) who reviewed Thorndike's books *The Psychology of Arithmetic* (1922) and *Psychology of Algebra* (1923) noted that British teachers reformed their teaching based on common sense approaches and a general feeling for the aims of school mathematics, whereas their American peers based their reforms on the results of psychological experiments. Although he believed that both approaches were problematic, he felt that the American approach resulted in too much emphasis being placed on the "relatively mechanical aspects of learning" (p. 174). This did not lead to what he considered to be valuable mathematics.

Throughout the twentieth century, researchers continued to try to identify features associated with teachers or teaching that contributed to students learning valuable mathematics. Skemp (1976) proposed that mathematics teachers could be divided into two groups. One group taught for *instrumental understanding* and concentrated on students possessing rules and being able to apply them. The other

group taught for *relational understanding* – “knowing what to do and why” (p. 21). This required students to understand conceptually and to link this understanding to other mathematical concepts. He considered this type of understanding to be the most valuable for students’ ongoing learning of mathematics.

Didactical contract – widening the perspective to interactions

Another aspect that received attention was the mutual and mostly tacit understanding between teachers and students about what constitutes an appropriate approach to mathematics teaching and learning. This was conceptualised as a *didactical contract* by Brousseau (Brousseau, Balacheff, Cooper, Sutherland, & Warfield, 1997) and as *classroom social norms* by Cobb, Stephan, McClain and Gravemeijer (2001). Blomhøj (1995) stated that for teaching and learning to occur, a didactical contract needs to be in place between the teacher and students. This type of contract frames the activity and interactions in the classroom. It develops over time from a balancing of the parties’ different positions, obligations, and perspectives. Consequently, the teacher organises the teaching in ways that are compatible with these regulations and the students’ mathematical and socio-psychological background. The teacher evaluates the students’ learning and the students on their part do their best to fulfil the requirements made of them. Blomhøj (1995) saw the relationship between teacher and students and an avoidance of failure as the forces driving the development and maintenance of a didactical contract:

The mutual dependence between teacher and student ... lead to both the teacher and student having a strong incentive to succeed with their shared project: *the student’s learning*. The interplay between teacher and students may be restricted in a range of ways and degrees, for example, physical conditions and time limitations, the difficulty and importance of topics, the teacher’s and the students’ mathematical basis, curriculum and exam provisions, their own expectations and those of the environment. The fewer degrees of freedom that are at their disposal in this project, the more both parties will focus on avoiding failure – that is, recognition that the learning project has failed. In the course of time, with this charged atmosphere as a driving force, a didactical contract is built between teacher and students through the teaching. The observance of this contract in a sense may be said to constitute an insurance against the learning project ending in failure – at least for the great majority of the students (Blomhøj, 1995, p. 17; translated by TL, italics in original).

The notion of the didactical contract originated within the French school of “Didactique des Mathématiques” and linked to the theory of didactical situations of Brousseau (Brousseau et al., 1997; Wedege & Skott, 2007). Balacheff (1990) loosened this linkage to more generally include the social interactions:

The rules of social interaction in the mathematics classroom include such issues as the legitimacy of the problem, its connection with the current classroom activity, and the responsibilities of both teacher and pupils with respect to what constitutes a solution or to what is true. We call this set of rules a *didactical contract*. A rule belongs to the set, if it

plays a role in the pupils' understanding of the related problem and thus in the constitution of the knowledge they construct. (p. 260; italics in original)

In contrast to Balacheff (1990), Blomhøj (1995) emphasised the socio-political framing and the social-psychological dynamics of the social interaction. According to Blomhøj (1995), the didactical contract constructed in traditional mathematics teaching implied that:

- the teacher carefully goes through the methods and algorithms that are presented in the textbook,
- the teacher only sets problems which the students have got tools to solve beforehand,
- a problem is solved when its component questions are answered,
- the required answers can be brief, for example a number, a figure or at most a short sentence,
- the students have a right to get the teacher's judgment when a problem is solved,
- the students' learning is judged only from whether they can solve the posed problems,
- the students on their part do their best to solve the posed problems (p.17-18. Lange's translation).

However, the establishment of a set of rules of the game does not eliminate all misunderstandings. All students in a class may not hold the same perspectives, and 'rules' that work for most students may not work for all. In regard to instrumental and relational understanding, Skemp (1976) mentioned two types of mismatches. One is a student who aims for instrumental understanding while the teacher teaches for relational understanding. The other is the reverse. For a child who wants one kind of understanding, but is facilitated at school into developing the other, the consequences can be frustration and possible damage to the student's learning (Skemp, 1976).

Didactical contracts are rarely discussed explicitly, so mismatches can occur without any awareness by participants. Especially when the teacher and students are new to each other, they may not know how much they share perspectives and even that there may be different perspectives to consider. When participants hold their own perspective as the 'natural' one, then it is not negotiable. Herbel-Eisenmann (2003) described how misunderstandings endure for a long time without participants ever being aware that differences existed.

School learning of whatever type requires a meeting of two agents, teachers and students, and thus the co-ordination of the different processes of teaching and learning. The didactical contract facilitates this co-ordination. If an undiscussed didactical contract is in place, then unexpected outcomes may occur. For example, Cobb, Wood, Yackel and McNeal (1992) suggested that in one classroom that they filmed, the students came "to view mathematics in school as an activity that involves manipulating symbols that do not signify anything when their teachers would honestly like them to learn with understanding" (p. 581). Nuthall (2007) stated that

students do not learn content as such, but rather learn about what constitutes classroom activity – “students learn what they do” (p. 36). Doing exercises from a textbook, using concrete equipment, or fighting to gain the teacher’s attention can be the understandings that children learn, rather than the actual knowledge of how subtraction or addition works. For Nuthall (2007), successful teaching was only likely to occur if the teacher made use of knowledge of students’ own culture, such as their friendship groupings as well as fashion and music interests.

As agents in their own lives, students continually make sense of the activities in which they are engaged. Seeing education as a meeting of agents, highlights the ‘spaces’ that learning environments provide for students’ agency to unfold in relation to learning activities. The question then is how does the existing didactical contract impede or support the active involvement of the learner?

Discussions about the didactical contract have concentrated on what happens in classrooms. However, Herbel-Eisenmann (2003) was critical of approaches that only focussed on the socio-cultural environment of the mathematics classrooms:

[A]t least two components that seem to be important to understanding mathematics classrooms are not addressed: 1) students are part of other communities of practice that influence how they come to participate and be part of the schooling system (or not) ... and 2) teachers typically know a lot about the context in which they teach and this knowledge effects what they do/say in their classrooms (Herbel-Eisenmann, 2003, p. 9).

Valero (2004) went further by criticising the discursive constructions of students as ‘schizomathematicslearner’. She felt that in most mathematics education research reports, students were seen as mainly cognitive subjects, neither fully human nor social beings situated “in a particular historical time, geographical location, and social position” (p. 44). She proposed “a ‘realized’ view of students as whole learners, who have multiple motives for learning, and who live in a broad context which influences their intentions to participate in school mathematics practices” which would help “recognize the *agency* that students have in the whole educational enterprise” (p. 48; italics in original).

For students to learn valuable mathematics such as relational understanding, it is not just a matter of the teacher providing ‘good teaching’. Teaching and learning is complicated and requires teachers and students to share a set of perspectives about the learning process and about mathematics. Although understanding the contribution of classroom practices to this process provides valuable information, there is also a need to explore other contributing factors outside the immediate classroom situation.

ASCRIBING MEANING IN CLASSROOM MATHEMATICAL ACTIVITIES

In recent times, research into mathematics education has shown that classroom learning cannot be extrapolated from its surroundings. Figure 1 illustrates the ideas of

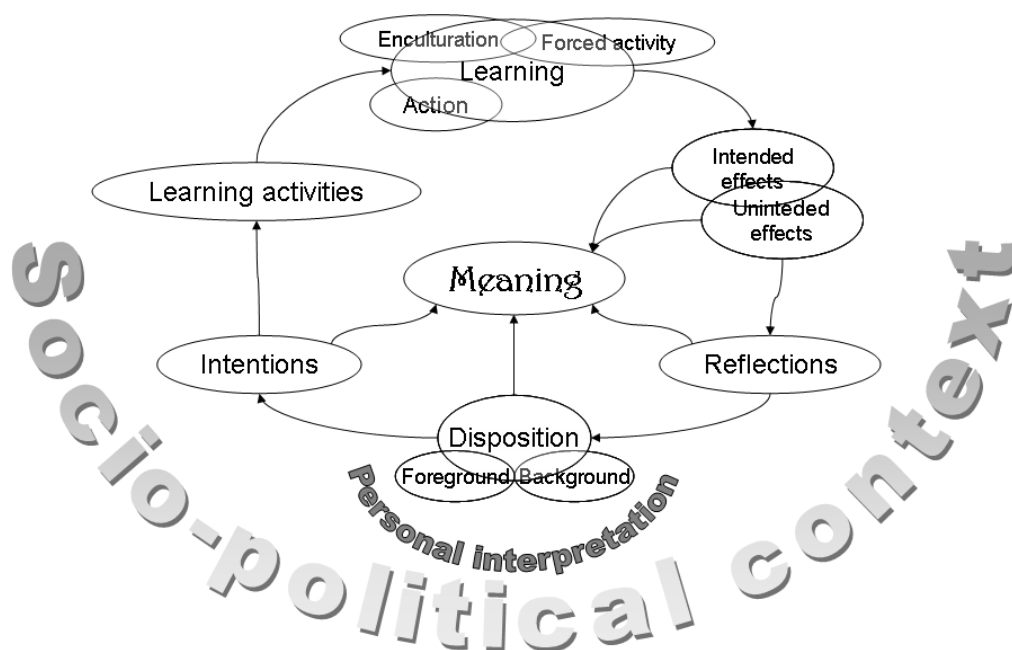


Figure 1. An illustration of the complexity of meaning in learning

Ole Skovsmose, who in writing with Helle Alrø, provided a comprehensive description of how the ascribing of meaning to different activities is influenced by a number of different components. Skovsmose (2005b) wrote “[m]eaning in learning comes to refer to a relationship between the dispositions of the learner, the intentions of the learner, the intended and unintended effects of learning activities, and the learner’s reflections on these effects” (p. 93).

Figure 1 shows how Skovsmose (2005a) related dispositions to the socio-political situation:

By the *foreground* of a person I understand the opportunities, which the social, political and cultural situation provides for this person. However, not the opportunities as they might exist in any socially well-defined or ‘objective’ form, but the opportunities as perceived by the person. Nor does the background of a person exist in any ‘objective’ way. Although the background refers to what a person has done and experienced (such as situations the person has been involved in, the cultural context, the socio-political context and the family traditions), then background is still interpreted by the person. Taken together, I refer to the foreground and the background of a person as the person’s *dispositions*. (p. 6-7)

The dispositions of a person “embody propensities that become manifest in actions, choices, priorities, perspectives, and practices” (Skovsmose, 2005a, p. 7). These propensities may be contradictory because the person may conceptualise different foregrounds and backgrounds at different times and situations.

In the centre of Figure 1, dispositions are interconnected with intentions, learning environments and reflections on effects of learning activities, to contribute to students' development of meaning. Alrø and Skovsmose (2002) were interested in learning as action. They took intentionality as a defining element of action, thereby separating action from mere activity. If the learning situation allowed the active involvement of students, the resulting learning process could be one of action. Students identify with the intentions of the learning activity, and thus joint ownership and shared perspectives between teacher and students could develop. Intentional learning acts constitute forms of learning that are described as action. The meaning ascriptions resulting from learning-as-action would be different to those where students do not engage willingly.

Alrø and Skovsmose (2002) did not believe that all learning came from the active involvement of the learner. Much learning, including what occurs in schools, happens by enculturation or assimilation, where children adopt knowledge or skills without much awareness that they have done so. In everyday life, the acquisition of a first language would be a prime example of this. In schools, Nuthall's (2007) finding that children first of all learn what they do is evidence of such forms of learning. In situations where the learner has no say in what or how they learn, then this learning is forced activity (Alrø & Skovsmose, 2002). An example would be the rote learning of times tables.

In considering students' agency in different learning environments, Alrø and Skovsmose (2002) identified two paradigms of school mathematics education. One is the Exercise Paradigm and the other is Landscapes of Investigation. In the exercise paradigm, goals and activities are related to the mastering of different procedures for tackling sets of exercises. This would lead to Skemp's (1976) instrumental understanding and a 'traditional' didactical contract (Blomhøj, 1995). Within the exercise paradigm, students have limited options to express their agency in relation to the mathematical subject matter (cf. Boaler & Greeno, 2000).

On the other hand, landscapes of learning enable learning as action (Alrø and Skovsmose (2002). Instead of exercises, a 'scene' is set so students can ask questions and become part of an inquiry process. The key component is that a cooperative inquiry is undertaken so that a 'landscape' is explored with results and conclusions not being determined in advance. Processes of inquiry can only start with students' previous understandings.

Investigating landscapes cannot be a forced activity as students must be owners and active participants. As ownership, participation and intentions cannot be forced upon students. The teacher's role is to invite students to cooperate and students can accept or reject the invitation. Their reasons for doing so could be very complex. Acceptance could come from interest in the topic of inquiry or the 'scene', concerns about relationships to classmates or teacher, or fear of exclusion. Students need good reasons to enter a landscape of investigation, so that their intentions become

connected to the learning process. The teacher cannot force the students to accept the invitation, nor control the reasons why students accept. Teachers, of course, can influence the students' choices and reasons by making use of the students' experiences and previously acquired understandings when designing landscapes of investigation. However, the 'working conditions' provided by the school setting as perceived by the teacher need to encourage, sustain and valorise such creativity in design.

If students are not invited to engage in meaningful learning acts, the field is left open to all sorts of other meaning productions, such as *underground intentions* (Alrø & Skovsmose, 2002), which "refer to the students' zooming-out of the official classroom activity ... partly setting an alternative scene for what is going on in the classroom." (p. 158). These intentions could result in students learning how to manoeuvre themselves so that they sit next to the right person or to finish tasks quickly in order to prevent homework from making inroads on their leisure time.

The forms of communication that go with the exercise paradigm and landscapes of investigation are different. Within the exercise paradigm, the learning activities focus on getting correct answers to exercises. Communication involves the teacher checking the students' answers, pointing out mistakes, and guiding them to the right answer. The teacher is the authority, with the textbook and its answer key. The students' contributions are often minimal as they concentrate on guessing what the teacher would like to hear (Alrø & Skovsmose, 2002; Blomhøj, 1995). This communication pattern is one reason for the exercise paradigm being in some sense a comfort zone. Each participant has well defined obligations, goals, and ways of assessing whether the obligations are fulfilled and to what extent the goals are met. On the other hand, landscapes of investigation are risk zones with ill-defined rules. Not only could invitations be accepted or rejected, the investigations themselves do not involve finding one specific result: knowledge develops differently for each participant. In co-operative activity, the communication between teacher and students must be explorative and dialogic, recognising that they are trying to understand each other's perspective.

For students to gain valuable mathematical understandings, they need to be part of a classroom where they have opportunities to engage in activities that require genuine investigation. The relationship between the teacher and the students is influenced both from outside and inside the classroom. These influences contribute to students accepting invitations to participate, as well as the way that they actually participate. In the next sections, we analyse extracts from mathematics lessons in different countries, suggesting how the students' perspectives contribute to their ascription of meaning to the activities. In the first case, we illustrate how the student's perception of the didactical contract is very difficult to change. In the second case, we discuss how underground intentions arise when students do not know what to do in a more inquiry based process.

METHODOLOGY

Our focus is on students' perspectives and so the descriptions of the learning activities do not draw inferences about the teaching practices. Teachers are restrained and facilitated in a number of ways and it would be unfair to portray the teacher's actions or non-actions as entirely matters of individual and free choice.

The following sections describe the situation for two mathematics learners in different countries. From conversations about our respective research projects, in Denmark and New Zealand, it became clear that although the classrooms were situated differently, the mathematics learning was more likely to be instrumental understanding in both cases. It was the differences in the situations, but with the similarity of outcomes that fascinated us.

The following sections use extracts from larger projects. As part of an investigation of children's perceptions of being in difficulties with mathematics, Troels Lange interviewed ten/eleven year old children in a Danish Year 4 classroom (see Lange, 2007). He observed the class for nine months on a weekly basis including keeping field notes and audio recording of some of his interactions with the children during the lessons. He was seen by the students as another adult who could provide help with doing mathematics.

The mathematics lessons typically began with a whole class activity addressing the students' homework, practicing number skills (e.g. multiplication tables), or introducing the next mathematical topic or type of exercises. In this part of the lesson, the teacher tried to engage with all of the students. In the remaining time, the students did exercises individually, but with the opportunity to talk to their neighbours. These exercises were, usually done from the textbook though sometimes, the teacher brought in other activities such as worksheets. Work that was not completed in class was set for homework.

Tamsin Meaney investigated the acquisition of mathematics language by a six/seven year old child in New Zealand (see Meaney, 2007). For one day a week for twenty weeks, both at home and during maths lessons, the child was audio recorded. The class discussion was captured on another voice recorder. The child's mother was the research assistant for the project and so attended the mathematics lessons to ensure that they were recorded. The mother was a trained secondary English teacher and also provided assistance to children who asked for help.

These mathematics lessons began with the children sitting on a mat on the floor, in front of a whiteboard. After the introduction, the children did activities in groups. One group worked with the teacher, whilst the other groups completed worksheets or activities in pairs. After a period of time, the teacher swapped the groups and spent time checking on the pair work.

Neither situation would necessarily be typical of Danish or New Zealand classrooms. However, the extracts illustrate typical situations from our larger data

sets and they allow us to talk generally about these children's learning of mathematics. The extracts are quite long because we wanted children's own voices rather than the researcher's interpretations of them to be presented first. When focusing on children's meaning making, their perspective and ways of expressing themselves should be the starting points. The Danish transcript is translated into English fairly literally and sometimes at the expense of 'good' English or what would resemble native English children's speech.

Each extract is analysed individually to consider how students ascribe meaning to the activities. We describe how we see the didactical contract as being evident in the extracts. Following the individual analyses of the extracts, we re-analyse the data after introducing more information about the children's dispositions. From this, we consider how students' agency is manifested in the extracts and the impact that this has on their learning of valuable mathematics.

CORRECTING ERRORS AND ADDING DECIMALS IN A DANISH CLASSROOM

In March 2007, seven months into Year 4, the initial activity in this lesson involved the teacher correcting the homework by reading the answer key. The homework was textbook exercises that the students had begun in the previous lesson. Some exercises referred to drawings of sticks of different lengths labelled alphabetically. The exercises were stated as $a+b$, $c-d$, $c+b+a$ etc.

The teacher instructed the students to put a tick if an answer was correct and a minus if it was wrong. A student asked if it was okay if there was "one centimetre between". The teacher responded by checking the student's measurement of stick a in the first exercise. The student had measured it as 6.6. Most students agreed to this but one student said seven. The teacher said that it should not be that far away, before realising that the student meant 6.7 and not seven centimetres. The teacher would accept 6.5 and 6.7, and it was ok if they were "one on either side". The answers to the exercises could vary and be a little different from what she said. For instance, her answer to the first exercise, $a+b$, was 9.4 centimetres. It was fine and right if they had 9.3. Then there would be a difference of one millimetre. It would even be okay if they had 9.5 or 9.6. It could vary two millimetres. The answer was allowed to vary 0.2 both ways because it could be difficult to measure down to the millimetre. She could accept that. Hence, because it was two lines, both of which they maybe had measured a little short she would accept 0.2 on either side: that is, anything between 9.6 and 9.2 was ok. Asked by a student if 9.1 were ok, she said it was a bit on the high side but not altogether wrong. Then the teacher started reading the correct answers and the students marked their own answers as right or wrong. [*Field notes and audio recording 3:10-7:00 from 7/3-2007*]

The extract illustrates the exercise paradigm, the operation of a traditional didactical contract, and an emerging instrumental understanding of decimals. The textbook activity focused on obtaining correct answers. Although the drawings of the sticks provided a semi-real context, their actual purpose was for students to produce

numbers to substitute for the letters. There was no suggestion that the sticks, their lengths, or the sums and differences of their lengths, were of intrinsic interest. These closed exercises allowed students to practice various measurement and number skills. The students almost never, and the teacher only sometimes, mentioned the units (cm, mm) of the lengths. Without a need to consider seriously the context, the students – and possibly the teacher – conceived the exercise as a mere exercise on numbers. The questions that students asked were limited to gaining the correct answers. Hence, the activity was within the exercise paradigm.

The didactical contract had many features in common with the rules of the traditional didactical contract listed above. In previous lessons, the teacher had introduced the students to methods and procedures needed to solve the exercises. The exercises were solved when their component parts were completed, in this case when the sticks were measured and the numbers added/subtracted. The students did not need to make sense of the exercise as a whole, for instance interpreting an answer as the combined length of two sticks. Answers were brief, just a number, possibly without a unit. All participants positioned the teacher with the authority and the responsibility to judge the correct answers. Finally, the students did their best to solve the posed problems.

The operation of the exercise paradigm and a traditional didactical contract meant that the students asked about accuracy in terms of correctness, i.e. from the perspective of students' 'rights' to know the rules. They did not display interest in mathematical features of calculations with the measured quantities. Although the teacher's response indicated awareness of these issues, she eventually presented acceptable divergences for sums and differences between numbers. Uncertainty became a matter of teacher authority instead of a topic for discussion. However, this happened in response to the students call for 'legal' advice on acceptable accuracy.

Mathematics education research has shown that a common understanding of decimals is that they are composed of two numbers, one before and one after the decimal point (e.g. Brekke, 1996). This understanding works well in common contexts like money (e.g. kroner and øre, dollars and cents) and measurements (e.g. metre and centimetre, kilogram and gram). The question "is it okay if there is one centimetre between" and the following discussion seem to reflect an emerging understanding of this type. Despite the word *centimetre*, the student's question was about a divergence of one from the 'second' number, the digit after the decimal point. The contribution 'seven' from the other student suggested a similar understanding. Although, the teacher certainly held a mathematical concept of decimals, she understood the students, and when expressing that 6.5 and 6.7 was close enough to 6.6, she phrased it in two-number terms as "one on either side". The examples suggest that a two-number conception of decimals was developing.

Following this interaction, the students corrected errors in their homework. Troels talked with Research Child 1 (RC1) while she did this and another exercise on adding decimal numbers.

- 1 RC1: You shall just correct these. That one
- 2 Troels: Which ones are you in doubt about?
- 3 RC1: It is this one. There is a mistake because I plussed them [*instead of 'minused' in 'a-b' exercise*]
- 4 Troels: Oh. And now you have corrected them?
- 5 RC1: Yes
- 6 Troels: But does it look right?
- 7 RC1: You must tell if it is right or wrong
- 8 Troels: Must I tell if it is right. (yes) Okay - It seems, it seems quite right to me
- 9 [*Pause for 59 seconds while RC1 calculated*]
- 10 RC1: You said that it was right (mmm). Then it is just that [*'a+b+c' type; RC1 has 20.9 cm instead of 21.1 cm. The addition of the three measurement numbers is correct.*]
- 11 Troels: But isn't it right what you have added? Haven't you added the numbers correctly?
- 12 RC1: No because, I did not...
- 13 Troels: You had 20.9. Doesn't it give 20.9?
- 14 RC1: I don't know
- 15 Troels: Have a look at the numbers
- 16 [*Pause for 17 seconds while RC1 adds the numbers again and gets the same result as before*]
- 17 Troels: So you have added the numbers okay
- 18 RC1: What have I done wrong then?
- 19 Troels: What could you have done wrong?
- 20 RC1: I don't know
- 21 Troels: What was it you should do? What was the problem about?
- 22 RC1: That you should just plus them
- 23 Troels: Which ones should you plus
- 24 RC1: Those that are there [*points to 'a+b+c'*]
- 25 Troels: Well but what is it that are there?
- 26 RC1: It is those and that and that (okay) nothing special
- 27 Troels: Could it be that you measured a little inexactly?

- 28 RC1: I don't think so
- 29 Troels: You don't think so?
- 30 RC1: No (Okay)
- 31 ...
- 32 *[A little later RC1 adds 39.7 and 33.6 and gets 733. The numbers are vertically aligned.]*
- 33 RC1: Is it right?
- 34 Troels: Let's try and have look at it. That is about forty and that is about thirty (yes). And forty and thirty is about?
- 35 RC1: Seventy__
- 36 Troels: Seventy yes. And there it says 733
- 37 RC1: Is it then right?
- 38 Troels: If it were money it would be about forty kroner plus about thirty kroner. That would make about seventy kroner, wouldn't it?
- 39 RC1: But is it right?
- 40 Troels: But can it be true that thirty nine and thirty three is seven hundred and something?
- 41 RC1: No but this is thirteen [the tenths 6+7]
- 42 Troels: That is right
- 43 RC1: And then I put a one up there (yes that is also right) and then these two are right and then I put a one on top and then is also gets right
- 44 Troels: That is right. That is right but isn't it right that it is seven hundred and thirty three there?
- 45 RC1: Yes
- 46 Troels: But it cannot be right that thirty and thirty [that] that gives seven hundred
- 47 RC1: Okay (about to erase)
- 48 Troels: Don't erase because what else could be wrong? It is right what you have done
- 49 RC1: I don't know
- 50 Troels: If you put a point between the threes would it then make a difference?
- 51 RC1: Yes (Okay)

Given the teacher was positioned as an authority, it is not surprising that RC1 wanted Troels to correct the answers (lines 1, 7, 33, 39). RC1 clearly perceived mathematics to be about getting right answers and judgement on their accuracy was the responsibility of an external authority. Consequently, it was RC1's right to have

the answers judged by this authority. In the first part, RC1 requested Troels to “correct these” (1) and tell if it was “right or wrong” (7), and in the second part he was asked twice, “is it right?” (33, 39). Troels’ attempt to direct RC1’s attention to the relation between the numbers to add and the answer was in vain (36, 38, 40, 44, 46). RC1 did all the component calculations correctly, but the unreasonableness that was so obvious to him was not significant for RC1 (34-41, 44-47).

The didactical contract construed the teacher as being responsible for evaluating the students’ answers, not the students themselves. Troels, as a teacher-like person, was expected to exert that authority. His persistent attempts to evade this expectation by inviting RC1 to reason was not sufficient to upset the didactical contract (2, 8, 34, 38). Eventually, he gave up and complied (27, 50). The child’s insistence on maintaining the existing rules of the game resulted in Troels changing his behaviour. However, by refusing to conform to the rules of the game, RC1’s perception of these rules was exposed, at least to Troels.

RC1 began by realising that the numbers had been *plussed* instead of *minused* (3). The Danish equivalents to these non-standard verbs are linguistic inventions of mathematics classes and appear frequently in mathematics classroom discourses. These verbs indicate the actions that should be undertaken when plus and minus symbols occur in exercises. However, their common usage suggests a separation of the mathematical operations from an understanding of why textbook questions require their application.

The use of these verbs and their interchange, (3), suggested that RC1 interpreted the task as one to produce numbers, which both *plussing* and *minusing* do, and not to solve authentic problems. When the answer diverged from that of the answer key, the drawing of the sticks and their links to a semi-reality did not contribute to understanding what caused the divergence. As well, the teacher’s rules for acceptability of the answer (“0.2 both ways”) was not applied, maybe because RC1 did not realise that the answer 20.9 (cm) was within acceptable distance from the expected 21.1 (cm) (10-20). It could be that with a two-number conception of decimals, the application of “between-ness” as the measure of divergence is not transparent. Between the numbers to the left and right of the decimal point, there is one (20 vs. 21) or eight (9 vs. 1), both of which are quite different from zero point two or even two.

Being a clever student working in a didactical contract similar to the traditional one described by Blomhøj (1995), RC1 had learned to filter out the context of the problem, and look for the numbers involved and clues for identifying the expected operation. RC1 did the assigned homework, wrote neatly in the notebook, and strived to solve the posed task, all as prescribed by the didactical contract. No zooming-out occurred and no visible underground intentions developed. Over the course of time, RC1 is likely to learn where to put the decimal point when adding decimal numbers.

Consequently, RC1 is likely to continue developing instrumental mathematical understanding.

How did this series of events evolve? Under a didactical contract such as this, students blinkered themselves into conceiving of learning mathematics as a question of figuring out what the teacher/textbook/worksheet wanted them to do. Gaining relational understanding of mathematical ideas was not an option that they saw as belonging to their foregrounds. Their conceptions of the didactical contract meant that there was little likelihood of constructing intentions for learning of mathematics and thus getting involved in learning-as-action. Deprived of the possibility of intentional learning acts and meaning construction of valuable mathematics, learning took place as forced activity.

DOING FRACTIONS IN A NEW ZEALAND CLASSROOM

The learning environment in the New Zealand classroom was different. However, Research Child 2 (RC2) did not appear to learn any more conventional mathematics than RC1. The students had to fold a paper circle, twice so that four equal quarters were produced. They then had to cut and glue the newly found quarters onto posters, which already showed two halves from a previous lesson. The students had individual posters, but worked in pairs. Although only one answer was anticipated, students were expected to manipulate the shape so that they discovered how to find four quarters. The teacher seemed to expect students to evaluate whether they achieved the required outcome. Her role was to facilitate the students into doing this. Thus, the learning environment was more a landscape of investigation than belonging to the exercise paradigm (Alrø & Skovsmose, 2002). However, this extract illustrates that although the teacher may have wanted to operate in a landscape of investigation, students' reasons for accepting the invitation to participate could be co-opted by other influences. These affected students' learning intentions so that underground intentions developed.

The extract comes from the second day of recording at the end of July 2005. The teacher began the lesson by discussing fractions and emphasised that the quarters had to be equal in area. Then the children were separated into groups.

- 52 Teacher: Okay, and freeze. I just need to change a couple of partners over, Partner, could you work with RC2 please, ... Okay. Quarters. ...
- 53 Partner: I like the fraction. [*Quite noisy as class getting into pairs*]
- 54 ...
- 55 RC2: Look I can cut it in half. Like that, and that, done. [*Pause*]
- 56 Partner: RC2?
- 57 RC2: Mm?
- 58 Partner: If the quarter, get it, the quarter crashes, so it dies, so we have it next

- 59 RC2: What?
- 60 Partner: Instead of quarters.
- 61 RC2: I'm going to find the half one, here's the half thing.
- 62 ...
- 63 RC2 I'm going to have the whole pizza.
- 64 Partner: Where's the whole pizza?
- 65 RC2: This, mine.
- 66 Partner: I can't see, I can't see. I get this.
- 67 RC2: I get this and that.
- 68 Partner: Oh, and these two whole, whole, whole [*makes gulping noises*]
- 69 RC2: I got the whole pizza.
- 70 Partner: Who ordered a whole pizza? I ordered three whole pizzas.
- 71 RC2: Yep
- 72 Teacher: Remember the paper you have to show two ways of cutting that into quarters.
- 73 RC2: Oh, I was, two ways.
- 74 ...
- 75 RC2: Where on earth is the pieces?
- 76 ...
- 77 RC2: What? Two ways of cutting in quarters.
- 78 Partner: Cutting in quarters
- 79 RC2: Mum, what are two ways of cutting this into quarters?
- 80 Partner: Impossible.
- 81 Mum: Think about the way you did it on the poster. Maybe make this whole piece into quarters.
- 82 RC2: I've got one. This is, I'll show you, like this, and that.
- 83 Partner: Where is it? Where is it? Where are you naughty thing?
- 84 Teacher: Ok, where are you up to Partner?
- 85 Partner: I'm going like before.
- 86 Teacher: I beg your pardon, you've been doing that for a long time, where's the pen gone?
- 87 Partner: I don't know. ...
- 88 Teacher: You write a quarter.
- 89 RC2: I've got one to do, I just need to find my scissors.

- 90 Teacher: Remember we did the folding and cutting?
- 91 RC2: Yeah, I'm doing that, and then.
- 92 Teacher: Have you folded it RC2, to check?
- 93 RC2: Oh.
- 94 Teacher: Fold, fold it and check if you're going to do it that way. Oh, what's happened? Are you going to have quarters? I'll give you a new piece and you can try it again.
- 95 ...
- 96 Teacher: Ok, well, have you've done your quarters in your head? *[to RC2 and Partner]*
- 97 RC2: Squares. Look what I did.
- 98 Teacher: Ok, how many pieces have you got?
- 99 RC2: Four.
- 100 Teacher: So what's the, hold up one quarter. Ok, put it back down. Show me one quarter in the pizza, which one would be a quarter?
- 101 RC2: Oh no, not that one. That's a half.
- 102 Teacher: That's a half.
- 103 RC2: Ummm.
- 104 Teacher: Have you got one quarter? You haven't have you, could you cut that pizza into quarters.
- 105 RC2: Yep.
- 106 Teacher: That's it, well done.

The activity revolved around active, hands-on problem solving. However, as the activity progressed gaining relational mathematics understanding become a secondary focus for both the students and the teacher. The teacher wanted the students to produce four quarters by folding the paper and thus gain a relational understanding that: each of the four parts was equal in size; each one was called a quarter; and four quarters made a whole. When they realised that they could not easily do the task, the children engaged in imaginative play that contributed to them interacting socially, whilst at the same time not being seen by the teacher as being off-task.

The teacher's contributions suggested that she believed that students would learn that quarters were four equal parts of a whole, if they folded the paper appropriately and then cut them out. She had done a lot of preparatory work at the start of the lesson with physically cutting objects such as broccoli that could not produce equal quarters and discussing how fraction parts needed to be equal in size. As the teacher expected the activity would lead to understanding, giving direct instructions on how to produce the quarters was only to be used as a last resort. However, by the end of

the extract, the teacher was channelled into doing this by the students' inability to complete the task. Consequently, the aim changed to producing four equal parts. Blomhøj (1995) suggested that in the didactical contract that operates in a traditional mathematics classroom, the teacher “develops a whole arsenal of small instructions and corrections to problem solving” (p. 18) that are used to ensure that students gain success. The students come to rely on these being implemented. The teacher in this class may have wanted to operate in a landscape of investigation. However, her reversion to funnelling questions and commands (72, 88, 90, 92, 94, 98, 100, 104) showed she adopted a more traditional approach in order for the children to be successful. Rather than the teacher driving what happened in the class, the children's lack of success resulted in the teacher changing her practices in the same way that RC1 had altered how Troels responded.

Although RC2 began by focussing on what had to be done (55), Partner quickly turned the pair work into imaginative play by talking about crashing quarters (58). Then RC2 described the shapes as pizzas (63), probably because the teacher had described the paper shape in this way earlier. RC2 accepted that the teacher's intervention meant that they had to return their focus to the task (73). RC2, like RC1 in the previous extract, tried hard to fulfil the requirements of the task. However, she had little understanding of what was required of her (77, 79) and she only produced the four quarters after specific instruction from the teacher (94).

Alrø and Skovsmose (2002) described a resistant group in a Year 9 mathematics class who, instead of engaging in the task, chose to zoom out. The students thought that they were doing what the teacher required as well as doing some of what they wanted to do. Nonetheless, very little conventional mathematics was learnt by that group. The situation for RC2 was different. The zooming-out to imaginative play with Partner was not done in tandem with completing the activity or from deliberate resistance to participating. RC2's confusion over what quarters were and the two ways of folding contributed to the move into imaginative play and zooming-out.

Nuthall's (2007) comment that students learn what they do suggests that RC2 and her partner did learn to produce four equal parts. However, it was uncertain that either of them ascribed to this activity a relational understanding about what a quarter was and how it related to a whole. They also learnt that they could reduce the opportunities for being in trouble for being off-task by making statements such as “I've got one to do, I just need to find my scissors” (89). These comments suggested to the teacher that the children were engaged, even if they were doing the task much more slowly than other children. The remarks, however, restricted the type of support that the teacher offered because she did not realise that they had little idea of what to do. Even when the teacher directly challenged Partner about the amount of work done (86), it was unlikely that she recognised that they had not produced the quarters because they did not know how. Her later interventions became more directive, but never really made connections with the relational understanding about fractions.

Although at the end of the extract, RC2 realised that two halves had been produced rather than four quarters, no connection was made between halves and quarters.

The lack of strategies for gaining clarification about the task contributed to the move from a landscape of investigation into a form of the exercise paradigm. RC2 asked the mother for help but not the teacher, nor Partner. In none of the recorded mathematics lessons did RC2 request help, including when the mother was not in the class, and at times insisted that pair work did not involve working together (Meaney, 2007). The child's reticence to ask the teacher for help, combined with the teacher's belief that the children would learn more if they did it themselves resulted in a more instrumental understanding about quarters being gained. Although an invitation to a landscape of investigation was accepted (53), RC2 and partner did not have skills to zoom in on the task by asking questions about it and how it related to their learning.

RC2 and Partner accepted the teacher's invitation to participate in a landscape of investigation. However, the students' incomprehension about what was required meant that they quickly moved into activity that they could do, imaginative play. The teacher's belief that the activity would lead to relational understanding was distorted by the invitation's lack of correspondence with the students' prior understanding. Consequently, the activity was reduced to cutting a shape into four equal parts and thus became forced activity. RC2's underground intention of playing whilst staying out of trouble was from a very different base than Alrø and Skovsmose's (2002) students. Previous classroom experiences contributed to RC2's beliefs about the importance of being seen to be doing the task and not asking clarifying questions. However, these were not the only contributions to what influenced the change of the activity from one of being a landscape of investigation to one of forced activity.

DISPOSITIONS TO LEARN

Although the contexts for the lessons were quite different, the outcomes for the students were similar, that is instrumental rather than relational understandings. Both students ended up being engaged in "forced activities" rather than ones in which their own learning intentions came into play. However, it was both students' reactions, RC1's ignoring of Troels' requests to "think again about what could be wrong" and RC2's inability to produce the four quarters, that resulted in the adults changing their aims. This contributed to the development of instrumental understanding.

RC1's aim was to produce numbers when responding to problems. Skemp (1976) described how mismatches between students and teachers' expectations of the need for relational and instrumental mathematical understanding could result in frustration. RC1's frustration occurred because the teacher-like person did not realise that unreasonableness in answers was something that could be ignored. This person also did not fulfil his obligations to the didactical contract because he refused to confirm or deny the correctness of the answers. Although RC1 knew the answer did not match the key, what the child felt was needed was not provided by Troels. The

problem solving context, and how RC1 perceptions of the appropriate way to operate, formed the didactical contract. This did not lead to relational understandings of mathematics.

The type of problem solving that RC2 was asked to engage in was different. It conformed to Blomhøj's (1995) suggested rules for the didactical contract in traditional mathematics classrooms only in some ways. Therefore, RC2 had more opportunities for gaining relational understandings about mathematics. However, RC2's interpretation of the didactical contract was that if the task was too difficult to do, then it was necessary to be seen to do something. This was more appropriate than asking for help from the teacher or Partner. Consequently, RC2 participated in zooming-out behaviour. This example suggests that it is not just resistant groups, such as those described by Alrø and Skovsmose (2002), that zoom out and thus lessen their learning opportunities. It would be interesting to know whether students such as RC2, if not given opportunities in future classes to engage with their teacher to change the didactical contract, become members of resistant groups when they enter high school.

Previous classroom experiences and expectations about future behaviour required of them will have contributed to both students' interpretations of how to interact in the learning environment. However, this is not the complete story. In the following sections, we hypothesise about how knowing more about the children's backgrounds will affect our understanding of their learning intentions and thus the meaning that they ascribe to what they are doing. We ponder whether it adds or modifies our interpretation if some socio-political features are taken into account or whether it could also just become an excuse for attributing the lack of learning to the students. Although this consideration of background as affecting dispositions should be balanced by also considering foregrounds, we do not have information from the children's themselves about these.

Backgrounds and their influence on understanding how meaning is ascribed

In discussing the classroom episodes, we deliberately restricted the information about our students to the bare minimum of their age and country. We did not disclose their gender by naming them Research Child 1 and 2. We said nothing about their family background, apart from a little about RC2's mother in her capacity of research assistant. Now we ask if it makes a difference to us and to others if we describe both children as girls whose families are immigrants in their respective countries.

Being girls: There is evidence to suggest that girls in some parts of the world approach how they operate in a classroom differently than boys do (Kenney-Benson, Pomerantz, Ryan, & Patrick, 2006). Girls were more likely to "refrain from disruptive classroom behaviour" and this contributed to "greater effortful learning over time" (p. 11) Females also generally rate their mathematical abilities lower than males (Alton-Lee & Praat, 2000). If RC1 and RC2 are representative of the girls in these

other studies, it may be that this influenced their ascribing of instrumental mathematical understanding to the activities in which they participated.

RC1 concentrated hard on solving all the questions, which is what she perceived as being required of her in a mathematics classroom. This seems to match with the suggestion that girls make more effort at their learning. She also wanted Troels to check the correctness of her answer and would not be encouraged to evaluate her own answers. This could be interpreted as RC1 showing little confidence in her own mathematical ability.

RC2 did not participate in disruptive behaviour, even though she was unsure about what she should do. Her imaginative play stayed under the radar of the teacher. It is difficult to know whether, if she had understood what to do, she would have made a more concerted effort to learn. Over the course of the twenty weeks, RC2 rarely got in trouble even though she was often confused about what she had to do. It was unlikely that she learnt any relational understandings in mathematics in this period.

Of course, with only one interaction analysed for both girls, it is not possible to understand fully how gender affects these students. It is possible that the typical behaviours associated with being female are visible in the extracts. However, it may be that other aspects of the students' backgrounds and foregrounds also contributed to the meaning ascriptions attached to the activities.

Being immigrants: As well as being girls, both RC1 and RC2 were from immigrant backgrounds. RC1's family was part of a minority of Muslim immigrants from the Middle East in Denmark. It was likely that her parents were refugees from the civil war in Lebanon. RC1 had been born in Denmark. RC2's father had come to New Zealand from Samoa to study, whilst RC2's mother had been born in New Zealand, but of Samoan parents. In both families, the children spoke the dominant language, Danish and English respectively, but also the language of their parents. RC1 had more fluency in Arabic than RC2 had in Samoan.

The culture of Middle Eastern minority families in Denmark is in some respects different from that of the majority of ethnic Danish families. According to Khader (2006), a Danish politician who migrated from Syria when he was a child, the family is the basic, central, almost holy, social unit in the Middle East Islamic societies. The father is responsible for bringing up the children according to Islamic prescriptions. Maintaining the honour of the family is essential for all family members. Migrants from the Middle East bring this type of family culture with them, and even if adjustments are made over the course of time, central features persist. Hence, children in Muslim families of Middle East origin are positioned differently in the family compared to mainstream Danish majority families.

These attitudes are reflected in the small amount of mathematics education research that has been done in this area in Denmark. Alrø, Skovsmose and Valero

(2008) interviewed a Muslim Kurdish girl, who had recently migrated to Denmark with her family. The girl explained that, in her culture, children could not say no to their parents. The same type of relation between children and adults was reflected in Troels' extensive interviews with students in RC1's class (Lange, submitted). He asked them if there were differences as to what children could decide in the different school subjects. Some children, all of Middle East minority background, including RC1, said that there were no differences, because children cannot say no to what the teacher says. The teacher tells them what to do and then the children do it.

A didactical contract, focusing on getting correct answers to exercises that had little inherent interest and fostering instrumental understanding, could be seen as coherent with RC1's family background. Both required 'obedience' to an external and, in principle, unquestionable authority and a corresponding 'demand' from the child to know what the rules were. If this speculation was reasonable, it would be an example of knowledge of students' background adding to our interpretation.

There are similar features in the Samoan background of RC2's family. Jones' (1988) research into Pacific Island girls in high school classes suggested that they "learned from their parents that the teacher, like the priest or pastor, holds valuable knowledge and as such is to be respected, not questioned by mere students" (p. 149). RC2 as a Samoan girl, although much younger than the girls that Jones studied, may also have perceived the teacher in this light. This may have contributed to her unwillingness to seek clarification about the task. It may also have affected her desire to be seen as doing what was required, and thus not get into trouble with the teacher.

However, Skovsmose (2005b) stated that the background of a person is a *personal interpretation* of the person's socio-political context and not the context as such in some 'objective' form. It is possible that RC1 interpreted her minority Middle East family context in a way that made her particularly susceptible and conducive to the construction of a traditional didactical contract, and once established, reinforced her adherence to it. It may also be that RC2's Samoan background made her reluctant to attract the teacher's attention either by asking a question or by being seen as off-task. This contributed to the teacher reforming her interactions so that they more closely aligned with the exercise paradigm. Other students could interpret similar 'objective' backgrounds in different ways, depending on the other experiences and foregrounds that they bring with them. Therefore, our analysis is only relevant if the girls themselves saw it as being about them.

Consequently, we do not want to suggest a deterministic general relation between being of Middle East descent and adhering to a traditional didactical contract. Nor do we want to suggest that girls of Samoan background were all likely to react in mathematics classrooms in similar ways. To do so would be to reduce people to categories and unreasonably simplify a very complex matter.

CONCLUSION

In this chapter, we considered how the didactical contract operating in classrooms affected the meaning ascriptions made by two students to the learning activities in which they engage. Rather than just concentrating on the snapshot of what happened in the two classroom extracts, we added more information about the students to see how this affected our interpretation. Information about the students' backgrounds did provide supplementary explanations for the children's interpretations of how they should act. However, like knowledge of the didactical contract, this information is only a part of what students use when ascribing meaning to the activities in which they engage. Teaching and learning are complex processes. Simplifying them in order to determine uncomplicated explanations as to why so many children do not gain valuable mathematical understanding is unlikely to help either student or teacher.

The didactical contract provides information about how the classroom culture affects the teaching and learning processes. This metaphor highlights the existence of a set of rules framing interactions, even when these rules are fluid as is the case in landscapes of investigation, and their nature a 'tacit negotiated compromise'. The didactical contract provides a frame for teaching and learning to take place. However, its relative stability does not mean that it is non-negotiable. Over the course of time, it simultaneously shapes the participants' conceptions of school mathematics teaching and learning, and these conceptions shape the frame. From our perspective of the students' meaning ascribing processes, we see how the students are framed and how they try to affect the framing. In the case of RC1 the frame is clearly a traditional mathematical contract. In the case of RC2, the contract is not traditional in the beginning but easily reverts when difficulties are encountered.

Schools are ambiguous places for children. On one hand, they are important social and societal institutions aiming at *the good* for society and children. On the other hand, they are created and controlled by adults and do not necessarily nor always accord with children's wants, needs and wishes. For us, both children have agency; they are not powerless. In both cases, they play off the teacher against the school setting.

RC1 brushed off Troels' attempts to engage her in conversations that she did not see as relevant to doing mathematical activities. Although she listened respectfully, she refused to be drawn into irrelevant side issues. Instead, she insisted on her right to have her answers evaluated and to be provided with direct instruction so she could get the "correct" answer. This was after all the purpose of the activity. Knowing the inherent appropriateness of her response, she could exert her agency in a respectful but forceful manner. Troels' alternatives were not to be taken seriously as they were not part of the way that mathematics teaching and learning was framed by the important mathematical authority, her own teacher, and her previous experiences.

In the case of RC2, the teacher intended that the children discover something about quarters. However, she was squeezed between wanting the children to be successful and the fact they had not finished the task with little time remaining. Achieving the product of the activity, the shape cut in four equal pieces became the goal and the intended (relational) understanding of mathematical concepts was sacrificed. It was the children's reactions that resulted in the teacher making changes to her approach. RC2 may have been invited into the activity, but her conceptual background, her lack of understanding of wholes and parts, meant she could not engage. Maybe her background contributed to RC2's being cut off from zooming-in to the activity. Faced with an unintelligible demand, and conscious of her non-comprehension ("Mum, what is cutting in quarters?") her response was to appear busy to avoid teacher attention. Her busyness was around the mere manipulative aspects of the exercise. The children were reinforcing the experience that eventually the teacher would give in and tell them what to do. They had not learnt what was intended, it was incomprehensible to them anyway, but they had produced the outer signs of learning. They might sense that the teacher was not quite happy about it, but they were safe and could not be blamed.

Since research into mathematics education began, researchers have been keen to inform teaching practices about how to increase the likelihood of students gaining valuable mathematics. However, Alrø and Skovsmose's (2002) ideas about what contributes to students' meaning ascriptions illustrate the complexity of the learning process. Knowledge of how the didactical contract operates provides some information. However, as the extracts of our two girls on either side of the world show, the didactical contract provides only some information about how meaning is ascribed. Concentrating on the girls' backgrounds also only provides limited information, with the significant risk that taken in isolation this could stereotype the lack of relational learning as being the responsibility of the girls and their home cultures or gender.

Our analysis instead turned to the students' enactment of their agency. Alrø and Skovsmose (2002) stated that students should be equal partners in investigations and this would lead to students' agency resulting in valuable mathematics learning being achieved. However, other demands such as trying to cater for the needs of a diverse group and time restraints can result in students' enactment of their agency in ways that resulted in a lack of relational mathematical understanding being learnt. Instead, what needs to be done is for teachers to find ways to discuss mathematics and mathematics learning so that students have more options for using their agency to form valuable learning intentions. In Figure 1, we left undiscussed the impact of reflection on meaning ascriptions. As a consequence of our analysis it seems clear that if these two children were to gain valuable mathematics understandings then they needed to engage with their teachers in reflecting about the supports and impediments for this to occur. Teaching is not something done by teachers that is completely independent of learning done by students. Yet without joint reflection this is what

classroom participants can end up doing with neither aware of that the other's perception of the situation is different. Joint reflection may well contribute to the teacher being able to harness the student's agency for a common goal.

ACKNOWLEDGEMENTS

We wish to thank Naomi Ingram, Tracey Smith, Paola Valero, and Arthur Winzenried for helpful comments during the writing of the chapter.

REFERENCES

- Alrø, H. & Skovsmose, O. (2002). *Dialogue and learning in mathematics education: Intention, reflection, critique*. Boston: Kluwer Academic Publishers.
- Alrø, H., Skovsmose, O., & Valero, P. (2008). Inter-viewing foregrounds: Students' motives for learning in a multicultural setting. In M.César & K. Kumpulainen (Eds.), *Social interactions in multicultural settings*. Sense Publishers.
- Alton-Lee, A. & Praat, A. (2000). *Explaining and addressing gender differences in the New Zealand Compulsory School Sector*. Wellington, New Zealand: Ministry of Education.
- Balacheff, N. (1990). Towards a problématique for research in mathematics teaching. *Journal for Research in Mathematics Education*, 21 (4), 258-272.
- Blomhøj, M. (1995). Den didaktiske kontrakt i matematikundervisningen. *Kognition og pædagogik*, 4 (3), 16-25.
- Boaler, J. & Greeno, J. G. (2000). Identity, agency, and knowing in mathematical worlds. In J.Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 171-200). Westport, CT: Ablex.
- Brekke, G. (1996). A decimal number is a pair of whole numbers. In L. Puig & A. Gutierrez (Eds.), *Proceedings of the 20th Conference of the International Group for the Psychology of Mathematics Education*, (Vol 2, pp. 137-144). Valencia, Spain: International Group for the Psychology of Mathematics Education.
- Brousseau, G., Balacheff, N., Cooper, M., Sutherland, R., & Warfield, V. (1997). *Theory of didactical situations in mathematics: Didactique des mathématiques, 1970-1990*. Dordrecht: Kluwer.
- Cobb, P., Stephan, M., McClain, K., & Gravemeijer, K. (2001). Participating in Classroom Mathematical Practices. *The Journal of the Learning Sciences*, 10 (1/2), 113-163.

- Cobb, P., Wood, T., Yackel, E., & McNeal, B. (1992). Characteristics of classroom mathematics traditions: an interactional analysis. *American Educational Research Journal*, 29 (3), 573-604.
- Hamilton, E. H. (1924). Reviewed works. *The Mathematical Gazette*, 12 (171), 174-176.
- Herbel-Eisenmann, B. (2003). *Examining "norms" in mathematics education literature: refining the lens*. Retrieved 21 June 2007, from <http://www.msu.edu/~jansenam/NCTM2003.html>
- Jones, A. (1988). Which girls are 'learning to lose'? Gender, class, race and talking in the classroom. In S.Middleton (Ed.), *Women and Education in Aotearoa* (pp. 143-152). Wellington: Allen & Unwin.
- Kenney-Benson, G. A., Pomerantz, E. M., Ryan, A. M., & Patrick, H. (2006). Sex differences in math performance: The role of children's approach to schoolwork. *Developmental Psychology*, 42 (1), 11-26.
- Khader, N. (2006). *Ære og skam : det islamiske familie- og livsmønster i Danmark og Mellemøsten*. (3 ed.) (København): Borgen.
- Lange, T. (2007). Students' perspectives on learning difficulties in mathematics. In L. Ø. Johansen (Ed.), *Proceedings of the 3rd Nordic Research Conference on Special Needs Education in Mathematics*, (pp. 171-182). Aalborg: Adgangskursus, Aalborg Universitet.
- Lange, T. (submitted). "Tell them that we like to decide for ourselves" - Children's agency in mathematics education. In *Proceedings of the Sixth Congress of the European Society for Research in Mathematics Education*.
- Meaney, T. (2007). Authority relations in the acquisition of the mathematics register at home and at school. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education*, (pp. 1230-1239). Department of Education, University of Cyprus: European Society for Research in Mathematics Education. Available: <http://ermeweb.free.fr/Cerme5.pdf>
- Nuthall, G. (2007). *The hidden lives of learners*. Wellington: New Zealand Council for Educational Research.
- Skemp, R. (1976). Relational and instrumental understanding. *Mathematics Teaching*, 77, 20-26.

- Skovsmose, O. (2005a). Foreground and politics of learning obstacles. *For the Learning of Mathematics*, 25 (1), 4-10.
- Skovsmose, O. (2005b). Meaning in mathematics education. In J.Kilpatrick, C. Hoyles, & O. Skovsmose (Eds.), *Meaning in mathematics education* (pp. 83-100). New York: Springer Science.
- Thorndike, E. L. (1922). *Psychology of arithmetic*. New York: Macmillan.
- Thorndike, E. L., Cobb, M. V., Symonds, J. S., Wald, E., & Woodyard, E. (1923). *Psychology of algebra*. New York: Macmillan.
- Valero, P. (2004). Postmodernism as an attitude of critique to dominant mathematics education research. In M.Walshaw (Ed.), *Mathematics education within the postmodern* (pp. 35-54). Greenwich, CT: Information Age Publishers.
- Wedeg, T. & Skott, J. (2007). Potential for change of views in the mathematics classroom. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education*, (pp. 389-398). Department of Education, University of Cyprus: European Research in Mathematics Education. Available: <http://ermeweb.free.fr/Cerme5.pdf>

“TELL THEM THAT WE LIKE TO DECIDE FOR OURSELVES” – CHILDREN’S AGENCY IN MATHEMATICS EDUCATION

Troels Lange

Aalborg University, Denmark

Interviews with primary school children about their lived world of school mathematics, unanimously and strikingly revealed that the practical/creative school subjects were their favourites. These subjects granted them agency and modes of bodily expressions that were not available in mathematics and the other academic school subjects. The interviews are analysed from a perspective of school mathematics education as a social practice that draws attention to and valorises the children's perspective. The question is raised whether the children's preferences reflect a genuine perception of postmodern life conditions that should be taken seriously.

Keywords: children’s agency, embodied agency, children’s perspectives

INTRODUCTION

If learning is assumed to involve intentional action (Skovsmose, 2005), then students’ agency in mathematics teaching and learning is an important issue. Yet, studies on agency in mathematics classrooms (e.g. Boaler & Greeno, 2000; Klein, 2001b) have rarely considered the perceptions of primary school children. In high school classes and teacher education situations, agency has been discussed in terms of students’ opportunities to make choices and to have authorship within the discourse around mathematics. Interviews with 10-year-old children in a Year 4 class in Denmark also revealed restrictions on agency in mathematical activity in these respects. As well, the children perceived their bodily actions as being restricted. When asked about their preferred school subjects, almost unanimously, the children pointed to design (needlework), visual art, physical education, and swimming as the subjects, they liked the best. These subjects provided opportunities for creative, physical, and/or playful forms of agency. This was in stark contrast to the subjects they considered to be the most important subjects, i.e. Danish, mathematics and English where they experienced very little, if any, agency and much tighter bodily control. They felt that they had to do what the teachers requested and could hardly imagine the situation being any different, i.e. what agency could be in these subjects.

The children's preferences could be a reflection of the long-term effort of learning mathematics and the challenges involved, as opposed to the immediacy of the practical/creative subjects, or they could be a voicing of popular notions of so-called academic schools subjects as tedious. Regardless of their validity, these explanations to children’s views seem unlikely to be exhaustive, and troubling questions remain. Could it be that the children's preference for practical/creative school subjects – with their space for creative playful whole-body agency – reflect a valid perception of

what is important for them to develop in order to grow up as competent citizens in a postmodern world [1]? What does the perceived absence of agency do to their perception and learning of mathematics? Are children in difficulty in learning mathematics especially affected by this apparent lack of agency?

THE NOTION OF AGENCY

The Oxford English Dictionary defines *agency* as “the faculty of an agent or of acting; active working or operation; action, acting”. *Agent* comes from Latin *agere*, to act, or to do. An agent acts or exerts power, as distinguished from the *patient* and the *instrument*; the agent acts upon the patient/instrument. Hence, in sociology and social sciences, *human agency* denotes the faculty to act deliberately according to one’s own will and thus to make free choices. A central issue in these sciences is the relation between *structure* and *agency*; i.e. how social and cultural factors such as social class, religion, gender, ethnicity, customs, etc. shape the opportunities that individuals have, and how does human agency change these factors.

Schooling, and mathematics education as part hereof, constitute a major social and societal arena in the organisation and rhythm of children's daily life as well as their future lives as independent adult. In this arena of mathematics teaching and learning, children's agency could be seen to involve three aspects. The first is based on an assumption of *children as social actors* (Højlund, 2002; James, Jenks, & Prout, 1998; Kampmann, 2000). Consequently, they make sense of their experiences in school mathematics irrespective of the agency granted to them at school. They ascribe meaning (Skovsmose, 2005) from a ‘global’, holistic life world perspective (Kvale & Brinkmann, 2009) that integrates their experiences in mathematics learning with their future life perspectives (Lange, 2008a). The second aspect concerns the organisation of their *mathematical activity*, which may leave them more or less agency in the sense of opportunities or expectations to (co-)create mathematical concepts, discuss mathematical ideas, make choices, think for themselves, etc. as part of their learning process (Boaler & Greeno, 2000). The third aspect relates to *embodied agency* (Benner, 2000; Shilling, 1999) in that school norms impose physical restraints on students’ bodily freedom such as requiring them to sit on their chair at their desk, keep quiet, have their mobile phones turned off, etc. As is discussed later, children are very aware of these restraints.

Interviewing high school students in advanced calculus classes in USA, Boaler and Greeno (2000) found that ‘traditional’ mathematics education, dominated by instruction in and training of procedures to find the one correct answer to diverse mathematical problems, afforded virtually no agency to students, but required them to “surrender agency and thought in order to follow predetermined routines” (p 171). Boaler and Greeno discussed students’ agency with reference to the notion of *figured worlds*, a key term in Holland, Lachicotte, Skinner and Cain’s (1998) discussion of social systems. Within this framework, agency is conceived in terms of authorship and as a prime aspect of identity. Seeing mathematics classrooms as figured worlds

and agency as authorship, draws attention to the children's/students' and teachers' interpretations of the rituals of their shared practice and their positions and roles, and to the shaping of their sense of self, their identities, in the social practices of mathematics education. Boaler and Greeno (2000) found that:

[i]n the schools in which the students worked through calculus books alone, the students appear to view the domain of mathematics as a collection of conceptually opaque procedures. The majority of students interviewed from the traditional classes reported that the goal of their learning activity was for them to memorize the different procedures they met. Such a figured world of didactic teaching and learning rests on an epistemology of received knowing. In this kind of figured world, mathematical knowledge is transmitted to students, who learn by attending carefully to teachers' and textbook demonstrations (Boaler & Greeno, 2000, p. 181).

In order to be successful, students in 'didactic' classes needed to "assume the role of a received knower and develop identities that were compatible with a procedure-driven figured world" and be willing "to build identities that give human agency a minimal role" (p. 183). The students saw success as requiring "a form of received knowing, in which obedience, compliance, perseverance, and frustration played a central role" (p. 184). Some students, girls in particular, rejected mathematics because

they were not prepared to give up the agency that they enjoyed in other aspects of their lives, or the opportunities to be creative, use language, exercise thought, or make decisions. ... [T]hey wanted to pursue subjects that offered opportunities for expression, interpretation, and agency (p. 187).

Referring to Pickering's (1995) discussion of agency in mathematics and science Boaler and Greeno concluded that the students only had opportunities to learn what Pickering termed "the agency of the discipline" which is the agency aspects of mathematics, in which human agency play the least role, thereby seriously distorting their perception of mathematics as a scientific discipline.

While Boaler and Greeno criticised procedural teaching for its reduction in students' agency, Klein (2001a; 2001b) criticised pedagogical practices that base mathematics education on conjecture, reasoning, investigation and inquiry. Writing from a poststructuralist position, she claimed that current practices are framed by humanist notions of rational, autonomous learners. These notions take students' agency for granted, overlook always present power relations, disregard that identity and agency are discursively constituted and not an individual disposition, and hence do not recognise that students' agency needs to be considered in every learning encounter (Klein, 2001a). Like Boaler and Greeno (2000), Klein discussed agency in terms of *authorship*, but with reference to Bronwyn Davies:

[S]tudents can experience a sense of agency in a discourse where they have a knowledge of themselves as respected and competent in (a) speaking and writing the commonly accepted truths of the discourse, in (b) enacting established ways-of-being, and in (c)

going beyond these to forge something new (Davies, 1991). Agency has to do with authority, not in the sense of control over but in the sense of *authorship*; authorship of voice and action in a community conversation. All pedagogic discourses, regardless of whether we see them as transmissive, child-centred, constructivist or social constructivist, support agentic behaviour to the extent that they impart a robust knowledge and skills base and authorise student initiated constructions and ways of making sense of experience (Klein, 2001b, p. 340).

Boaler and Greeno (2000) looked at high achieving high school students perceptions of agency in USA, and Klein analysed agency in an Australian teacher education context. I am exploring young children's perspectives (Lange, 2008b) on agency in a Danish *folkeskole* (public primary and lower secondary school). These children also seem to experience restrictions on expressing their agency in their mathematics lessons. However, apart from illustrating their perceptions of lack of choice and ability to author discourse, I discuss how bodily aspects of agency may be particularly relevant for smaller children. My contention is that the children seem to be suspended between two conflicting experiences. On the one hand, they experience joy and engagement arising from spaces of agency in the practical/creative school subjects that they do not believe is important. On the other hand, they think of mathematics as a school subject that are important for their future, but the agency they value so much is virtually absent in their perception of their learning experiences in this subject.

METHODOLOGY

The empirical material for this paper comes from interviews with children about 10 years old in a Danish Year 4 class. I observed their mathematics classes for almost a year and interviewed students in groups, pairs and individually. The aim of the research was to explore children's knowledge about their mathematics education, especially the meaning they ascribed to and the sense they made of their experiences with being in difficulty in learning mathematics (Lange, 2007). As I took the children's meaning ascriptions to be in a narrative form, my conversations with them invited them to tell about their experiences. Hence, the interviews I conducted were semi-structured life world interviews, i.e. interviews that "seek to obtain descriptions of the interviewees' lived world with respect to interpretation of the meaning of the described phenomena" (Kvale & Brinkmann, 2009, p. 27).

There were twenty children in the class. All but one participated in one of three group interviews early in the school year. Half of the children were interviewed in pairs or individually a little later, and again near the end of the school year, with some overlapping of the two groups. The interviews took place at the school, lasted 30-45 minutes, and were audio recorded; the group interviews were also video recorded.

Taking *children's agency* to be a theoretical construct, only "visible" in the interviews from theoretical perspectives, I wanted my interpretative activity to be as transparent

as possible. This was especially necessary because my empirical material was interviews with young children whose life world and linguistic universe are rather different from mine. I contend that children's meaning ascriptions, the “web of logic”, the discourse in which they embed their experiences with school mathematics, are to be found in stories about their lived school mathematics world. The children’s narratives that I was looking for were rarely found as rounded well-formed stories ready to be copy-pasted into research papers. More often they unfolded as dialogues involving my active listening and questions (Kvale & Brinkmann, 2009). Consequently, a longer transcript is given rendering an example of the children’s voices. The following interpretation shows the analytical process. For reason of space, extracts from other interviews are summarised within the interviewees’ horizon of understanding and such condensates are used as a points of departure for the interpretation (Kvale, 1984; Lange, 2008a).

WE LIKE TO DECIDE OURSELVES

In an interview in October 2006, Maria and Isabella (all names apart from mine are pseudonyms) expressed that they liked the school subjects of design, swimming, physical education and visual art. Recently Maria had also started to like maths. When asked to comment on my observation that all the children seemed to like these subject the dialogue went as follows [2].

- 1 Maria ... because in design we do something creative and such. I like that and in physical education it is not only think, think, think, think, think, think, think all the time ...
- 2 Isabella It is also more that you, for instance in design we are allowed to decide ourselves how it [a teddy bear] should look like, how it should be, and also in physical education and such we sort of run around and play. (*She explains the different ball games they play assisted by Maria*)...
- 3 Troels Ok. And some of the good things [about visual art and design] is that you are allowed to decide more yourself?
- 4 Isabella Yes I think so because
- 5 Troels Yes, is it so that in mathematics and Danish and English you are not allowed to decide very much?
- 6 Maria I don't think so
- 7 Isabella No, yes but (Maria: you are not allowed so much) we are not allowed like decide (Maria: ourselves how) we must just like do the problems we get and
- 8 Maria And then we must do them and we may decide ourselves the way we do it, just that it is right. And that, then I like better some (Isabella: yes some) subjects where you just “Ah, what sh[ould]? How? Oh, I think I will do like this.”
- 9 Isabella Yes for instance you decide (Maria: how you yourself also) if you are going to draw a drawing if it should be a face or it should be, yes then you decide yourself and then. Yes it is like more, you can just sew

- 10 Maria Also where you can come up with ideas yourself. You cannot really do that, 'cos you cannot really come up with ideas. _ I don't think _ I just think it would be a good idea if like this sum came in because it was more difficult or a little easier because you cannot just
- 11 Isabella No decide just like that
- 12 Maria Here you can come up yourself, because when we should sew those teddy bears then you figured out yourself. I figured out myself that mine should have dots and that it should have such long legs
- 13 Troels So it is important that about deciding for yourself?
- 14 Maria Yes
- 15 Isabella Yes I like that

By the end of the interview Maria and Isabella asked me for what I was going to use the interview and if it was because I wanted to become a teacher. I told them that I was a “teacher teacher”.

- 16 Maria So you can see what you should do to make your class better?
- 17 Troels You may say so. It is because I would like to know how children think about mathematics
- 18 Maria Are you only teaching mathematics?
- 19 Troels Yes that is I teach how student teachers, people who want to become teachers, I teach them how they should teach mathematics
- 20 Maria And then you can tell it to them
- 21 Troels Yes
- 22 Maria And then they can do it and then they can see that you like to decide for yourself
- 23 Troels Yes
- 24 Isabella Yes
- 25 Maria I think that is good

Maria likes design because they do something creative (1; numbers refer to the transcript lines). She also likes physical education because it not only about thinking (1). Isabella likes that in design they may decide how a teddy bear should look like and that in physical education they run and play ball games (2, 4). In mathematics, they must do the problems they get (7); they may decide how they do them as long as they get them right (8), but they cannot really come up with their own ideas (10, 11). They like to use their imagination (8-12) and find it important to be able to decide for themselves as they can in visual art and design (13-15). This is the message they want me to bring to my teacher education students (16-25).

Interpreting the interview excerpt from my adult, research perspective, Maria and Isabella express that they appreciate when school subjects make space for their creative imagination (1, 8, 9, 10, 12) and decision making (2, 4, 9, 12-14, 22-25) and/or the presence of their whole playful body (1, 2). They experience these spaces in design, visual art, and physical education but not in mathematics (7, 10, 11). Here they are given problems that they have to get right (7, 8), and they cannot imagine

how ideas of their own could come into play (10, 11). They do not talk about getting a right *answer*, which would presuppose that there was a question. In Danish, Isabella talks about “lave opgaver” (“do problems”; 7), which is common “school mathematics” Danish. Nonetheless, it is a linguistic mix between the older phrase from the days of arithmetic “lave regnestykker” (“do sums”) and the language of the more recent reform curriculum “løse opgaver” (“solve problems”). There is a linguistic consistency between how they describe their activity as *doing* problems (7) and getting them *right* (8) – as opposed to *solving* problems, or *answering or exploring* questions as stipulated in the curriculum – and their experience of not being able to *come up with ideas* (10).

The other children interviewed in the same round of interviews as Maria and Isabella also liked practical/creative subjects and by and large for the same reasons: that they could use their imagination, do something with their hands, decide something, or engage in playful, physical activity often with competitive elements. They also thought that they did not make decisions in mathematics. The following paragraphs add more details to the picture drawn from the interview with Maria and Isabella.

Asked about differences between the subjects, in regards to what the children could decide, some children, all of immigrant background, said that there were no differences. After all, children cannot say no to what the teacher says (Hussein and Kamal); the teacher tells them what to do and then the children do it (Sahra and Bahia). Responding to the question, Kamal said that in history they are told off the least. Sometimes, they may decide a little in swimming. In maths, they are not allowed to decide anything and they are not told off so much either. Jette [the maths teacher] gives many five-minutes [short breaks]. An interpretation of this statement could be, that in the absence of agency in learning situations, what becomes of interest is how the teacher control is exercised (amount of telling off) and the allowance for time and space that is free of teacher control.

In school discourse, the academic subjects, in particular Danish, mathematics, and English (as a second language), are positioned and resourced as more important than the practical/creative. The children have incorporated this in their meaning ascription to their school experiences. Mathematics is important because being good in mathematics gives access to education which is a prerequisite for at future of their own choice (Lange, 2008a). Some children are explicit about the different valorisation of school subjects. Bahia and Sahra said that apart from mathematics, Danish was also an important subject; visual art not so much, design a little bit, and physical education was there in order to have fun. Kalila reflected the valorisation indirectly. When I asked which subjects she liked, she said that she liked mathematics and Danish, and asked, “Is it not that kind of subjects you are thinking of?” In reality, of all the subjects, she liked design and swimming the best. “That is more like something for me, I think”.

Many of the children described physical and bodily restraints imposed on them at school. Kalila in particular gave a vivid and heart-felt description of this and of her joy of using her imagination: In design, the teacher explains something if you keep your mouth shut. After that, you may run around, get up, talk and jump. In Danish, you must remain seated and not talk to your neighbour. In swimming, you may talk and be together and you cannot do that in maths. In design you make your own imagination of a doll, for instance, one crooked and one long eye, no nose, eyebrows – you may decide yourself. It is good to use your imagination. Kalila imagines her doll while the teacher tells about it. In Danish and maths, you cannot use your imagination. You must calculate in maths and not make your own numbers. After school, the smaller children in the recreation centre cannot go out and then come back whereas in the club for the bigger children like her you may go home and come back, go to the kiosk, bring lollies and have you mobile phone open. Children are generally very aware that they are growing. Agency is an important marker in this process; as Kalila explained older children have more physical freedom to move and to decide for themselves than younger children.

Thus, the subjects that the children like because of the agency, imagination and bodily freedom they are allowed, are positioned as not important, and the subjects positioned as important grant them little agency, space for choice or creativity, and exert a tight control of their bodies.

I DON'T LIKE MATHS WHEN I DON'T KNOW WHAT TO DO

These children grow up in a society where it is highly unclear which experiences of the older generations are valid, where the faculty to chose in almost every issue of life is paramount, and where creativity is highly valued in public discourse about present and future needs of individuals and society. Choice making and creativity are prime examples of agency, and the children in this research really appreciated when such features were part of their learning. The practical/creative subjects, thought of in the school discourse as recreational, seem to have more to offer in this respect, than mathematics and the other subjects positioned as the most important.

When making sense of their experiences, the children perceived no agency for them in school mathematics learning, and they could not imagine what it could be either. You are not supposed to make up your own numbers, as Kalila put it. Like the much older US high school students that Boaler and Greeno (2000) wrote about, these much younger student in a Danish comprehensive school were ascribed identities with minimal human agency. In the terminology of Klein (2001b), they did not perceive invitations and support to develop their authorship of mathematical constructions and ways of making sense. They did make sense – the sense seen in the interviews, but their sense-making was not part of their “official” mathematical activities. These sense-making processes are active undertakings on part of the children in which they contribute to the construction of the discursive field embedding mathematics education and thus need to be seen as an aspect of children's

agency. As such, they are co-creators of the social practices of mathematics education, even when these social practices lead to a restriction on agentic behaviour.

The “no agency” experience of mathematics learning is problematic for several reasons. It gives a distorted picture of academic mathematics, and it reinforces instrumental learning rationales (Mellin-Olsen, 1981). Such rationales are not conducive to the learning of students in difficulty with mathematics (Lange, 2008a) – if they were, they would not be in difficulty. When such children do not succeed in “getting it right” in what to them seem unrelated tasks, void of inherent meaning and agency, they are left with having to cope with unproductive and awful feelings of helplessness. Maha expressed these feelings when she said that she hates Sudokus and metre and centimetre, and that she does not like mathematics when she does not know what to do, and nobody comes to help her, and she just sits and waits and waits.

NOTES

1 I understand *postmodernity* as “a social condition, comprising particular patterns of social, economic, political and cultural relations” (Hargreaves, 1994, p. 38)

2 The Danish transcript is rather detailed and forms the basis of the interpretation together with the audio recording. The translation into English is a compromise between a direct translation, an attempt to retain some of the linguistic features of children's spoken language, and a light approximation to written language by removing some of the repetitions and incomplete sentences.

REFERENCES

- Benner, P. (2000). The roles of embodiment, emotion and lifeworld for rationality and agency in nursing practice. *Nursing Philosophy*, 1(1), 5-19.
- Boaler, J. & Greeno, J. G. (2000). Identity, agency, and knowing in mathematical worlds. In J.Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 171-200). Westport, CT: Ablex.
- Hargreaves, A. (1994). *Changing teachers, changing times. teachers' work and culture in postmodern age*. London: Cassell.
- Højlund, S. (2002). *Barndomskonstruktioner. På feltarbejde i skole, SFO og på sygehus*. [Kbh.]: Gyldendal Uddannelse.
- Holland, D., Lachicotte, W., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds*. Cambridge, Mass.: Harvard University Press.
- James, A., Jenks, C., & Prout, A. (1998). *Theorizing childhood*. Cambridge: Polity Press.
- Kampmann, J. (2000). Børn som informanter og børneperspektiv. In P.Schultz Jørgensen & J. Kampmann (Eds.), *Børn som informanter* (pp. 23-53). Kbh.: Børnerådet.
- Klein, M. (2001a). A poststructuralist analysis of mathematics inquiry in a Year 6

- classroom: The rhetoric, realisation and practical implications. In J. Bobis, B. Perry, & M. Mitchelmore (Eds.), *Proceedings of the 24th annual conference of the Mathematics Education Research Group of Australia, Sydney*, (Vol 2, pp. 347-354). Sydney: MERGA.
- Klein, M. (2001b). Correcting mathematical and attitudinal deficiencies in pre-service teacher education: The conservative effect of blaming the victim. In J. Bobis, B. Perry, & M. Mitchelmore (Eds.), *Proceedings of the 24th annual conference of the Mathematics Education Research Group of Australia, Sydney*, (Vol 2, pp. 338-345). Sydney: MERGA.
- Kvale, S. (1984). Om tolkning af kvalitative forskningsinterviews. *Tidskrift för Nordisk Förening för Pedagogisk Forskning*, 4(3/4), 55-66.
- Kvale, S. & Brinkmann, S. (2009). *InterViews: Learning the craft of qualitative research interviewing*. (Second ed.) Los Angeles - London - New Delhi - Singapore: Sage Publications.
- Lange, T. (2007). Students' perspectives on learning difficulties in mathematics. In L. Ø. Johansen (Ed.), *Proceedings of the 3rd Nordic Research Conference on Special Needs Education in Mathematics*, (pp. 171-182). Aalborg: Adgangskursus, Aalborg Universitet.
- Lange, T. (2008a). A child's perspective on being in difficulty in mathematics. *The Philosophy of Mathematics Education Journal*,(23) Retrieved 1 Nov 2008a, from <http://people.exeter.ac.uk/PErnest/pome23/index.htm>
- Lange, T. (2008b). The notion of children's perspectives. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education*, (pp. 268-277). Department of Education University of Cyprus: European Society for Research in Mathematics Education.
- Mellin-Olsen, S. (1981). Instrumentalism as an educational concept. *Educational Studies in Mathematics*, 12(3)
- Pickering, A. (1995). *The mangle of practice: Time, agency, and science*. Chicago: University of Chicago Press.
- Shilling, C. (1999). Towards an embodied understanding of the structure/agency relationship. *British Journal of Sociology*, 50(4), 543.
- Skovsmose, O. (2005). Meaning in mathematics education. In J.Kilpatrick, C. Hoyles, & O. Skovsmose (Eds.), *Meaning in mathematics education* (pp. 83-100). New York: Springer Science.

CHILDREN'S IDENTITY WORK IN MATHEMATICS

WHEN YOU ARE BAD AT IT, IT IS BORING:
CHILDREN'S IDENTITY WORK IN THE ARENA OF SCHOOL
MATHEMATICS

TROELS LANGE
AALBORG UNIVERSITY, DENMARK¹

¹ This research was undertaken as part of my Ph.D. research supervised by Associate Professor Paola Valero.

Abstract

School mathematics education is submerged in a discursive field of social valorisation and within this nested system provides an arena for children's identity work as it has a significant part in children's lived experience. Kalila¹ was a ten/eleven old girl living in Denmark who in a number of interviews articulated her experiences with mathematics learning in a way that showed how being in difficulties with mathematics affected her developing sense of identity. As a descendant of Middle East Muslim migrants, she belonged to a contested minority in the public discourse of the majority population. She believed mathematics was important to fulfil her dreams for her future. For this reason, she experienced mathematics learning as fun when she succeeded. On the other hand, experiences of struggling with learning mathematics were difficult for her because they threatened her hopes for her future. Kalila faced such big implications in her encounters with the social practices of school mathematics education. In the article, I look into how Kalila identified herself, what stories she created about who she was, and how she created the discursive counterpart to her lived experiences with school mathematics learning. I show how her identity work bore the marks of the discursive field that pervades mathematics education.

WHEN YOU ARE BAD AT IT, IT IS BORING: CHILDREN'S IDENTITY WORK IN THE ARENA OF SCHOOL MATHEMATICS

1. INTRODUCTION

In needlework we make our own imagination of a doll. You decide yourself what you want to do. It's cool. I don't think you can use your imagination in mathematics because there you must calculate. You should not make up your own numbers, if you see what I mean. (Kalila in interview, November 2006)

During the last century, children came to be recognised as human beings in their own right and subsequently child centred pedagogies were developed. The UN Convention on the Rights of the Child from 1989 was the first legally-binding, international document that gave children the full range of human rights; civil, cultural, economic, political and social. These rights included respecting the views of children. Recently, childhood research has begun to see children as agents in their lives, as opposed to mere subjects of upbringing. As a mathematics education researcher, I take seriously the quote above that comes from a ten-year-old girl. When researchers consider children as agents with their own valid interpretation of their life world, and when – in parallel – mathematics education research recognises learning, teaching and education as a much more complex phenomena than was conceptualised previously, then making sense of how the world looks through children's eyes is a task worth achieving.

In this paper, I discuss children's identity work in the area of social life constituted by school mathematics education. My discussion uses a case study of a ten/eleven year old girl who was struggling with learning mathematics in a Danish *folkeskole*, a comprehensive public school for Year zero/one to Year nine/ten. My aim is to show how she transformed her experiences with school mathematics into identity narratives about who she was. To do this, I draw on empirical material from a larger study involving interviews and observations of her mathematics class.

I conceive mathematics learning as an arena for identity work for children with the discourse that pervades mathematics teaching and learning as a 'force field' of socio-cultural valorisation that is 'inescapable' for teachers and students. Following Sfard and Prusak (2005), identity is conceived as the discursive counterpart of people's lived experiences and is defined as narratives made up from stories in the social environment. Thus, school mathematics education is the lived experience of children and their related identity narratives are the discursive counterpart of these experiences. The narratives are composed of stories 'floating around' in the environment, including the discursive field surrounding mathematics education. Studying such identity narratives can provide insight into children's perspectives,

their meaning ascription and sense making in regards to their experiences in school mathematics, and thereby contribute to the understanding of the complexity of mathematics education. This is indeed the case when studying identity narratives about a child who is confronted with perhaps not being 'normal' in respect to achievement in school mathematics.

The contention of the paper is that school mathematics constitutes a valorising field where children's identity construction takes place as a move between the individually and socially constructed ideas of ability and normality in the teaching of mathematics. In the next section, these theoretical ideas are described in more depth. Following a presentation of the methodology, I investigate the contention through a detailed analysis of one child's identity work.

2. MATHEMATICS EDUCATION IN A 'FORCE FIELD' OF SOCIAL VALORISATION

Mathematics education is an area of life that can be conceptualised as a social practice. Fairclough (2003) defined social practice as an intermediate organisational entity between structures and events that mediates the social structure and the events brought about by the agency of the participants.

Social structures are very abstract entities. One can think of a social structure (such as an economic system, a social class or kinship system, or a language) as defining a potential, a set of possibilities. However, the relationship between what is structurally possible and what actually happens, between structures and events, is a very complex one. Events are not in any simple or direct way the effects of abstract social structures. Their relationship is mediated – there are intermediate organizational entities between structures and events. Let us call these 'social practices'. Examples could be practices of teaching [...] in educational institutions. Social practices can be thought of as ways of controlling the selection of certain structural possibilities and the exclusion of others, and the retention of these selections over time, in particular areas of social life (Fairclough, 2003, p. 23f).

Thus, mathematics education can be considered a social practice that mediates between the socio-political structure and the events of mathematics classrooms. It is neither completely determined by the social structure, nor unlimitedly malleable at the will of the participants. The participants in mathematics education are social agents that have "their own 'causal powers' which are not reducible to the causal powers of social structures and practices" (Fairclough, 2003, p. 22); their actions are socially constrained, not totally determined. Conceiving of mathematics education as a social practice situated in an historical time, endows it with

complexity as an object of research because of the connections between the social, political, economic, and cultural context and the educational practices.

Any attempt to understand mathematics teaching and learning will refer explicitly or implicitly to an explanatory model, comprising the features used to explain observed phenomena. Every explanatory model will include basic assumptions on teaching, learning, schools, (school) mathematics, social structure, and human agency. Thus, these models address different aspects of the complexity of the social practice that mediates between the socio-political structure and the events of the mathematics classroom (cf. Ernest, 1998).

The simplest model would be the classical, didactic triangle, seen in Figure 1, with 'student', 'teacher', and 'subject' – in this case 'mathematics' – in the corners (Steinbring, 2005). These three factors act in unity and operate in any form of education. Someone, a student, is interested in something, e.g. mathematics, that someone else, a teacher, knows something about.

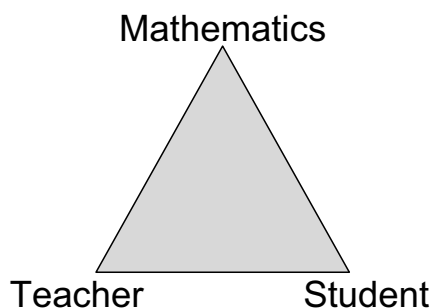


Figure 1. The didactic triangle

The model has its merits in pedagogical deliberations in the German/Nordic Didaktik tradition (see Hopmann, 2007). Yet, it does not indicate that mathematical learning takes place in a social context wider than that constituted by a student and a teacher. In addition, the model lends itself to problematic interpretations of learning as a primarily cognitive enterprise (Valero, 2004). Twenty years ago and from her background in educational anthropology, Eisenhart (1988) pointed to the desirability for mathematics education research to study, instead of taking for granted, the intersubjective meanings that constitute schools, classrooms, teaching practices, the arrangements in time and space, etc.

Recent research, described by Lerman (2000; 2006a) as “the social turn in mathematics education”, addressed these limitations by focusing on mathematics classrooms as the social context where mathematical meaning was negotiated and socio-mathematical norms were developed among students and teachers (e.g. Cobb

& Yackel, 1996). Figure 2 describes the micro-culture of a classroom as the unit for explaining mathematics learning as something more than a cognitive activity. The classroom becomes the instructional unit, where elements cannot be studied in isolation.

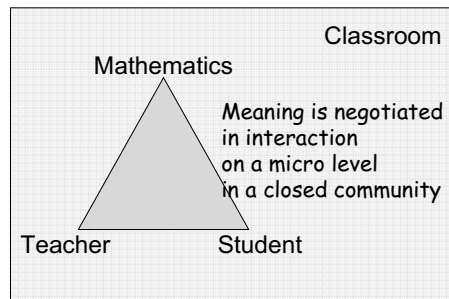


Figure 2. The classroom as the learning 'space'

While classroom-focused research opens up more complex conceptions of learning, it also has limitations and blind spots. Valero (2002; 2004) argued that this type of research gave an idealised picture of classroom activities in which the diversity of students, their whole human integrity, school life and life experiences disappeared.

The discourse of the reform about the student, as portrayed in dominant research, depicts a student who is either a context-free universal mind, a classroom bounded being or a participant of a limited learning community. This view opposes the nature of the students that one meets in real classrooms (Valero, 2002, p. 8).

This critique is partly ameliorated in Figure 3 through acknowledging students' differences, and the fact that what goes on in a classroom takes place within the organisation and logic of a school.

However, this model leaves out significant complexities of mathematics education. In a review on norms in mathematics education research, Herbel-Eisenmann (2003) raised the questions of how "other aspects of the participants lives [...] affect the ways in which they participate in the classroom [...] and what the participants take away from the classroom context?" (Herbel-Eisenmann, 2003, p. 13). She was questioning the assumption in classroom-based research that the participants can be reduced 'safely' to their classroom roles as teachers and students. Vithal and Valero (2003) made a similar point when arguing that mathematics education research and practice should recognise the social and

political conflicts in which they take place, and be concerned with the complexities and implications arising from such a recognition.

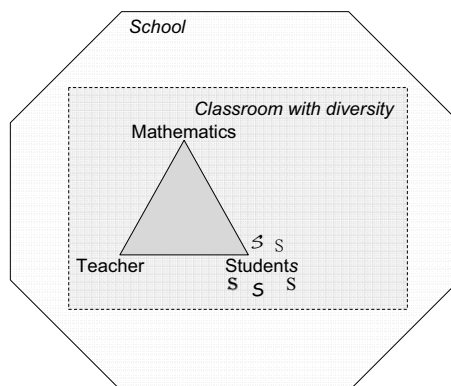


Figure 3. 'Real' classrooms situated in a school context

Schools, classrooms, interactions between teachers and students and between students themselves are situated in a specific historical, social, cultural and political context that values and gives preferences to certain forms and expressions of knowledge. Mathematics is considered important for society and individuals in modern, Western societies because of the power of mathematics to create the social world (Niss, 1996; OECD, 2004). However, from a critical standpoint, Popkewitz (2002, p. 35) sees mathematics as having an ideological function as “one of the high priests of modernity” carrying “the salvation narrative of progress” (cf. Skovsmose, 2005b). As a school subject, mathematics has a high status and is often a gatekeeper to further education. Being ‘good at maths’ is closely associated with being ‘bright’, ‘intelligent’ and other highly valued attributes (Ernest, 1998; Bartholomew, 2002). The negative mirror image of this is that school mathematics causes strong emotional reactions in people, as documented by research on the affective domain (e.g. Leder & Grootenboer, 2005). Publicly recognised phenomena such as maths anxiety (see Evans, 2000 ch. 4 for a review) and matching programs aimed at treating this condition are evidence of these effects.

The importance given to mathematics and achievements in mathematics means that the discursive field pervading mathematics education becomes highly charged. The notion of discursive field appears to be little used in mathematics education research.² In this paper, this notion emphasises that discourses support some ways of talking and hinder others. Inherently, a discursive field attributes value to some phenomena. I prefer the term valorisation to valuation because it better reflects that the value attribution is not an assessment of some natural or essential quality of

mathematics education, but rather the result of human agency.³ The field quality of discourses can be metaphorically illustrated with a physical analogy. As gravitational and magnetic fields define directions in the physical world, the discursive field assigns what is 'up' and 'down', 'south' and 'north', 'along' and 'against' thus constituting what could be termed a force field of social valorisation. The force field affects students' and teachers' perceptions of themselves and others, and their actions and interactions. It shapes backgrounds and foregrounds of students and their dispositions to engage in learning mathematics (Alrø, Skovsmose, & Valero, 2008; Skovsmose, 2005a). Being 'good' or 'bad' in mathematics, for instance, is embedded in a socio-political nexus beyond an individual's control. The force field of this discursive world is inescapable for students and teachers in the same sense that we cannot escape the gravitational field. It does not mean that people cannot talk or think in ways not aligned with the valorisations of the discursive field; rather, that they are always affected by the discursive field – socially constrained but not determined (see Lange, 2007b for an example). Figure 4 is a pictorial representation of the idea of the discursive field pervading school, classroom, teachers and students. The unidirectional arrows representing the discursive field, the force field of social valorisation, should not be taken as indicating that the 'force field' is non-contradictory.

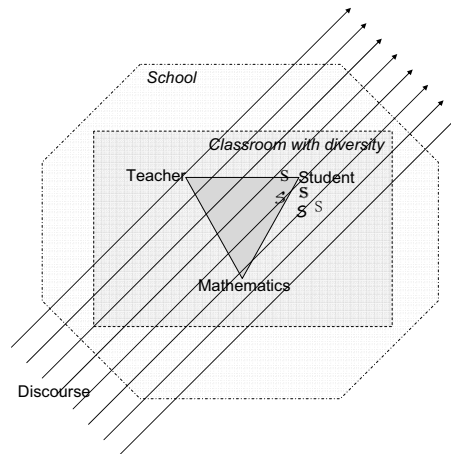


Figure 4. School mathematics teaching and learning in a discursive field

The force field 'materialises' in various ways. One example of relevance for this paper is the 'materialisation' of ideas connected to perceptions of mathematical ability in the frame of what is defined as mathematical competence. The PISA surveys provided an operational definition of mathematical competence, through

the notion of “mathematical literacy”, a definition that, for the purpose of the surveys, has a supposedly universal validity. The only other school subjects that have literacy defined for them are reading and science (OECD, 2004). Thus, in national and international public discourses that relate education and economic wealth, these three school topics are positioned as the most significant. By implication, other school subjects are of lesser importance. The measurements form the basis for international comparisons between countries and for national educational policies. Diving into the details, one can find students' performances distributed across “proficiency levels” constructed by complicated statistical procedures in the PISA framework. ‘Facts’ emerge from these distributions that feed into the discourse around mathematics education. One fact is that 15.4 % of Danish 15 year-olds performed at or below the lowest of the six proficiency levels in mathematics in PISA 2003 (OECD, 2004, p. 354). These facts contribute to the construction of very particular “social realities” (Jablonka, 2009) such as that of “mathematical learning difficulties” or “mathematical disabilities”, which need to be tackled by national educational policies and by teachers' practices.⁴

The force field of social valorisation around definitions of literacy, competence and ability has implications for children not performing in mathematics in ways prescribed by curriculum and tradition. Often, such students are said to *have difficulties* in mathematics or are described as being *weak*. As a jargon among teachers and even mathematics education researchers (e.g. Hannula, Maijala, Pehkonen, & Nurmi, 2005), these and similar expressions might be thought of as ‘linguistic shorthand’ for a type of recurring experiences of students. However, such expressions identify low performance as a personal attribute, a characteristic, or demerit of the child. Words have a life of their own, and reification of someone's actions in school mathematics into a characterisation of the person as ‘weak’ in mathematics is far from neutral, but heavily laden with disparaging associations and connotations. In addition, they may spur or legitimise social actions because “distinctions that are treated as real are real in their consequences” as Cobb and Hodge (2002, p. 259) described in a slightly different context. Rarely heard of are students who are considered to have difficulties in geography or to be weak in needlework. Mathematics is one of the few subjects where this phenomenon occurs (Damkjær & Lange, 2006). Contrary to these descriptions of mathematics difficulties as being owned by the children, current thinking in special needs education (Holst, Langager, & Tetler, 2004) describes low achievements in mathematics as a mismatch between children and their surroundings, a ‘system fault’ so to speak (Magne, 2001; Lange, 2007a; see also McDermott, 1993). In the end, school mathematics teaching is a prerequisite for performance in school mathematics that can be assessed one way or another. Hence, saying that a child *is in difficulty* in mathematics would linguistically recognise low achievement as a

socially constructed phenomenon and not as an essential characteristic of the child. This is not a game of words. If low achievement is seen as a manifestation of a child having/with difficulty, interventions will logically be directed at the child, whereas a child seen as being in difficulty also invites interventions directed at the system level (e.g. Dalvang & Lunde, 2006). Changing the way that an issue is discussed will impact on how explanatory models of teaching and learning are conceived.

The discursive practices in mathematics education tend to operate in such a way that performance and achievement in school mathematics are constructed as personal attributes of being good/bad, ability, level etc. (Valero, 2007). If learners experience the practices in mathematics education in this way then learning and teaching of mathematics become not primarily a place for learning mathematics, but an arena for identity work.

3. MATHEMATIC EDUCATION AS AN ARENA FOR IDENTITY WORK

As previously discussed, school mathematics learning does not take place in a normative vacuum. Schools present children with societal expectations, valorisations, and notions of normality, of which mathematics mediates its fair share. Children live whole lives and integrate their experiences with mathematics into coherent identities. Their experiences of meeting expectations, normality, and valorisations affect their perception of themselves (Wiliam, Bartholomew, & Reay, 2004; Hannula, Majjala, & Pehkonen, 2004). They work on their identity as they interpret, integrate, and come to terms with their experiences. Therefore, it is reasonable to think of school mathematics as a significant arena for children's ongoing formation of their identity. Consequently, identity building bears the marks of the force field of social valorisation that pervades mathematics education.

Up to now, I have used a common-sense notion of identity as a sense of 'who I am'. In the 1990s identity became popular in education research in varying interpretations, "an everyone help yourself" construct (Hoffman, 1998). In mathematics education research, there is a growing body of literature utilising the concept (e.g. Boaler & Greeno, 2000; Wiliam et al., 2004; Sfard & Prusak, 2005; Grootenboer, Smith, & Lowrie, 2006; Lerman, 2006b; Ingram, 2008; Stentoft & Valero, 2008; Black, Mendick, & Solomon, 2009). Grootenboer et al. (2006) advocated using the concept in mathematics education research because they saw identity as a unifying concept connecting elements in the learning environment that participants brought with them, such as emotions, cognitive capacities and life histories, that usually were studied separately. They viewed identity to be "how individuals know and name themselves [...] and how an individual is recognised and looked upon by others" (p. 612), and identified three main conceptualisations

of, or discourses on, identity: the psychological/developmental, the socio-cultural, and the poststructural characterised respectively in relation to locus of identity, identity formation, and theoretical alignment.

Lerman (2006b) also saw identity as a unifying concept. He gave no concise definition but took "identity as a way of capturing a fuller sense of the process of development in mathematics classrooms" (p. 6) and quoted Lave and Wenger (1991) for saying that learning and a sense of identity are inseparable. In the literature, he found a number of identities: "mathematical identity, [...] pedagogic identity, performative identity, social/localised identity in the late modernity, and identity expressed as voice/message" (p. 11).

Sfard and Prusak (2005) described identity as more useful than other concepts for conceiving of individuals' interactions with mathematics education. They found identity to be important for engaging with the questions: "*Why do different individuals act differently in the same situations? And why, differences notwithstanding, do different individuals' actions often reveal a distinct family resemblance?*" (p. 14; italics in original). They argued that identity "is a perfect candidate for the role of 'the missing link' in the researchers' story of the complex dialectic between learning and its sociocultural context" (p. 15). This was a reaction to the use of motivational notions such as beliefs and attitudes because of their "well-documented weaknesses" (p. 15) of an epistemological as well as ontological nature. For me, adopting the notion of identity can be helpful in dealing with the relationship between individual student's experiences of mathematics and the force fields of valorisation where they take place.

4. IDENTITIES AS NARRATIVES

In this section, I describe my use of Grootenboer et al.'s (2006) view of identity as "how individuals know and name themselves [...] and how an individual is recognised and looked upon by others". For the notion of identity to be a useful research concept, it needs to be defined operationally so that it retains this meaning. This is not a trivial matter. Sfard and Prusak (2005) argue that definitions of identity relying on expressions such as "who one is" or "being a certain kind of person" are untenable and harmful.

It is untenable because it leaves us without a clue as to where we are supposed to look for this elusive 'essence' that remains the same throughout [a] person's actions. It is potentially harmful because the reified version of one's former actions that comes in the form of nouns or adjectives describing this person's 'identity' acts as self-fulfilling prophecy (p. 16).

Sfard and Prusak (2005) suggested a narrative definition of identity and "equate identities with stories about persons" (p. 14) told by ourselves and others. By

defining identities as narratives, they construe “identity-making as a communicational practice and thereby reject the notion of identities as extra-discursive entities that one merely ‘represents’ or ‘describes’ while talking” (p. 16). This definition highlights human agency and the collective shaping of identities. Consequently, identities become the discursive counterpart of lived experience. Therefore, understanding identities becomes useful in understanding the discursively constructed force field of social valorisation of mathematics education and its impact on individuals.

Identity narratives are reifying, significant, and endorsable stories about a person. Narratives are endorsable when they faithfully reflect the state of affairs in the world to the identity-builder; significant when any change is likely to affect the storyteller's feelings about the identified person; and reifying when properties of the person's actions are turned into properties of the person. Linguistically, reification is often brought about by talking about *being* and *having* instead of *doing*, by the use of the verbs *be*, *have*, *can*, and by signalling recurrence by means of adjectives such as *always*, *never*, *usually*. For example “In the majority of school tests and activities so far, she has regularly done well and attained above-average scores” is reified into “She is an able student” or “She has a gift” (Sfard & Prusak, 2005, p. 16). Experiences of inclusion and marginalisation are likely to give rise to significant identity narratives. Institutional descriptions of “who one is” – e.g. tests, certificates etc. – provide reifying and significant narratives that the identity builder has little option but to endorse.

Identifying is the process of creating identity narratives. It enables us to see constancy in the flow of life:

despite the process of change, much of what we see now will repeat itself in a similar situation tomorrow. Based on this assumption, identity talk *makes us able to cope with new situations in terms of our past experience and gives us tools to plan for the future*. (Sfard & Prusak, 2005, p. 16; italics in original).

Identities are created from stories ‘floating around’ and are “products of discursive diffusion—of our proclivity to recycle strips of things said by others even if we are unaware of these texts’ origins” (Sfard & Prusak, 2005, p. 18). What we say about others and ourselves is a melting pot of social stereotypes, categories, and narrative genres. We do not create our stories from scratch (cf. Bruner, 1996; Goodson & Sikes, 2001).

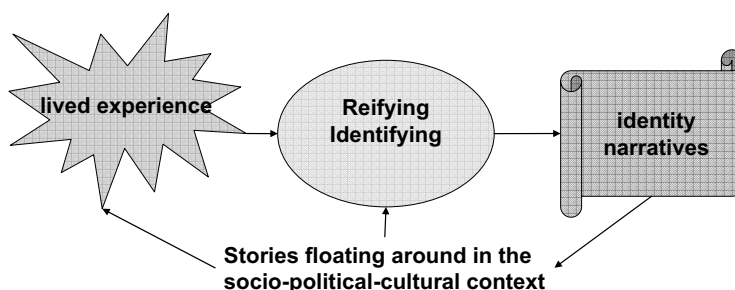


Figure 5. The reification of lived experience into identity narratives

Consequently, *identity work* is the effort on part of the identity-builder to create significant, endorsable and reifying identity narratives about him/her self. Identity work is the process of identifying with stories or narratives about yourself. Figure 5 pictures the process. Children's experiences with learning mathematics and of being in difficulties with mathematics, are part of their lived experience. In identifying, the discursive counterpart of experience is produced through the reification of identity narratives. The narratives are products of discursive diffusion, created from stories floating around in the socio-political-cultural context. Being part of this context, the social valorisation of mathematics is imprinted on the identity narratives. Hence, (some) identity narratives link children's lived experience with the discursive field pervading mathematics education.

In order to link learning and its sociocultural context, Sfard and Prusak (2005) distinguished between *actual* and *designated* identities. Actual identities are stories about the current state of affairs whereas designated identities are stories presenting a state of affairs, which is expected to be the case, if not now then in the future. Designated identities are not necessarily desired, but always are perceived as binding and giving direction to one's action. A perceived gap between actual and designated identities is likely to cause feelings of unhappiness unless it can be closed by learning.

In the following sections, I describe the empirical study from which I draw the material for this paper. I then interpret my interviews with Kalila, a ten/eleven year old girl, with respect to her identity work in learning mathematics. Although her views were those of one child, in many ways she articulated what many of the other children mentioned with less fluency.

5. THE STUDY, ITS METHODS, AND METHODOLOGY

The interviews with Kalila were part of a qualitative study aimed at exploring children's perspectives on mathematics learning in general and more specifically of being in difficulty with learning mathematics (Lange, 2007a). I interviewed children aged 10 or 11 years in a Danish Year four class and observed their mathematics lessons for almost a whole school year, on a more or less weekly basis. The observations of their mathematics classes served as background for the interviews. I explained my presence in the classroom to the children by saying that I wanted to learn from them what it was like to be in Year four, learn mathematics and sometimes find it difficult. Usually, I talked to individual students when they were working on their own. They saw me as another adult that could help them with mathematics. However, I abstained when they wanted me to exert a teacher's authority because this could have impeded the role of a dialogue partner that I wanted with them. The observations of the classes were recorded as field notes and audio files of the talks.

Three rounds of interviews were held. In the first, almost all students participated in one of three group interviews. In the second and third, approximately half of the students were interviewed in pairs or alone with some students participating in both rounds. The interviews lasted from 30-45 minutes and were audio recorded; the group interviews were also video recorded. They usually took place during the maths lessons, either in a meeting room adjoined to the staff room or in a classroom across the corridor from the children's normal classroom. I looked for students to interview singly or in pairs who, appeared to be low achieving. This was not so simple. Until recently, testing was not compulsory in the Danish Folkeskole until the final year. Therefore, even if I had wanted to use test performance as an indication of low achievement rather than my own judgement, it would not have been possible. In addition, it seemed important to represent gender and ethnicity, so in the end, 14 of the 20 students took part in at least one pair or single interview.

The assumption behind the methodological design was a general sociological experience that people – children included – confronted with not being 'normal', often become quite reflective about the normality to which their belonging is questioned (e.g. Højlund, 2002).⁵ Low achieving children could possess valuable and otherwise not easily accessible insight into school mathematics.

I also assumed that the students' knowledge could take the form of narratives as their experiences with school mathematics was part of their lived experiences. Consequently, I conducted semi-structured life world interviews. The notion of life

world originates from continental European philosophy and seems to be the same as what Sfard and Prusak (2005) termed lived experience:

The qualitative research interview has a unique potential for obtaining access to and describing the lived everyday world. The attempt to obtain unprejudiced descriptions entails a rehabilitation of the *Lebenswelt* – the life world – in relation to the world of science. The life world is the world as it is encountered in everyday life and given in direct and immediate experience, independent of and prior to explanations. ... The qualitative interview is a research method that gives a privileged access to people's basic experience of the lived world (Kvale & Brinkmann, 2009, p. 29).

In the previous section, identities were described as the discursive counterpart of lived experience. The descriptions of life worlds obtained in qualitative interviews are the discursive counterparts of the lived everyday world and have potential for bringing forth identity narratives. Consequently, using semi-structured life world interviews is in accordance with the research aim of exploring children's identity work as it unfolded in the arena of school mathematics. There is also resonance with the conception of mathematics as a socially constructed practice that could be interpreted in a multitude of ways.

The main informant for this paper, Kalila, participated in all three rounds of interviews. Kalila was 'at the edge' of several societal norms. She struggled with learning mathematics, whilst she carved out identity positions encompassing her minority background in the harsh Danish public discourse on the Muslim immigrants (Lange, 2008b). Importantly, she was also reflective about this process. This was clear in her participation in the group interview two months prior to the single interview analysed here (see Lange, 2008a).

Originally, I had not planned to include Kalila in the first round of pair interviews. In the group interview, Kalila was unruly several times to the point of disrupting the interview. The pressure to keep a minimum of order and become an authority figure threatened the role I wanted as the 'least adult' in the classroom. Nevertheless, she seemed to be the kind of 'voice from the margin' that I had been looking for by making very interesting contributions (Lange, 2008a). Subsequently, through frequent talks during the observations we established a good relationship. As the pair interviews began, she repeatedly harried me to be included and this allowed me to 'give in' on the condition that I interviewed her alone. The interview lasted 45 minutes and took place during a maths lesson.

In order to capture Kalila's voice and her making sense of and ascribing meaning to her experiences with school mathematics education, I have chosen to transcribe the interview as accurately as possible in her words. Notwithstanding

that oral speech should not be evaluated by standards for written language, the transcript reflects that Danish is not her first language. She sometimes missed words and many sentences were incomplete. In the interview situation, I understood her and when I was unsure, I asked clarifying questions. My choice of a close transcription made translation into English a non-trivial exercise. How to make it read as a transcript of a second-generation, non-native English-speaking child's English? My linguistic capacity does not allow for such a translation – and if it did, which non-native child's version of what version of English should it resemble? Therefore, in order to try to be true to Kalila's voice and her perspective (Lange, 2007b), the transcription is fairly accurate, the quotations lengthy, and given in Danish together with a literal – albeit a bit normalised – English translation .

In an endeavour to render the analytical process transparent, I follow Kvale's (1984) proposal of carrying out an interpretation on three levels. The first level is a summary of what the interviewee said in a language accessible to them and within their horizon of understanding. It is also called a meaning condensation. The second level of interpretation may transcend the interviewee's understanding while remaining within a common sense context. The interpretation can include general knowledge about the interviewee's statements, it can address the form of the statement, the way it is expressed and read "between the lines". At the third level of interpretation the interview is interpreted within a theoretical framework. The interpretation is likely to transcend the interviewee's self-understanding and a common sense understanding. In this paper, the theoretical framework used is the narrative definition of identity as outlined previously.

6. IDENTIFYING KALILA

This section identifies Kalila in common identity categories by presenting reifying, endorsable and significant identity narratives about her. I choose to italicise some of the keywords in the narratives so to introduce Kalila, by making evident the identity framework in which she moves.

Kalila was in a *Year four class* of 20 *children* with equal numbers of *girls* and *boys*. According to the official Danish terminology, she was a *descendant* because she was born in Denmark while her parents were born elsewhere (Danmarks Statistik, 2007). She lived in an apartment with her family of six children of whom she was number four. Her father had a shop and her mother worked at home. In the official educational terminology, she was a *bilingual* student because her *mother tongue* was Arabic. *Immigrants* and their children are a *minority* in Denmark.⁶ In this particular class, half of the children were descendants of immigrants from a Middle East region and the other half were ethnic Danes. The children talked about

Arabs and *Danes*, sometimes *Muslims* and *Christians*, whilst the *teachers* mostly talked about *bilingual* and *monolingual* students. To the children and teachers, gender, ethnicity, generation (child/adult), position at school (student/teacher) constituted major binary identity categories. In Bateson's (1972) words, they were differences that made a difference and therefore were named.

My observations began in the second week of the new school year. The children were re-establishing their social dynamics after the summer holiday and adjusting their identities to the changes involved in *moving up* to become a Year four class and physically moving from the *green corridor* of the beginner's level (Year zero to three) to their new classroom in the *blue corridor* of the middle level (Year four to six). From being the *oldest* among the *youngest* students, they were now the *youngest* ones in the *middle group* of students. Moving into the middle level meant new teachers, most importantly a new Danish and class teacher, and a new mathematics teacher.⁷ These changes seemed to cause some unrest in the class dynamics and unsettled the children in varying degrees. Kalila, for example, had many conflicts with her classmates and the mathematics teacher in the first months.

7. KALILA'S IDENTITY WORK

In the previous section, I presented Kalila using identifiers related to her position in the dominant categories of schooling. However, these identifications do not equate with the process of identification where Kalila and others tell significant, endorsable and reifying identity narratives about her. In the three interviews in which Kalila participated, I looked for identity work that is, operationally speaking, linguistic acts of identifying. The identity narratives themselves are of interest but more so the activity of identifying that Kalila engaged in during the interviews. Especially I was interested in how her identifying activity interacted with the force field of social valorisation that pervades school mathematics education. Kalila's identifying activity was woven into the dialogue and the same themes recurred several times across the transcript with small variations. Often her identifying activity did not result in clear-cut identity narratives in the way that Prusak and Sfard suggested. I present the recurrent themes in the analysis first and then exemplify them with excerpts from the single interview.

7.1 Kalila as a fashion designer

Kalila told several times about how she wanted to become a designer of clothes, or alternatively, have a clothes shop. That was one of her designated identities and a very important one at that point in time. This long-term designated identity, she had broken down in more immediate designated identities. In order to achieve that future, she needed "a good education". She conceived of mathematics, in line with Danish and needlework, as a particularly important subject in a good education. In

order to achieve in mathematics, she had to learn the multiplication tables and do her weekly assignments. To do this, she had to pull herself together and work hard with mathematics, listen to the teacher and not cheat by copying from others.

One might say that her designated identities were temporally layered: designer (shop owner) → design school → good education → mathematics → multiplication tables and weekly assignments → listen and pull herself together. Clearly, she thought of learning as means of bridging the gap between her actual identities, being a ten-year-old 'Arab' girl in Year four enjoying and being good at drawing clothes, and her designated identity of becoming a designer. In addition, she had a clear 'learning theory' for gaining mathematical qualifications. She mainly saw these as a collection of isolated skills, e.g. multiplication tables, "plus", "minus", times, and divide (see Lange & Meaney, 2008; Lange, 2008a). The discursive field pervading school mathematics education, the force field of social valorisation, is evident in Kalila's adherence to the socio-cultural narrative of education, including mathematics, as gatekeeper to the future.

In the interview, there appeared to be little about her actual identities apart from the understood common identity narratives indicated above. However, this is both not the case and a point. It is not the case because on some occasions, it seemed important for Kalila to 'narrate' herself as someone who was similar to everyone else. For instance, like most others, she knew most of the multiplication tables but not all; she was not the best nor the worst in reading; and in Year three she found mathematics "in the middle" in regards to easy and difficult.

The absence of sentences that expressed detailed actual identities – and this is the point – could be interpreted in the light of the words with which Kalila described her experiences with school mathematics education. These consisted of sets of binaries such as *fun/boring*, *can/cannot*, *good/bad at maths* or as two families of words, *fun – can – good* versus *boring – cannot – bad*. These binaries constituted two stories about mathematics. One was that maths is *fun* when you *can* because then you are *good* at maths, which is what maths is about because then you can get an education, which opens up a future of your choice. The opposite story was: maths is *boring* when you *cannot* because then you are *bad* at maths, which, in the logic of the first story, means that you have 'no future', at least not a future of your dreams. It is possible to argue that Kalila was aware of this and telling the second story – using easily identifiable reifying expressions – would have been traumatic, and so her actual identities were expressed mostly as vague sentences. To go into details would have been too painful. The vagueness served as a protection that let her maintain her hope.

In the following section, I provide some transcript excerpts of a single interview with Kalila in November 2006. The first excerpt and analysis exemplifies Kalila's identifying activity with respect to normality, and the second addresses the words she used to describe her experiences with learning mathematics.

7.2 Telling yourself in a force field of social valorisation

The interview opened with the question "What have you been doing today?" Kalila told that they had English, swimming, and history for two hours, which was rather boring. She got up at six o'clock, which was unusual but was because she looked forward to swimming, the second lesson that day. Until she went to school, she watched television, packed up her swimsuit and school bag, ate breakfast, put on her clothes, brushed her teeth, and had breakfast. Her mother made her lunch. She would not be at home this afternoon so Kalila would go to her dad's shop. He sold vegetables, sweets, and food, but most people bought Arabic bread. In history lessons, it was boring to watch a video and write down what was good and famous about Copenhagen [capital of Denmark]. They had also been told about bombs in Copenhagen and Aalborg some years ago [during the World War II] and she did not like to hear about bombs. She said it was boring. Swimming was fun because you did something, and you swam to the deepest end and moved your feet in a certain way. She could swim and dared jumping from the 'silver things' [platforms]. Not everybody in the class could swim well. Some stuck to the edge and dared not jump in the water.

The extract below⁸ follows on from that discussion. The extract and the analysis of it illustrate how Kalila 'tells herself' when she is not 'aligned' with the discursive field – the force field of social valorisation. The identity work is about how Kalila identifies herself when her most liked subjects, the practical/physical, are not the high ranking, academic, subjects.

- | | | | |
|-----|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 101 | Troels | Ok. - Hvad for nogle fag kan du ellers godt lide? | Okay. What other subjects do you like? |
| 102 | Kalila | Jeg kan godt lide matematik og dansk. Også selvom det ikke er – (uf) jeg mener ikke sådan her, mere sådan, læse og sådan noget. Er det ikke sådan nogle fag du mener? | I like mathematics and Danish. Even if it is not _ I mean not like, more like, reading and the like. Is it not that kind of subjects you are thinking of? |
| 103 | Troels | Nå jamen, jeg spørger sådan set hvad for nogle fag du bedst kan lide af alle dem der er | Well okay, I am asking what subjects you like the best of all the subjects that are |

- 104 Kalila Ok, så kan jeg bedst lide håndarbejde og svømning og sådan noget. Det er mere sådan noget for mig, synes jeg
- 107 Troels Det er mere noget for dig. Hvorfor er det noget for dig?
- 108 Kalila Altså, jeg kan godt lide sådan noget, jeg kan godt lide at lave sådan noget
- 109 Troels Hvad er det du godt kan lide ved det?
- 110 Kalila Jeg synes det er sjovt
- 111 Troels Du synes det er sjovt
- 112 Kalila Ja, for i håndarbejde der laver vi mange forskellige ting, så skal man sy og man skal lave det og sådan noget. Og i idræt der - der leger man leg og sådan noget. Det er rigtig sjovt. Og i svømning der svømmer man og sådan noget. Det er rigtig sjovt.
- 113 Troels Det vil sige man gør nogle ting
- 114 Kalila Ja
- 115 Troels Og det gør man ikke i dansk og matematik?
- 116 Kalila Nej, men det er ellers – jeg kan ellers godt lide de fleste fag. ...
- 119 Troels ... Hvad kan du godt lide ved dansk og matematik?
- 120 Kalila Altså, matematik der er det sådan nogle gange, altså, altså jeg kan ikke, jeg synes bare sådan det er ok
- 121 Troels Det er ok?
- Okay, then I like best needle work and swimming and the like. That is more like something for me, I think
- That is more something for you. Why is that something for you?
- Well, I like things like that, I like to do things like that
- What is it you like about it?
- I think it is fun
- You think it is fun
- Yes, 'cos in needlework we do many different things, then you sew and then you make this and the things like that. And in physical education you – you play games and things that like. That is really fun. And in swimming you swim and things. It is really fun.
- That is you do things?
- Yes
- And you don't do that in Danish and mathematics?
- No, but otherwise it is – otherwise I like most subjects. ...
- ... What do you like about Danish and mathematics?
- Well, mathematics there it is sometimes, well, well I cannot, I just think it is like ok
- It is okay?

122 Kalila Ja, altså der ikke sådan noget der er dårligt ved det. Yes, like there is not like something that is bad about it

In summary, Kalila liked mathematics and Danish if it is “that kind” of subjects I am thinking of (line 102 above). In fact, she liked needlework and swimming the best; these were more for her (104). She liked these subjects and physical education as well because you did or made something (108, 112-114). This was not the case in Danish and mathematics. Apart from that, she liked most subjects (116-118), although mathematics was only okay (120-122).

In a common sense interpretation, Kalila distinguished between two kinds of school subjects one of which included Danish and mathematics (102). By implication, the subjects she did not mention in the first place and that she actually liked the most, needlework, swimming, and physical education (104, 112), belonged to the other kind. The difference between the two groups seemed to be that the first involved reading (102) and the second did not.

From a theoretical point of view, the general school discourse in Denmark distinguishes between so-called academic subjects involving books and reading (the Danish term is *boglig* – ‘bookly’), and the non-academic, so-called practical/creative subjects. The former group is held to be the more important, intellectual, and prestigious subjects, and considered to be more “real” school subjects than the other group of subjects. Kalila seemed to have picked up this distinction, and presupposed that I held the same valorisation since she interpreted my question as only concerning the academic subjects (102). The reason for her presupposition may be that she expected me to represent this discourse as I was doing observations and interviews, because I was interested in children's mathematics learning. Her reaction showed how her narratives were marked by the force field of social valorisation. She was identifying herself when saying that needlework and swimming were “more something for her” (104), and that she liked the creativity, physical activity, and play that characterised these subject (107-113). She did not experience these features in Danish and mathematics (116). Nonetheless, she also identified herself as a positive student when saying that she liked most subjects (116), although mathematics only moderately (120-122).

This is not the only situation where the discursive counterpart of Kalila's lived experience, her life world, seemed to jar with the dominant public discourse. Later in the interview I asked her if somebody helped her with her homework. Her answer developed from “it is my dad” to “it is also my big sister” to “mostly my big sister”, and finally “You can pretty well say it is my big sister”. Considering that the sister in contrast to her parents has gone to Danish school for ten years, this could seem a sensible way for the family to support Kalila in her schoolwork. The

reason for Kalila being hesitant in describing the actual state of affairs could be that the Danish public discourse including the teacher only regarded help from parents as proper homework support (see details of this analysis in Lange, 2008b).

In both cases, Kalila's lived experience, the school subjects she felt was "more for her" and her family support, was positioned as 'low' in the discursive field. It devalued what she liked, her joy, what she felt allowed to express, and her family. In these cases, Kalila's identity work was uphill. It took extra effort because it was unaligned with the force field of social valorisation.

7.3 Being good is fun and future – being bad is boring and ...

In this section, Kalila's experience of learning mathematics is analysed by means of the words she uses to describe her experiences. The analysis shows how experiences described as fun were linked with being good and having a future and conversely how experiences described as boring were connected with being bad and having no future. Coping with and 'digesting' this vast range of identity issues and bringing this lived experience into narrative form as identity narratives is identity work. The discursive field provided the frame or set the premises for Kalila's identifying herself in respect to school mathematics. The extract below follows on from the former extract.

- | | | | |
|-----|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 123 | Troels | Er der nogle ting som du sådan særligt godt lide ved matematik, eller særlig godt, meget ikke kan lide? ... Er der nogle af tingene du bedre kan lide end nogle andre? | Are there some things about mathematics that you especially like or especially do not like? ... Do you like some of the things better than others? |
| 124 | Kalila | I matematik der er jo det der for eksempel med at man skal - lave streger og sådan der når man skal hoppe og lave streger og så hvor højt [en øvelse i natur og teknik hvor eleverne skulle hoppe og sætte en streg så højt oppe som muligt] | In maths there is for example that where you shall – make lines and such when you shall jump and make lines and then how high [an exercise in a science lesson where students should jump by a wall and put a line as high as possible] |
| 125 | Troels | Nåh, det I lavede dernede sammen med | Oh that you did down there with |
| 126 | Kalila | Ja det kan jeg ikke sådan rigtig lide | Yes that I kind of do not really like |

Children's identity work 23

- 127 Troels Det kan du ikke lide You don't like that?
- 128 Kalila Det er kedeligt. Men der er nogle ting der er noget der er rigtigt It is boring. But there are some things, there is something that is really
- 129 Troels Hvad er det for eksempel? What for example?
- 130 Kalila For eksempel man skulle løbe og så skulle man hoppe fem – altså sådan, løbe, ik å, tage tilløb for eksempel herfra. Så skulle man løbe og så hoppe her - en to tre fire fem. Det var ret sjovt. [dvs. tage tilløb og springe "fem-spring"] For example you should run and then you should jump five – like run, you know, run up for example from here. Then you should run and then jump here – one, two, three, four, five. That was quite fun [i.e. run up and jump five jumps]
- 131 Troels Ja, ok. – Hvad så når I sidder, nogle gange så sidder I og regner opgaver på et stykke papir Yes, okay. – What then, when you sit, sometimes you sit and do sums on paper?
- 132 Kalila Ja det kan jeg godt lide Yes I like that
- 133 Troels Det kan du godt lide You like that?
- 134 Kalila Ja for jeg synes, altså når man er god til noget så er det, så er det rigtigt sjovt. Når man for eksempel er dårligt til noget så synes man sådan "ah det er ret kedeligt" og sådan noget, at man ikke vil lave det for man kan jo ikke finde ud af det, så nytter det jo ikke noget når man ikke kan finde ud af det. Så når man ikke kan finde ud af det og man prøver og prøver og man ikke kan så nytter det jo ikke noget. Så får man jo heller ikke lært når man ikke kan Yes 'cos I think, really when you are good at something then it is, then it is really fun. When you for example are bad at something then you think like "ah it is rather boring" and such, that you don't want to do it 'cos you cannot work it out. Then it is of no use when you cannot work it out. So when you cannot work it out and you try and try and you cannot then it is of no use and then you don't get [it] learned either when you cannot
- 135 Troels Nej No
- 136 Kalila Hvis du forstår hvad jeg mener? If you understand what I mean?
- 137 Troels Nej prøv at forklare det lidt mere No try to explain a little more

- | | | | |
|-----|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 138 | Kalila | Altså for eksempel hvis der sidder en i klassen som ikke er god til at læse (ja) ja. Og hun prøver og prøver og prøver (ja). Altså hvis man nu skulle læse noget og man kunne ikke (ja). Så er det jo heller ikke særlig sjovt (nej). Så vil man jo ikke læse (mm ja). Og hvis det er sådan at man kan godt læse så synes man det er sjovt "Aj jeg vil blive ved med det. Aj det er spændende. Hvad kommer der efter det?" og sådan (mm) | Like for instance if there is one in the class who is not good at reading (yes) yes. And she tries and tries and tries (yes). Then if you should read something and you could not (yes). Then it is not particularly fun either (no). Then you don't want to read (hmm yes). And if it is so that you can read then you think it is fun "Eh I want to go on with this. Eh this is exciting. What comes next?" and such |
| 139 | Troels | Så det er træls når man ikke synes man kan? | So it is a drag when you don't think you can? |
| 140 | Kalila | Ja og det er så, aj, så synes man ikke det er spændende at læse (nej, nej, hmm). En gang der lånte jeg så en bog fra biblioteket. Det var ret sådan lidt svært. Altså jeg kunne forstå hvad den handlede om. Jeg kunne læse det men jeg kunne ikke forstå det | Yes and it is so, ay, then you don't think it is exciting to read (no, no, hmm). Once I borrowed a book from the library. It was rather like a little difficult. Like I could understand what it was about. I could read it but I could not understand it |
| 141 | Troels | Hm. Du kunne godt læse ordene men du kunne ikke forstå hvad meningen var? | Hm. You could read the words but you could not understand the meaning? |
| 142 | Kalila | Ja | Yes |
| 143 | Troels | Ja ok. Og så blev det kedeligt eller hvad? | Yes okay. And then it was boring or what? |
| 144 | Kalila | Ja så kan jeg bare ikke lide at læse | Yes then I just don't like to read |

In summary, Kalila thinks it is fun when she is good at something (134). That excites her, and she wants to do more (134). If she is bad at something it is boring (134). Then she does not want to do it (134). When she cannot even if she tries it is

of no use and she will not learn what she should (134). Once she borrowed a book that was too difficult for her and then she did not like to read (138-144).

At the common sense level, I noticed that when Kalila talked about activities she liked the best and the least in *mathematics* she gave me two examples that took place in a recent *science* lesson - jump up and put a mark on the wall, and jump five jumps (124, 130). The reasons why Kalila thought of them as maths activities could be that they involved measuring and that the maths teacher was also the science teacher. However, her answer could also be triggered not so much by the subject keyword in my question, mathematics, as by the experience keywords, like and not like. Both activities involved physical activity and from what she said earlier about swimming and physical education (112) you would expect her to like them. Her very different reaction to these seemingly uniform activities, she disliked the first and liked the second (124-130), could be that she felt unsuccessful – “bad” – in the first and successful – “good” - in the second by implication from what she said a little later (134). Prompted by my question about how she liked to do sums (131), which she did (132), she then explained the logic of liking and not liking (134). When you do something you are ‘good’ or ‘bad’ at then it is ‘fun’ or ‘boring’ respectively. She qualified the good/fun and bad/boring further in the following. The words linked to bad/boring were ‘cannot’, ‘not understand’, ‘difficult’, ‘not exciting’, ‘do not want to do’, ‘of no use’, ‘trying and trying’ and ‘not learn’ (134, 138, 140, 144). In contrast, ‘can’, ‘want to do’, ‘exciting’, and ‘curious’ were linked to good/fun (138). In her explanation, there are two almost complete families of words.

Table 1 shows the two groups of descriptors with the addition of the not-mentioned but implicated counterparts in italics. The quick/slow pair is not mentioned by Kalila in this interview, but occurred in the group interview (cf. Lange, 2008a) and in an interview at the end of the school year. Thus, Kalila provided a rich description of two different sets of experiences with learning situations. She exemplified her experiences consistently across three different activities: physical (124-130), mathematics (131-136), and reading (137-144).

From a theoretical perspective, the use of personal pronouns shows that identity work was involved. Until the story about reading (in 137-144), Kalila used the impersonal ‘you’ (‘man’ in Danish) with one exception (126). Then the pronouns started to change. From an unspecified ‘one in the class’, a single gendered third person ‘she’ is followed by several instances of the indefinite ‘you’ and finally to the first person singular ‘I’. This ‘I’ clarified that she had transformed personal lived experience into narrative form. I interpret the evolving choice of pronouns in two ways. On one hand, she generalised her own story and presented it as a common experience. On the other hand, she circled around whose story she was

telling, from anybody to a “she”, back to an indefinite, and finally to disclosing that it was her story. The circling suggested that it was a difficult story to tell.

Table 1. Kalila's dichotomies describing her mathematics learning experiences.

Good	Bad
Fun	Boring
Can (able)	Cannot (not able)
<i>Understand</i>	Not understand
<i>Easy</i>	Difficult
Exciting	<i>Unexciting</i>
Want to do	Do not want to do
Curious (“what comes next”)	<i>Incurious</i>
<i>Of use</i>	Of no use
<i>Trying with success</i>	Trying in vain (“try and try and try”)
<i>Learn</i>	Not learn
Quick	<i>Slow</i>

The dichotomous groups of descriptors in Table 1 seem to describe different categories of experiences that I have labelled as *experience-as-lived*, *experience-as-reflected*, and *experience-as-valorised*. The two first categories refer to a distinction that can be made in Danish (and German) between *oplevelse* (*Erlebnis*) and *erfaring* (*Erfahrung*), but not easily in English because both words translate to *experience*. When a distinction is made in Danish, *oplevelse* is the immediate unreflected experience-as-lived, whereas *erfaring* is the indirect accumulated experience-as-reflected. Words such as *fun*, *boring*, *exciting*, *don't feel like I take to* express immediate and unreflected experiences and accordingly categorise them as experience-as-lived, whereas words like *can*, *cannot*, *easy*, *difficult* are taken to involve more interpretation and reflection and hence labelled experience-as-reflected. The words *quick/slow* and *good/bad* are classified as experience-as-valorised because they evaluate experiences against a social norm. Sorting Kalila's words in these categories produces Table 2. The last category suggests that the sorting of Kalila's words into dichotomies is closely linked to some serious consequences.

Table 2. Categorisation of the words that Kalila used to describe her experiences with mathematics learning

Type of experience	Good & fun group	Bad & boring group
Experience-as-lived	Fun Exciting Curious (“what comes next”) Feel like Want to do Of use	Boring Unexciting (“not exciting”) Incurious Don’t feel like Don’t want to do Of no use
Experience-as-reflected	Can (know/able) Trying successfully Easy Understand Learn	Cannot (not know/able) Trying in vain (“try try try”) Difficult Not understand Not learn
Experience-as-valorised	Quick Good	Slow Bad
Consequences	Education “Future”	No education “No future”

One may argue about the categories and the exact placement of the words. For example, does ‘of use’/‘of no use’ express an experience-as-lived more than an experience-as-reflected. However, the main point is that each word/descriptor implicates or resonates with all the others in the same group and only has its full meaning from contrasting it to other group.

This suggests that the word ‘boring’ is to be understood as a ‘common denominator’ for all of the other experiences in this group. The interview with Kalila illustrated how a dialogue aimed at being sensitive to children’s perspectives may unravel details behind ‘boring’. ‘Boring’ was the ‘default’ word used by Kalila and the other children to describe unpleasant experiences. One reason for this could be that for children of this age it can be difficult to express their emotions and experiences and that they, therefore, resort to a general descriptor.

Another reason for the prominence of ‘boring’ as descriptor of unpleasant experiences could be that children can share experiences of being bored. ‘Boring’ blames the activity and not the person. Mathematics is fun when you can do it;

boring when you cannot. Boring means that you have tried and not succeeded and now you do not want to try anymore because it feels of no use. Hence, you are left in a very unpleasant situation with no possible actions that could change the situation. This is a state of powerlessness. Thus, the identity narrative "I am powerless" is lurking just around the corner of expressions like 'it is boring'.

Kalila's designated identity was to become a designer of clothes and in her perception that required her to get a good education. In her here-and-now perspective this implied being good at school, in particular at reading and mathematics. The chain of words from fun via can/know to good is linked to education which is linked to a 'future'. Conversely, the boring – cannot – bad chain is linked to no education and 'no future'. School, reading, and mathematics education are not free choices for children in many societies around the world. Therefore, children's experiences of being powerless are not self chosen but imposed upon them with all of the authority of school in general and reading and mathematics in particular.

8. DISCUSSION

School mathematics education as a social practice is an arena for children's ongoing identity construction. Their identifying processes take place in the highly charged discursive field pervading school mathematics education. This field was described metaphorically as a force field of social valorisation. In the arena of school mathematics education, children exert their causal powers, their agency, when working out how to identify themselves, that is, when constructing the narrative counterpart to their lived experience with mathematics learning. However, in narrating themselves, they recycle narrative elements from a collective fund of stories 'controlled' by the social practice of mathematics education and the pervading discursive field. Hence, their narrative agency, so to speak, is constrained by the force field of social valorisation. The impact on Kalila identity work is seen when she identified with the 'grand narrative' in the Danish society of education as the road to her future. She saw "a good education" as a necessary stepping stone to her dream of becoming a clothes designer. This designated identity was broken down to a temporally sequenced set of designated identities like doing her homework and being good at important school subjects, in particular mathematics and reading, in order to finish school successfully. The impact of the discursive field on her identity work was also seen in Kalila's effort to identify herself as normal in respect to the social practice of mathematics education.

The school and the teacher contributed to Kalila identifying herself as a normal mathematics learner in different ways. The teacher never publicly ranked the children according to her perception of their mathematical achievements. As well

the school prioritised its resources so that special assistance for students was provided in reading but not in mathematics. Consequently, the category of 'students with special educational needs in mathematics' was not present in the practices and discourses at this school. Thus, Kalila was not labelled as a student with difficulties in mathematics, either by the teacher nor by the school. Nevertheless, the class teacher expressed concerns for her academic achievement. Literacy in Danish is a main focus for Danish schools especially in early school years. For this reason and because she was a bilingual student, Kalila's linguistic skills in Danish were monitored. Based on her reading performance, she received special tuition in reading, together with two other students in the class. I learned this from the other children, not from Kalila herself, which suggests this was a sensitive issue for her. In the interview extract, this may be why her concern for her reading skills only surfaced after a longish circling around it (see lines 138-144) and from the despair that emanated from her description.

The non-labelling of Kalila as a student in difficulties with mathematics seemed to protect her designated identity, which was her hope for her future. This gave her the energy to "pull herself together" – as she phrased it – in order to do her mathematics homework so that she could learn her multiplication tables and do her assignments with a limited number of errors.

Kalila illustrated Sfard and Prusak's (2005) point that designated identities give direction to one's action and that learning is the primary means of closing a gap between actual and designated identities. Kalila's designated identity directed her to make an effort to overcome the up-hill battle involved in learning mathematics. The reasons behind her engagement in the learning of mathematics – needing an education to be a clothes designer – dominated the immediate meaning that she gave to mathematics. Her main resource for learning mathematics and thus closing the gap between her designated and actual identities was her need to pull herself together, to trust the teacher and listen to her, something the teacher often told the students to do. Kalila might not pick up all of the mathematical clues that the teacher intended, but she listened when the teacher recycled strips of the discourse. For example, when the teacher explained cheating, as something which only cheated yourself because you were the one who did not get an education, she recycled the teacher's words. She also trusted the teacher as guaranteeing her learning (Lange, 2008a).

In other circumstances, Kalila could have been excluded from the normality of the class community because of her low achievement. Instead, she was included and could uphold her actual identities of being a normal student because of the inclusive and non-labelling practices of the teacher and the school, and because students are not streamed in a Danish folkeskole. This sustained her sense of

belonging, her trust in the teacher and her hope for her future, which gave her the strength to continue trying to learn mathematics as she thought it should be learned.

CONCLUDING REMARKS

In this paper, I suggest that school mathematics is embedded within a force field of social valorisation and this has an impact on the identity work that children are constantly involved in as they make sense of their lived experience. Participating in school mathematics is part of children's lived experiences and, as such, are incorporated into their identity narratives. Although participants in school mathematics can exert some influence over these experiences, they are constrained in what they are able to do by this force field of social valorisation.

Kalila's stories about her mathematics experiences were integrated into her wider stories about learning and her future. Her experiences with learning mathematics were not separated from the rest of her life. Although these stories were from just one child, other interviews suggest that she was not alone in meshing her mathematics learning experiences into considerations about her future. Consequently, there is a need for teachers and other adults to pay more attention to how the stories that they tell, generally in order to motivate students to become more engaged, can in fact result in distress. Children, like Kalila, who are unable to fulfil societal expectations about performing at a certain level in mathematics can be faced with long-term implications for their future that they can only expect to live out over the years ahead. Stories from children at the edge, as Kalila was, show a significant awareness of what the norms are and what needs to be done to stay within the boundaries of being normal.

Fortunately, by still seeing herself as having some success in learning mathematics, albeit in a reduced form of what mathematics learning could be, she was able to retain her positive attitude towards mathematics as part of her future. It is doubtful whether this situation can be maintained for too many more years, even if she stays with the same teacher, in the same school. As the daughter of Arabic-speaking, immigrant parents, the societal discourse is likely to contribute to Kalila's ultimate story of failure by allowing adults in her educational experiences to expect such a result as being typical of these children. She has been able to maintain her sense of being normal by telling stories about being in the middle of the class for learning, with some children ahead of her and some behind. Her stories revealed a designated identity that also saw her as having normal expectations for a future, which was not unlike those of her native Danish speaking peers. Thus, at this point, although she is able to exert some influence over how she relays her experiences, she is still constrained, and is most likely to be further constrained in the future, by the force field of social valorisation. At some point,

she is likely to realise that she is not able to perform at the same level in mathematics as her peers and then her expectation of a “good future” also will need to be seriously readjusted.

From the perspective of mathematics education research, Kalila's stories show the value of listening to children describe what they know about mathematics learning. All too often in the research literature, children's perspectives are when researchers have asked children about something that the researcher is interested in. What can be learnt from Kalila's stories is that asking children about their perceptions can actually provide informative views about mathematics education. Kalila's learning theory shows just how problematic some teaching approaches can be if we want children to see some relevance in learning mathematics. Children who describe their mathematics lessons as boring cannot be dismissed as not being engaged and who if they only tried would be able to learn. Expressing that a lesson is boring can be an indicator that the child is struggling and is facing some serious implications for their future. By blaming the tasks, they are reducing their own feelings of inadequacy from not meeting performance expectations and reducing the impact on their identities.

ACKNOWLEDGEMENTS

I wish to thank Tamsin Meaney and Paola Valero for good discussions and helpful comments on earlier versions of this article.

REFERENCES

- Abreu, G. d. & Cline, T. (2007). Social valorization of mathematical practices: The implications for learners in multicultural schools. In N.S.Nasir & P. Cobb (Eds.), *Improving access to mathematics: Diversity and equity in the classroom* (pp. 118-131). New York: Teachers College Press.
- Alrø, H., Skovsmose, O., & Valero, P. (2008). Inter-viewing foregrounds: Students' motives for learning in a multicultural setting. In M.César & K. Kumpulainen (Eds.), *Social interactions in multicultural settings*. Sense Publishers.
- Bartholomew, H. (2002). Negotiating identity in the community of the mathematics classroom. In P. Valero & O. Skovsmose (Eds.), *Proceedings of the Third International Mathematics Education and Society Conference*, (pp. 185-195). Copenhagen: Centre for Research in Learning Mathematics. Available at <http://www.mes3.learning.aau.dk/default.htm>
- Bateson, G. (1972). *Steps to an ecology of mind*. New York: Ballantine books.
- Black, L., Mendick, H., & Solomon, Y. (2009). *Mathematical relationships in education: Identities and participation*. New York: Routledge, Taylor and Frances.
- Boaler, J. & Greeno, J. G. (2000). Identity, agency, and knowing in mathematical worlds. In J.Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 171-200). Westport, CT: Ablex.

- Bruner, J. (1996). *The culture of education*. Cambridge, Mass.: Harvard University Press.
- Cobb, P. & Hodge, L. L. (2002). A relational perspective on issues of cultural diversity and equity as they play out in the mathematics classroom. *Mathematical thinking and learning*, 4(2&3), 249-284.
- Cobb, P. & Yackel, E. (1996). Sociomathematical norms, argumentation, and autonomy in mathematics. *Journal for Research in Mathematics Education*, 27, 458-477.
- Dalvang, T. & Lunde, O. (2006). Med kompass mot mestring - et didaktisk perspektiv på matematikkvansker. *NOMAD - Nordic Studies in Mathematics Education*, 11(4), 37-64.
- Damkjær, H. S. & Lange, T. (2006). Lavt præsterende elever, matematikvanskeligheder og regnehuller. *Mona*, (1), 87-90.
- Danmarks Statistik (2007). *Indvandrere i Danmark 2007*. København: Danmarks Statistik. Available at www.dst.dk/ebog/indvandrerereidk
- de Freitas, E. (2004). Plotting intersections along the political axis: The interior voice of dissenting mathematics teachers. *Educational Studies in Mathematics*, 55(1-3), 259-274. Retrieved 15 Dec 2004, from <http://dx.doi.org/10.1023/B:EDUC.0000017694.18374.d6>
- Eisenhart, M. A. (1988). The ethnographic research tradition and mathematics education research. *Journal for Research in Mathematics Education*, 19(2), 99-114.
- Ernest, P. (1998). A postmodern perspective on research in mathematics education. In A. Sierpinska & J. Kilpatrick (Eds.), *Mathematics education as a research domain. A search for identity. An ICMI study* (pp. 71-85). Dordrecht: Kluwer Academic Publishers.
- Evans, J. (2000). *Adult's mathematical thinking and emotions: a study of numerate practices*. New York: Routledge Falmer.
- Fairclough, N. (2003). *Analysing discourse : Textual analysis for social research*. London and New York: Routledge.
- Goodson, I. F. & Sikes, P. J. (2001). *Life history research in educational settings*. Buckingham: Open University.
- Gorgorió, N. & Planas, N. (2005). Norms, social representations and discourse. In M. Bosch (Ed.), *Proceedings of the Fourth Congress of the European Society for Research in Mathematics Education*, (pp. 1176-1181).
- Grootenboer, P., Smith, T., & Lowrie, T. (2006). Researching identity in mathematics education: The lay of the land. In P. Grootenboer, R. Zevenbergen, & M. Chinnappan (Eds.), *Proceedings of the 29th annual conference of the Mathematics Education Research Group of Australia*, (pp. 612-615). Adelaide SA: MERGA Inc.
- Hannula, M., Maijala, H., & Pehkonen, E. (2004). Development of understanding and self-confidence in mathematics; grades 5-8. In *Proceedings of the 28th International Conference of the International Group for the Psychology of Mathematics Education*, (Vol 3, pp. 17-24).
- Hannula, M. S., Maijala, H., Pehkonen, E., & Nurmi, A. (2005). Gender comparisons of pupils' self-confidence in mathematics learning. *NOMAD - Nordic Studies in Mathematics Education*, 10(3-4), 29-42.
- Herbel-Eisenmann, B. (2003). *Examining "norms" in mathematics education literature: refining the lens*. Retrieved 21 June 2007, from <http://www.msu.edu/~jansenam/NCTM2003.html>
- Hoffman, D. M. (1998). A therapeutic moment? Identity, self, and culture in the anthropology of education. *Anthropology & Education Quarterly*, 29(3), 324-346.
- Højlund, S. (2002). *Barndomskonstruktioner. På feltarbejde i skole, SFO og på sygehus*. [Kbh.]: Gyldendal Uddannelse.
- Holst, J., Langager, S. C., & Tetler, S. (2004). *Specialpædagogik i en brydningstid*. (1. udgave ed.) Århus: Systime Academic.

- Hopmann, S. (2007). Restrained Teaching: The Common Core of Didaktik. *European Educational Research Journal*, 6(2), 109-124.
- Ingram, N. (2008). Who a student sits near to in maths: tension between social and mathematical identities. In M. Goos, R. Brown, & K. Makar (Eds.), *Proceedings of the 31st Annual Conference of the Mathematics Education Research Group of Australia*, (pp. 281-286). MERGA Inc.
- Jablonka, E. (2009). Mathematics for all. Why? What? When? In C. Winsløw (Ed.), *Nordic research in mathematics education* (pp. 293-305). Rotterdam: Sense.
- Klein, M. (2008). How humanism can foster mediocrity in early years mathematics education: a poststructuralist comparison. In M. Goos, R. Brown, & K. Makar (Eds.), *Proceedings of the 31st Annual Conference of the Mathematics Education Research Group of Australia*, (pp. 311-316). MERGA Inc.
- Kvale, S. (1984). Om tolkning af kvalitative forskningsinterviews. *Tidskrift för Nordisk Förening för Pedagogisk Forskning*, 4(3/4), 55-66.
- Kvale, S. & Brinkmann, S. (2009). *InterViews: Learning the craft of qualitative research interviewing*. (Second ed.) Los Angeles - London - New Delhi - Singapore: Sage Publications.
- Lange, T. (2007a). Students' perspectives on learning difficulties in mathematics. In L. Ø. Johansen (Ed.), *Proceedings of the 3rd Nordic Research Conference on Special Needs Education in Mathematics*, (pp. 171-182). Aalborg: Adgangskursus, Aalborg Universitet.
- Lange, T. (2007b). The notion of children's perspectives. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education*, (pp. 268-277). Department of Education, University of Cyprus: European Society for Research in Mathematics Education.
- Lange, T. (2008a). A child's perspective on being in difficulty in mathematics. *The Philosophy of Mathematics Education Journal*, (23) Retrieved 1 Nov 2008a, from <http://people.exeter.ac.uk/PErnest/pome23/index.htm>
- Lange, T. (2008b). Homework and minority students in difficulties with learning mathematics: the influence of public discourse. *Nordic Studies in Mathematics Education*, 13(4), 51-68.
- Lange, T. and Meaney, T. (2008). *If a quarter crashes, so it dies : children's meaning making in mathematics lessons*. Manuscript submitted for publication
- Lave, J. & Wenger, E. (1991). *Situated learning. Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Leder, G. C. & Grootenboer, P. (2005). Affect and mathematics education. *Mathematics Education Research Journal*, 17(2), 1-8.
- Lerman, S. (2000). The social turn in mathematics education research. In J. Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 19-44). Westport: Ablex Publishing.
- Lerman, S. (2006a). Cultural psychology, anthropology and sociology: the developing 'strong' social turn. In J. Maasz & W. Schloeglmann (Eds.), *New mathematics education research and practice* (pp. 171-188). Rotterdam: Sense.
- Lerman, S. (2006b). Learning mathematics as developing identity in the classroom. In P. Liljedahl (Ed.), *Proceedings of the 2005 Annual Meeting of the Canadian Mathematics Education Study Group*, (pp. 3-13). Burnaby, BC: Canadian Mathematics Education Study Group.
- Magne, O. (2001). *Literature on special educational needs in mathematics. A bibliography with some comments*. Malmö: Department of Educational and Psychological Research, School of Education, Malmö University. Available at <http://www.lut.mah.se/pedinst/specialped.html>

- McDermott, R. P. (1993). The acquisition of a child by a learning disability. In S. Chaiklin & J. Lave (Eds.), *Understanding practice: Perspectives on activity and context* (Paperback 1996 ed.) (pp. 269-305). Cambridge: Cambridge University Press.
- Morgan, C. (2009). Questioning the mathematics curriculum: A discursive approach. In L. Black, H. Mendick, & Y. Solomon (Eds.), *Mathematical relationships in education: Identities and participation* (pp. 97-106). New York: Routledge, Taylor and Francis.
- Niss, M. (1996). Goals of mathematics teaching. In A. J. Bishop, K. Clement, C. Keitel, J. Kilpatrick, & C. Laborde (Eds.), *International handbook of mathematics education* (pp. 11-47). Dordrecht: Kluwer.
- OECD (2004). *Learning for tomorrow's world. First results from PISA 2003*. OECD.
- Peters, M. & Burbules, N. C. (2004). *Poststructuralism and educational research*. Lanham, Md.: Rowman & Littlefield Publishers.
- Popkewitz, T. S. (2002). Whose heaven and whose redemption? The alchemy of the mathematics curriculum to save (please check one or all of the following: (a) the economy, (b) democracy, (c) the nation, (d) human rights, (e) the welfare state, (e) the individual). In P. Valero & O. Skovsmose (Eds.), *Proceedings of the Third International Mathematics Education and Society Conference*, (pp. 34-57). Copenhagen: Centre for Research in Learning Mathematics. Available at <http://www.mes3.learning.aau.dk/default.htm>
- Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher*, 34(4), 14-22. Retrieved 25 Oct 2005, from
- Skovsmose, O. (2005a). Foreground and politics of learning obstacles. *For the Learning of Mathematics*, 25(1), 4-10.
- Skovsmose, O. (2005b). *Travelling through education. Uncertainty, mathematics, responsibility*. Rotterdam: Sense Publishers.
- Steinbring, H. (2005). Analyzing mathematical teaching-learning situations: the interplay of communicational and epistemological constraints. *Educational Studies in Mathematics*, 59(1-3), 313-324.
- Stenoft, D. and Valero, P. (2008). *Identities-in-action: exploring fragility of discourse and identity in learning mathematics*. Manuscript submitted for publication
- Valero, P. (2002). The myth of the active learner: From cognitive to socio-political interpretations of students in mathematics classrooms. In P. Valero & O. Skovsmose (Eds.), *Proceedings of the Third International Mathematics Education and Society Conference*, (pp. 1-13). Copenhagen: Centre for Research in Learning Mathematics. Available at <http://www.mes3.learning.aau.dk/default.htm>
- Valero, P. (2004). Postmodernism as an attitude of critique to dominant mathematics education research. In M. Walshaw (Ed.), *Mathematics education within the postmodern* (pp. 35-54). Greenwich, CT: Information Age Publishers.
- Valero, P. (2007). A socio-political look at equity in the school organization of mathematics education. *ZDM Mathematics Education*, 39, 225-233.
- Vithal, R. & Valero, P. (2003). Researching mathematics education in situations of social and political conflict. In A. J. Bishop, K. Clement, C. Keitel, J. Kilpatrick, & F. K. S. Leung (Eds.), *Second international handbook of mathematics education* (pp. 545-591). Dordrecht; Boston: Kluwer Academic Publishers.
- William, D., Bartholomew, H., & Reay, D. (2004). Assessment, learning and identity. In P. Valero & R. Zevenbergen (Eds.), *Researching the socio-political dimensions of mathematics*

education. Issues of power in theory and methodology (pp. 43-61). Boston, Mass.: Kluwer Academic Publishing.

NOTES

¹ All names are pseudonyms.

² “[M]athematics education is a *discursive field* in which the discourses of mathematics and education come together in teaching strategies that structure the learning experience” (Klein, 2008, p. 315; my italics). According to searches on Google and Ebsco Education 17th November 2008, this was the only use of the expression ‘discursive field’ in relation to mathematics. Even though the notion of discursive field is not explicitly used, similar ideas have been discussed by others, e.g. Valero (2007), Morgan (2009), de Freitas (2004), Vithal and Valero (2003).

³ Valuation and valorisation in relation to mathematics are discussed in Abreu and Cline (2007) and Gorgorió and Planas (2005). Valuate has a sense of assessing the ‘real’ or ‘market’ value of something, whereas valorise conveys the sense of value as something ascribed by human agency and as somewhat arbitrary.

⁴ For a discussion of this issue in the Nordic region, see the fourth issue of the eleventh volume of *Nordic Studies in Mathematics Education* on the topic of difficulties in/with mathematics (<http://www.ncm.gu.se/node/1863>).

⁵ “It is often by studying the ‘deviants’ defined as such by a particular society that we reveal the characteristics and complexities of the ‘normal’ – which are rarely recognized or justified as anything other than natural. ... [B]y studying who gets counted as ‘black,’ we learn how ‘whiteness’ is a color too – and not just an absence of color” (Peters & Burbules, 2004, p. 71)

⁶ The official Danish statistics distinguishes between immigrants, descendants i.e. children of immigrants, and Danes. Immigrants and descendants comprised 8.8% of the population in 2007. About two thirds of the immigrants and descendants originated in non-Western countries (Danmarks Statistik, 2007).

⁷ It is common practice in Danish *folkeskoler* that classes have the same teachers in their main subjects in year 1-3, in year 4-6 and in year 7-9. This class for instance changed their Danish teacher, who was also the class teacher, and their mathematics teacher from the beginning of year 4. These two teachers taught most of the subjects of the class.

⁸ In the transcript, hyphens (-) signal pauses, commas (,) that the speaker starts again on a sentence, underscore () inaudible words, and three dots (...) omissions. Small sounds or comments by the listening person are indicated by brackets (); they are only transcribed when the speaker responds to them. The line numbers refer to the original transcript.

Chapter 4: Looking back and forward

In this chapter, I discuss the papers as a whole in regards to how they made use of the total body of empirical material as well as how they responded to the research question. Not all the empirical material was explicitly mentioned in the papers. The next section describes why this was the case by discussing the decisions around including specific transcripts but also through showing how other material was drawn on more implicitly.

Rather than write papers that specifically addressed individual sub-questions, I considered each of the sub-questions to a greater or lesser degree in each of the papers. In the second section, I go through the papers to show how each of them contributes to what we can now say in relationship to the questions.

The implicit complexity in the research question and sub-questions meant that clear answers could not be expected. Instead, the answers give some elaboration about being in difficulties in mathematics from children's perspectives, but there is still more to be unpacked.

Writing about the empirical material

In the papers written so far, I concentrated on analysing interview extracts (papers 1-3 and 5-6) or a teaching episode and a conversation during a lesson (paper 4). This section describes in more detail how the larger body of empirical material contributed to the analysis. Table 3 shows how the interviews were used in the papers. The last

four interviews in the table came from School B and informed paper 2.

Table 3. List of interviews, the recording date , and their use in papers. A “++” means that an extract of the interview is used in the paper heading the column, “+” indicates explicit reference, and “(+)” that it informed the writing.

Interview	Date	Paper					
		1	2	3	4	5	6
Pilot	Jan 05	++					
Group 1	Sep 06		++			+	+
Group 2	Sep 06		(+)			+	(+)
Group 3	Oct 06		(+)		(+)	+	(+)
Isabella Maria	Oct 06		(+)			++	(+)
Ghazala Maha	Oct 06		(+)	(+)		+	(+)
Frederik Kasper	Oct 06		(+)			(+)	(+)
Hussein Kamal	Oct 06		(+)			+	(+)
Kalila	Nov 06		(+)	++		+	++
Bahia Sahra	Dec 06		(+)	(+)	(+)	+	(+)
Frederik Simon	May 07		(+)			(+)	(+)
Kalila Maha	May 07		(+)	++			+
Hussein Ishak	May 07		(+)	(+)			(+)
Sahra Zahra	May 07		(+)	(+)	(+)	(+)	(+)
Isabella Maria	May 07		(+)				(+)
Maths teacher A	May 07			++			
Girl 1 Girl 2	May 07		(+)				
Girl 3 Girl 4	May 07		(+)				
Boy 1 Boy 2	May 07		(+)				
Maths teacher B	May 07						

Paper 1, "The notion of children's perspective", has the simplest empirical background as it only had the one interview from the pilot study to draw upon. The remaining papers have a more complex relationship to the empirical material from the main study.

In paper 2, "A child's perspective on being in difficulty in mathematics", only extracts from the first group interview were used and these focused on Kalila's contribution in this interview. However, the other interviews were interrogated for statements that supported or contradicted the analysis in the paper. For the purpose of structuring and focusing the paper, it was useful to concentrate on Kalila's perspective because she was so articulate, but my construction of her perspective was informed by the meaning the other children ascribed to mathematics. Their perspectives had many commonalities with each other and with Kalila's perspective in regards to the general sense the children made of mathematics. Hence, although Kalila's perspective was personal, it was not idiosyncratic.

Paper 3, "Homework and minority students in difficulties with learning mathematics: the influence of public discourse", referred explicitly to interviews with Kalila and Maha and their mathematics teacher. Interviews with the other children of immigrants showed that their families were similar in respect to number of children in the family and older siblings providing homework support.

Paper 4, "If a quarter crashes, so it dies: Children's meaning making in mathematics lessons", was different to the other papers, in that it used a teaching episode and a conversation with Sahra ("RC1" in the paper) during a lesson. The analysis was informed by my knowledge of her perspective on mathematics from pair interviews and the group interview in which she took part. Other conversations with her and other children during lessons also informed my interpretation of the operation of a traditional didactical contract.

Paper 5, "'Tell them that we like to decide for ourselves' - Children's agency in mathematics education" focused on an extract from an interview with Isabella and Maria but also referred to a number of other interviews. Again, it was these girls' ability to

articulate ideas, which resulted in their interview being chosen for inclusion in the paper. The page limit of a conference paper meant that I had to choose a concise extract that conveyed the main points expressed by many of the children.

Paper 6, “When you are bad at it, it is boring: School mathematics as an arena for children's identity work”, focused on Kalila. Consequently, it specifically quoted the single interview but also drew on her other interviews. Paper 6 to some degree can be seen as a deeper analysis of the issues dealt with in paper 2. Consequently, and as was the case with paper 2, the analysis was informed by the broader picture from the other interviews from the same class, in particular contributions from other children ‘at the edge’.

The papers were composed so that there was a focus on individual children with Kalila as the “main character”. The examination of the empirical basis for the papers shows that the children's perspectives presented have a broad foundation in the interviews. This suggests that the descriptions in papers 2 to 5 of children's experiences with mathematics teaching and learning were common to all the children in this class.

So far, no papers have been written based on data from School B. In fact, the field work at School B is not even mentioned. Attempts were made but always disappeared before a final version of a paper was reached. Without claiming entirely rational decision making, there are several reasons for the choice to concentrate on the material from School A. Their common core – which perhaps is clearer in hindsight than in the course of the events - has to do with the issue of mathematics education in a multicultural setting.

At the time of my enrolment in PhD studies, Helle Alrø, Ole Skovsmose and Paola Valero had a research program, “Learning from diversity – Conflict, Communication and Mathematics Education in the Multicultural Classroom” (<http://www.lfd.learning.aau.dk/>; Alrø, Skovsmose, & Valero, 2003). As it was part of my upcoming research environment, I looked for connections. Though my project was not defined in relation to issues related to multicultural classrooms, I saw some affinity between

students in difficulties and students with another ethnic background than that of native Danish:

“It is the same problematic – deviations from a presupposed homogeneity but with the multicultural as a starting point. How can you in the way you think of teaching take as point of departure that conflicts are a fact and find the resources in that? It is a question of inclusion, marginalisation and exclusion”.²⁴

In the later study plans, this aspect was left out in order to keep a clear focus. It re-entered the field of enquiry inadvertently, but not unwelcomed, when half of the children, in the class at School A, turned out to be descendants of immigrants. The multicultural aspect was absent in the class at School B, where there were only children of ethnic Danish descent.

My interest in the multicultural aspect was spurred by a meeting with teachers at School A. Answering my question about the origin of the immigrant children, they said that they did not really know, “mostly from Arabia and some from Croatia”. What triggered my curiosity in regards to this apparent lack of interest in the students’ background was the institutional dimension. To only see this as a personal choice of the teachers would miss the more important point that such choices apparently did not clash with the policy of the school or of the local community or with national school policy. I saw the non-recognition of ethnic background, a core identity issue, as an example of “system violence”.

At the same time, the achievement of immigrant children (including descendants) was high on the public agenda in the period of the project (cf. paper 3). Being embedded in the public Danish discourse on immigrants at the time, just as anybody else was, I was interested in seeing if I could add a multicultural dimension to my project. Hence, I found the multicultural setting at School A more

²⁴ Translated from “Ansøgning til CVU Midt-Vest om flerårsaftalemidler 2004/2005” of 1. March 2004, which was my application for a Ph.D. stipend at CVU Midt-Vest. It was the first description of the project.

interesting. I observed for a longer time, did more interviews and my data seemed richer. In addition, once I started writing papers that should form a thesis, it seemed easier to attain coherence if I stuck to the same set of data.

A decisive reason to concentrate on the empirical material from School A was Kalila. In her I found an informant who combined being in difficulties with mathematics, with being a descendant of immigrant parents. She attracted my attention during observations because of what I now see as identity work, giving me rich descriptions of her life-world and stories about her lived experiences with school mathematics. Three of the papers, 2, 3 and 6, started as one paper attempting to focus on her. As the paper began to be written, it was soon clear that it had to be split in order to create a focus for each paper and to better utilise the empirical material.

The observations and interviews at School B have been useful in providing contrast to the field work at School A. They reminded me of the similarities and differences in between schools, classes, mathematics teachers and mathematics teaching. Differences notwithstanding, the data set from School B provided some 'triangulation' of my data in the sense that it showed to me that the particular cases of children's experiences were not "particularly particular".²⁵

"Answers" to the research question

In this section, I discuss how the research question has been addressed in the papers, and in doing this, I point out how the individual papers relate to the sub-questions. The research question and the three sub-questions were:

RQ: How do children experience being in difficulties with learning mathematics?

²⁵ The phrase is inspired from Aase Holmgaard who once said in the context of children with special educational needs that "all children are special but some are more special than others".

SQ1: What meanings do these children ascribe to mathematics and mathematics teaching and learning?

SQ2: How do these children experience processes of inclusion and marginalisation connected to mathematics teaching?

SQ3: How may these children’s narratives be contextualized and theorized?

Table 4 gives a snapshot of the relationship between papers and sub-questions. All of the papers have attempted to contextualise and theorise children’s narratives about their experiences with school mathematics (SQ3). Most of the papers have dealt specifically with children’s meaning ascriptions (SQ1) and some of them with the question about inclusion and marginalisation (SQ2). In the following section, the outline in the table is given more details in a discussion organised around the individual sub-questions.

Table 4. Papers and research subquestion. A "++" indicates that the question is a major focus in the paper whereas "+" that the question is dealt with in the paper.

	1	2	3	4	5	6
SQ1	+	++	(+)	++	++	++
SQ2	+	+	++			++
SQ3	++	++	++	++	++	++

The research question specified that “children in difficulties” were the children whose experiences I should look for. However, in the following, I will not always make a distinction between experiences of children in or not in difficulties. One reason is that this distinction was not always clear “in the field”. Another is that in many respects the differences in meaning ascription seemed to be limited to a question of degree rather than quality.

SQ1: Children's meaning ascription to school mathematics
 As part of the unpacking of the main research question, the first sub-question operationalised the term “experience” by focussing on

meaning ascriptions. The papers explored how children experienced learning mathematics to a lesser extent than expected by curriculum and school tradition. It was important to know what sense and meanings they ascribed to their experiences. This connected to how their self-concept, identity and social life were related to or influenced by their problems in learning mathematics.

In paper 1, my aim was to clarify the notion of children's perspective and as such it is not an empirical paper. However, the example used in the paper suggested that Dennis and David "interweave[d] the meaning of mathematics education into a fabric of friendship, belonging, expression and construction of identity, and the social practice of everyday life" (p. 274) and that their learning intentions were related to this fabric and not to mathematics as such.

Dennis and David's story about going "up" and "down" provided me with an initial insight into the force field of social valorisation which was theorised and defined in Paper 6. Dennis exerts his agency to remain in control by "making himself better" and hence "go up" and belong to "the best group". The teachers' grouping of the children according to "ability", possibly well-intended to serve teaching/learning needs of the students, was counter-acted by Dennis who made himself "better" for reasons of friendship (being in the same group as David) and status (going "up" and being in the "best" group).

In Paper 2, the analysis showed that the children made sense of their school mathematics experiences in a way that integrated a

comprehensive range of questions on what school mathematics is about, what productive ways of teaching are, how they learn, what signs tell them that they are learning, what it is like to learn mathematics, and why they should learn mathematics. Their sense making apparently seamlessly connected their immediate experiences in the classroom with the prospect of their future life into a coherent whole (p. 12).

The children's/Kalila's ascription of meaning to their experiences with school mathematics was clearly linked to their/her foreground of education and jobs. Mathematics "itself" (if such a "thing" exists in a

school setting) seemed fragmented into almost unrelated procedures. All authority to judge correct from incorrect resided with the teacher and took on a material form in the teacher's ticks. Kalila's foreground was directly connected to these ticks. The paper focused on Kalila's meaning ascription, which was particularly detailed but not qualitatively different from the other children. Kalila and Isabella, another child in difficulties, were particularly observant of the teacher's "tick practices" and explained them in great detail.

In paper 3, I argued that the social practice of school mathematics includes homework as a 'sub-practice' that extends school mathematics beyond classrooms to family life and positions the child as mediator and medium in the home-school interaction. Thus, the children's meaning ascriptions to homework are part of their meaning ascriptions to school mathematics. The homework practices in 'traditional' mathematics teaching ensures that children in difficulties need more help than children who achieve within the norms. These practices also operate around the norm that in 'proper' Danish families, parents help their children. Hence, the sub-practice of homework includes for some children, not least children who already are struggling with mathematics, the experience of their family/parents as insufficient, and this experience will be part of the meaning that they ascribe to mathematics.

Paper 4 picked up the thread from paper 2 concerning children's conception of mathematics. It showed how two children ascribed meaning and made sense of mathematics learning activities from a set of intentions that had more to do with the social practices of their mathematics classrooms than gaining relational understanding of mathematics. The analysis highlighted the children as "active agents" using their agency to maintain the exercise paradigm and a "traditional" didactical contract, even when these were challenged by the adults with whom they interacted.

I continued the discussion in paper 5 on children's agency from paper 4. The children ascribed to mathematics little or no space for agency, choice and creativity and this was similar to how they viewed other "academic" school subjects. Although they were able to argue that being able to decide for themselves was important in

mathematics, they had difficulty imagining how this could be. It seems to me that the ability to deprive children of this degree of agency is only possible because mathematics is ascribed such importance as this is in direct contrast to what children sense they need for their future lives in a post-modern world.

In paper 6, I deepened the analysis begun in paper 2 of the identity work involved for children when 'digesting' their experiences with school mathematics. I showed how the discursive field pervading mathematics education affected Kalila's identity narratives and that succeeding with learning mathematics was understood in terms of the perceived implications for her future. Therefore, Kalila's foreground is connected intimately to the meaning ascriptions given to her mathematics learning.

In summary, the main research question was: how do children experience being in difficulties with mathematics? Looking at the first sub-question, it seems that children do not experience mathematics learning in isolation but rather as part of their whole life experiences. It is characteristic of the stories that mathematics seems to be a field of performance and identity, that is either being "good" or "bad", rather than being a body of knowledge worthwhile in its own right.

SQ2: Experiences of inclusion and marginalisation

The sub-question about the experiences of inclusion and marginalisation for children in difficulty in learning mathematics was coined at a time when I had not realised that special needs education in mathematics was not provided by many schools, one of them being School A. I had in mind research reports on children not experiencing special education as the blessing it was intended to be (see chapter 1). Children were reported to feel stigmatised by being taken out of the social community of a class. In some cases but not all, an experience of special education as actually making a difference to a child's learning could compensate for this stigmatisation.

I had not expected to meet crude forms of exclusion or marginalisation, such as tracking/streaming that at an early age restrict children's future access to education and occupation. Rather, I had anticipated more subtle forms of marginalisation experienced by

children who did not learn mathematics easily in the conditions that were provided (societal, cultural, school setting, resources, teacher qualifications, textbooks, organisation of teaching, pedagogy, etc.). These conditions would consequently have imposed upon the children an impression of themselves as being inferior, where the inferiority came from the social status of mathematics and “mathematical ability”.

When I realised that I would not meet children labelled as having special needs in mathematics at School A, I was not quite sure what to do with this sub-question. Was it a fixed idea of mine based on untenable assumptions? If not, could I “answer” it with the empirical material I was likely to get? It did not become easier, when furthermore it turned out that it was not simple to point out children who not only could be said to be, but also felt that they were in difficulties (see paper 2 and 6). Eventually, I decided to keep the sub-question to see what happened and as a provocation to myself.

In paper 1, Dennis and David’s story about going “up”(being better) or “down” (being worse) is a story about public stratification that might not be explicit but that the children easily saw through. Apparently, the grouping of the children was not openly announced as being according to “ability”. It was possibly well-intended in the sense that it was meant to facilitate the children’s learning of mathematics. However, the children, represented by Dennis and David, interpreted the grouping arrangement in terms of stratification and status. In this case, Dennis was able to act against the stratification and the loss of status by “making himself better”. Nonetheless, the story may be interpreted in terms of “in/out” or inclusion/exclusion in relation to normality and it indicates that school mathematics is an arena where inclusion and marginalisation takes place. It also showed that Dennis could decide not to make himself better and to use his agency to withdraw from putting effort into his maths learning.

In paper 2, it can be seen that Kalila was not positioned as disadvantaged or labelled as being “in difficulties”. However, she was very aware of the significance of succeeding in mathematics for her future. This played out in her sensitivity to how success was

attributed (teacher's ticks) and to her experience of learning mathematics, and possibly in her detailed and rich reflections. Therefore, although stories about marginalisation and inclusion were not explicit in the children's stories, it was clear that they were just below the surface. Some of the aspects that contributed to them remaining below eye level are discussed in more detail in paper 6.

While paper 2 did not deal with issues of marginalisation directly, the main contribution of paper 3 was to illustrate how the subtle mechanisms of inclusion and exclusion operated. It did this by showing how Kalila dealt with her family being positioned in relationship to questions about homework support. She seemed to have picked up some of the discourse about the normality of the ethnic Danish family with father, mother and two children even if not told directly. This appeared in her stories about who helped her with her homework.

Non-Western immigrant children, including descendants, as a group is under achieving. They are already under pressure and so to not have the support mechanisms within their families recognised as legitimate is very problematic.

Paper 4 has no obvious contribution to the issue of inclusion and marginalisation. However, the issue is touched upon in the discussion about gender and ethnic/cultural background. These girls, one in Denmark and one in New Zealand, are not actively marginalised. However, if issues of gender and ethnicity/culturality are not addressed in the way the teaching is conducted, they may be disadvantaged. Marginalisation can take many forms and children not "being seen" is one of them. If the norms and forms of authority are different in the children's families and at school, not addressing these differences institutes the norms of the majority (white, Western, middle class). As the story of Kalila's homework indicates, these norms are sensed by the children and they react to them.

Paper 5 does not deal with issues of marginalisation and inclusion. Nevertheless, in this paper, I consider how reinforcing instrumental rationales for learning mathematics can lead children who have no or very little agency, to experience helplessness when they run into

difficulties. It may be that continuing experiences of helplessness can cause children to exclude themselves from mathematics learning opportunities.

Paper 6 is a story of Kalila holding onto her hope for the future. This paper connects being good in mathematics to a good education and a good future and vice versa. The children's descriptions of subjects or activities as boring is a way of keeping the blame for failure distant but also something that can be shared with others. It picks up the themes in many of the earlier papers. Although marginalisation and inclusion are not discussed directly by the children, understandings of the implications of being failures in mathematics are just below the eyelevel of the children.

The inclusion of this sub-question had been to challenge me to look for how inclusion or marginalisation may appear in the data. My original sense of marginalisation was about stigmatisation of children because of their poor achievement in mathematics. This could be the case for a child at School B, who received special needs education in mathematics and who appeared to be stigmatised for this reason. However, at School A, the children's perceptions of issues of marginalisation were not about how mathematics teaching and learning contributed to them being stigmatised; there was no explicit labelling and thus stigmatisation. Rather, the way the marginalisation occurred was through the combining of two heavy discourses, one about being in difficulties in mathematics and the other about being a descendant of immigrant parents. These two discourses reinforced each other, in paper 3, to put extra pressure on Kalila to position herself as normal. This is an elaboration of the point in paper 4 about needing to understand and respect children's backgrounds in providing mathematics learning opportunities. Children's awareness of mathematics as a social stratifier and gate keeper was evident in papers 1, 2 and 6.

SQ3: Contextualisation and theorisation

My research aim was to bring to the fore children's experiences of being in difficulties in learning mathematics. As was discussed in chapter 1, in the beginning, I chose not to adopt a particular theory to

guide my study, although I was influenced by ethnographic, sociological and socio-cultural theories. Mathematics was considered a social practice and learning difficulties to be socially constructed. I saw children's narratives as connecting their individual experiences with the cultural narratives on mathematics and the social construction of learning difficulties. The life-world contextualisation and the narrative, socio-political theorisation had methodological implications in that the research methods needed to invite, allow and encourage children to narrate their experiences and to support them in unfolding their perspectives. This was done through semi-structured life world interviews. The challenge was to construct a conceptual frame that could provide guidance and act as a theoretical lens with which to analyse and grasp the material of the study.

Paper 1 dealt with the notion of children's perspectives, which was an important initial consideration, given the focus of the project. Children's perspectives were defined as the "active making sense of and ascribing meaning to – in this case – mathematics learning [...] the meaning the child ascribes to actual and potential learning acts or other acts in the school mathematics field" (p. 270). Consequently, it was now possible to look for children's perspectives by identifying their meaning ascriptions. The definition provides a prelude to the focus on agency in later papers. The definition also made operative the link to Skovsmose's cluster of foreground, background, disposition, intentions, meaning, action and reflection that are discussed in detail in paper 4. The cluster emphasises the person's interpretation of the socio-political context and intentional action, agency in other words.

Children's perspective is an analytical construct and thus raises the question of the researcher's perspective: from what point of view does the researcher look in what direction and using what size of zoom lens?

In paper 2, I explored the notion of children's perspectives using material from the main research site, School A. The paper was an attempt to use the notion of children's perspectives and in so doing it raised some methodological issues. The analysis in three levels suggested by Kvale (1984) was a way of taking seriously children's

perspectives as an analytical construct. It also brought to the forefront, questions about how to include the transcripts. I justified the inclusion of long extracts written in both Danish and English in order to be true to their perspectives. The analysis confirmed that semi-structured life world interviews were possible with 10 year old children.

The analysis in paper 3 showed how Kalila's story about her homework could be understood within the context of the harsh public discourse about immigrants and their children's school achievement. This illustrates how stories of the classroom can be linked to the wider socio-political context. Without this wider context, the analysis would have been very different. Goodson suggested, as discussed in chapter 1, instead of giving voice, a non-contextualised analysis could have silenced Kalila's story as being just an individual's story.

Theoretically, paper 4 merges the framework of the didactical contract into Skovsmose's meaning cluster. The didactical contract conceptualises a facet of the social practice of school mathematics and makes visible a contractual aspect of the relation between students and teacher. In the absence of well-staged learning activities, intentions and meanings are formed without reference to the mathematical content knowledge that the activities were meant to foster.

The analysis in this paper also developed the notion of children's agency by arguing that their sense making of the learning experiences was an expression of their agency. Both children exerted their agency so that they fulfilled their expectations of what should occur and did not take up opportunities to learn mathematics in other ways that may have lead to more valuable understandings. These expectations would have been developed through previous experiences both inside and outside the classroom. In this paper, we also explored how contextual knowledge about the children could impact on researchers' interpretations of what occurs in the classroom. This is connected to the explanatory models discussed in paper 6.

The penultimate paper continued to explore ideas about agency. It describes three aspects of agency. These were children as social actors, agency in mathematical activity and bodily agency. In chapter 1, the idea of seeing children as social actors was introduced and in this paper, this idea is discussed in detail. Previous research on this in mathematics education had focussed on high school children, but the data clearly showed that younger children are also able to describe their need for agency. Making sense of their mathematics experiences from a whole life perspective resulted in the children being very aware of how their bodily movements were restricted in their mathematics lessons. They were able to contrast what happened in their mathematics lessons, with what happened in some of their other subjects, such as needlework and physical education.

In paper 6, I bring together a range of theoretical perspectives about how children's identity work is marked by the social force field of valorisation that pervades mathematics education. These themes, begun in earlier papers, were unpacked, elaborated upon and connected coherently in this final paper. School mathematics as a social practice mediates between the socio-political structure and the events of the mathematics classroom. When identities are the discursive counterparts of lived experiences, then the force field of social valorisation constrains, but without determining, the stories that are told and the ways in which these stories are told. This is why identities links individual agency with the social structure in which mathematics education is embedded.

The research question asked how children experienced being in difficulties in mathematics. It was broken down into three sub-questions. The first sub-question operationalised children's experiences to their meaning ascriptions. The second question was more specific and had the character of a hypothesis that focused on one possible set of experiences. The final sub-question was about making sense of children's experiences for adults, including myself, by requiring them to contextualise and theorise these experiences into a broader conceptual space. Thus, the reflections on the three research sub-questions form the "answer" to the main research question.

Conclusions and implications

In this final section, I reflect on the contribution of the project to understanding children's experiences of being in difficulties in learning mathematics. The contributions are three-fold, the stories themselves, the methodological insights and the theoretical connections. These lead onto a discussion about implications.

The papers illustrate that children make sense of their lived experiences with mathematics teaching in a comprehensive way, from a whole life or coherent identity perspective. Their stories form a valid set of data, which provides interesting insights to mathematics education that are not available in any other way. The United Nations Convention on the Rights of the Child (1989) required children's views to be heard and their stories reinforce the need for mathematics educators to pay attention to them. Children at the edge, that is children whose belonging to the social field of normality was questioned, were particularly insightful.

The methodological and theoretical issues have been closely intertwined throughout the project. The assumption that difficulties in learning mathematics were a social construct raised the question about how to research individual experiences of this socially constructed phenomenon. Therefore, the idea was to research the narrative counterpart of children's lived experiences of being in difficulties in mathematics. Narratives are inherently personal and social because they communicate ideas between individuals and they draw upon the discursive resources in the environment. These theoretical considerations were methodological considerations as well because they had implications for the sort of empirical material (stories) that I needed.

From there came the need for establishing situations in which the stories could be formed and told. This was about having an appropriate physical environment for the interviews and maintaining a listening, interested attentive approach on my part as the interviewer. It also had implications for the kind of questions that I asked. They were typically very open to the children's own interpretation. For example: "What do children decide in

mathematics? Is it different from / more than / less than in other subjects?"

Theoretically, it has increasingly made sense to think of mathematics education as a socially constructed practice because it opens up to ethnographic and sociological approaches to mathematics education research. This has enabled me to better understand how the individual is enfolded within the social in the case of children in difficulties in learning mathematics. In a cyclic manner, the lived experiences are narrated into stories about identity and meaning. Narrative elements in the environment as well as children's foregrounds and backgrounds are resources out of which the stories are composed. The identity narratives are of two kinds: actual and designated. It is from the gap between actual and designated identities that learning intentions and learning endeavours arise. The actions of learning, the learning acts, then become lived experiences and are themselves narrated into stories of identity and meaning.

This model is, like any other model, a simplification of a hugely complex set of interactions. However, what this model does is to provide an understanding of how changes can be made. It suggests three places to intervene to better support children who are in difficulties with learning mathematics. These concern the type of learning activities that form the lived experiences, the valorisations in the discursive field pervading mathematics education including discourses on difficulties and immigrants and their children, and the socio-political environment that children interpret as their foreground.

Postscript

My decision to write the thesis in English was not without complications. The obvious one was the mastery of the language at a sufficient academic level. Another was that I did not contribute to the maintenance of Danish as a complete language. Faced with the reality of mathematics education, which has a strong international body of researchers, but a small contingent in Denmark, there was a

requirement to write for conferences and journals in English anyway. I took it as a challenge to develop the linguistic skills and get the help I needed.

While writing in English about Danish schools, I increasingly became aware of the adverse consequences of writing in English. For instance, it was tempting to say that I was observing a year 4 class in a Danish *primary* school but actually the primary/secondary divide in the Anglo-Saxon tradition is not the situation in Denmark. Therefore, English is not only a lingua franca but its use involves the risk that local contexts and situations are no longer able to be described appropriately. My response to this potential colonisation has been to generally talk about *folkeskole* rather than primary and secondary school and to bring interview transcripts in Danish with an English translation. There is noticeable change from the first paper where I use the common terms of primary – secondary schools but in later papers use *folkeskole*. The consequence of including the Danish transcripts is that they take up more space than a native English researcher would require. The mechanisms for marginalisation are alive and well at all levels of mathematics education and it is only by discussing them that there is any hope of making changes in the future.

References

- Alderson, P. & Morrow, V. (2004). *Ethics, social research and consulting with children and young people*. Ifford UK: Barnardo's.
- Alrø, H. & Skovsmose, O. (1993). Det var ikke meningen! Om kommunikation i matematikundervisningen. *NOMAD - Nordic Studies in Mathematics Education*, 1(2), 6-29.
- Alrø, H., Skovsmose, O., & Valero, P. (2003). Communication, conflict and mathematics education in the multicultural classroom. Paper presented at CERME3, Thematic Working Group 10: Teaching and Learning Mathematics in Multicultural Classrooms.
- Alrø, H., Skovsmose, O., & Valero, P. (2005). Inter-viewing foregrounds. 25-7-2005. Unpublished Work
- Ambrosius Madsen, U. (2003). *Pædagogisk etnografi. forskning i det pædagogiske praksisfelt*. (1. udgave ed.) Århus: Klim.
- Andenæs, A. (1991). Fra undersøgelseobjekt til medforsker? Livsformsintervju med 4-5-åringer. *Nordisk psykologi*, 43(4), 274-292.
- Beck, H. J., Hansen, H. C., Jørgensen, A., & Petersen, L. Ø. (1999). *Matematik i læreruddannelsen. Undersøge, konstruere og argumentere*, 1. (1 ed.) [Kbh.]: Gyldendal.

- Blomhøj, M. (1995). Den didaktiske kontrakt i matematikundervisningen. *Kognition og pædagogik*, 4(3), 16-25.
- Bourdieu, P. & Ferguson, P. P. (1999). *The weight of the world. Social suffering and impoverishment*. Oxford: Polity Press.
- Bruner, J. (1996). *The culture of education*. Cambridge, Mass.: Harvard University Press.
- Burton, L. (2005). Methodology and methods in mathematics education research: Where is "the why"? In S. Goodchild & L. English (Eds.), *Researching mathematics classrooms: A critical examination of methodology* (Paperback version ed.) (pp. 1-10). Greenwich, Connecticut: IAP Information Age Publishing.
- Damkjær, H. S. & Lange, T. (2006). Lavt præsterende elever, matematikvanskeligheder og regnehuller. *Mona*,(1), 87-90.
- Doverborg, E. & Pramling Samuelsson, I. (1999). *Förskolebarn i matematikens värld*. Stockholm: Liber.
- Doverborg, E. & Pramling Samuelsson, I. (2000). *Att förstå barns tankar. metodik för barnintervjuer*. (3. ed.) Stockholm: Liber.
- Egelund, N. (2003a). Undersøgelse af specialundervisningen (20.1) i Danmark 2002. *Specialpædagogik*, 23(6), 3-11.
- Egelund, N. (2003b). *Undersøgelse af specialundervisningen i Danmark. En kvantitativ og kvalitativ redegørelse for situationen på 20.1 området*. (1. udgave ed.) Kbh.: Danmarks Pædagogiske Universitet.
- Egelund, N. (2004). *Notat om skolernes organisering af specialundervisningen og undervisningen i dansk som andetsprog*. Retrieved 3 Jan. 2005, from <http://www.uvm.dk/specialundervisning1.htm>

- Engström, A. (2003). *Specialpedagogiska frågeställningar i matematik. En introduktion.* (Ny, omarb. upplaga ed.) Örebro: Pedagogiska institutionen, Örebro universitet.
- Engström, A. (2004). *Democracy and participation. A challenge for special education in mathematics. proceedings of the 2nd Nordic Research Conference on Special Needs Education in Mathematics.* Örebro: Pedagogiska institutionen, Örebro Universitet.
- Engström, A. & Magne, O. (2003). *Medelsta-matematik. hur väl behärskar grundskolans elever lärostoffet enligt lgr 69, lgr 80 och lpo 94?* Örebro: Örebro universitet, Pedagogiska institutionen.
- Engström, A. & Magne, O. (2004). Middletown 1977 - 1986 - 2002. Students' recall of mathematics topics of the three successive Swedish curricula of 1969, 1980, and 1994. Paper presented at ICME-10, TSG 5, Copenhagen, Denmark, July, 4-11, 2004.
- Ernest, P. (1998). A postmodern perspective on research in mathematics education. In A.Sierpiska & J. Kilpatrick (Eds.), *Mathematics education as a research domain. A search for identity. An ICMI study* (pp. 71-85). Dordrecht: Kluwer Academic Publishers.
- Fosse, T. (1995). 6-åringen i "klasserommets amfi" : Et studie av barns sosialisering til matematikkundervisningen i skolen. *Tangenten*,(1), 19-25.
- Goodchild, S. (2001). *Students' goals. a case study of activity in a mathematics classroom.* [Bergen]: Caspar.
- Goodchild, S. (2005). Exploring students' goals in classroom activity. In S.Goodchild & L. English (Eds.), *Researching mathematics classrooms: A critical examination of methodology* (Paperback ed.) (pp. 39-65). Greenwich, Connecticut: IAP Information Age Publishing.

- Goodchild, S. & English, L. (2005). Introduction. In S. Goodchild & L. English (Eds.), *Researching mathematics classrooms: A critical examination of methodology* (Paperback ed.) (pp. xi-xiv). Greenwich, Connecticut: IAP Information Age Publishing.
- Goodson, I. F. (2003). *Professional knowledge, professional lives. Studies in education and change*. Maidenhead: Open University Press.
- Goodson, I. F. (2005). Lærende liv. In R. Ådlandsvik (Ed.), *Læring gjennom livsløpet* (pp. 77-100). [Oslo]: Universitetsforlaget.
- Goodson, I. F. & Sikes, P. J. (2001). *Life history research in educational settings*. Buckingham: Open University.
- Gulløv, E. & Højlund, S. (2003). *Feltarbejde blandt børn. Metodologi og etik i etnografisk børneforskning*. [Kbh.]: Gyldendal.
- Hannula, M. S., Maijala, H., Pehkonen, E., & Nurmi, A. (2005). Gender comparisons of pupils' selfconfidence in mathematics learning. *NOMAD - Nordic Studies in Mathematics Education*, 10(3-4), 29-42.
- Hansen, H. C., Jess, K., Pedersen, B., & Rønn, E. (2006). *Der er mere end ét svar. Matematik og specialundervisning*. (1. udgave ed.) Kbh.: Alinea.
- Harding, S. G. (1991). *Whose science? Whose knowledge? Thinking from women's lives*. Ithaca, N.Y.: Cornell University Press.
- Høines, M. J. (1987). *Begynneropplæringen : fagdidaktikk for matematikkundervisningen 1.-6. klasse*. Rådal: Caspar.
- Høines, M. J. (1998). *Begynneropplæringen : fagdidaktikk for barnetrinnets matematikkundervisning*. (2. utgave, 1. opplag ed.) Landås: Caspar.
- Højlund, S. (2002). *Barndomskonstruksjoner. På feltarbejde i skole, SFO og på sygehus*. [Kbh.]: Gyldendal Uddannelse.

- Holmgaard, A. (2004). Hvorfor spørge eleverne? *Læsepædagogen*, 52(5), 4-7. Retrieved 8 Mar 5 A.D., from
- Hygum, E. (2006). *Et professions- og generationsperspektiv på ny skolestart. Ph.d.-afhandling.* (1. udgave ed.) Viborg: PUC.
- James, A., Jenks, C., & Prout, A. (1997). *Theorizing childhood.* Cambridge: Polity Press.
- Kampmann, J. (2000). Børn som informanter og børneperspektiv. In P.Schultz Jørgensen & J. Kampmann (Eds.), *Børn som informanter* (pp. 23-53). Kbh.: Børnerådet.
- Krogstrup, H. K. (1997). *Brugerinddragelse og organisatorisk læring i den sociale sektor.* Århus: Systime.
- Kvale, S. (1984). Om tolkning af kvalitative forskningsinterviews. *Tidskrift för Nordisk Förening för Pedagogisk Forskning*, 4(3/4), 55-66.
- Kvale, S. (2004). *Interviews. An introduction to qualitative research interviewing.* (2. ed.) London: Sage Publications Inc.
- Lange, T. (2005a). "Du kan ikke kede dig når du løber" : *Analyse af interview med Dennis og David ["You cannot be bored when you are running" : Analysis of interview with Dennis and David].* Unpublished manuscript
- Lange, T. (2005b). *Difficulties in learning mathematics - students' voices: Summary of my Ph.D. project Project description written for the summer school for Nordic doctoral students in mathematics education at Jyväskylä University, August 2005 organised by Nordic Graduate School in Mathematics Education (NoGSME).* Unpublished manuscript
- Lange, T. (2006). *Difficulties in learning mathematics - students' voices: Project description to summer school for Nordic graduate students in mathematics education at Agder University College, June 2006*

organised by the Nordic Graduate School in Mathematics Education (NoGSME). Unpublished manuscript

- Lange, T. (2007). Students' perspectives on learning difficulties in mathematics. In L. Ø. Johansen (Ed.), *Proceedings of the 3rd Nordic Research Conference on Special Needs Education in Mathematics*, (pp. 171-182). Aalborg: Adgangskursus, Aalborg Universitet.
- Lange, T. (2008). *Homework and minority students in difficulties with learning mathematics: the influence of public discourse. Paper given at ICME 11 in TSG 7*. Retrieved 11 Aug. 2008, from <http://icme11.org/>
- Lange, T. (2009). A child's perspective on being in difficulties with mathematics. In K. Linnanmäki & L. Gustafsson (Eds.), *Different Learners - Different Math? Proceedings of the 4th Nordic Research Conference on Special Needs Education in Mathematics*. Vasa: Publication no 17/2009 from Faculty of Education, Åbo Akademi University.
- Lindenskov, L. (1992). *Hverdagsviden og matematik*. Roskilde: RUC, IMFUFA.
- Linnanmäki, K. (2002). *Matematikprestationer og självuppfattning. En uppföljningsstudie i relation til skolspråk och kön*. Åbo: Åbo akademis förlag.
- Linnanmäki, K. (2004). Matematikprestationer och självuppfattning. In A. Engström (Ed.), *Democracy and participation. A challenge for special education in mathematics. Proceedings of the 2nd Nordic Research Conference on Special Needs Education in Mathematics*, (pp. 205-221). Örebro: Pedagogiska institutionen, Örebro Universitet.
- Linnanmäki, K. & Gustafsson, L. (2009). *Different Learners - Different Math? Proceedings of the 4th Nordic Research Conference on*

Special Needs Education in Mathematics. Vasa: Publication no 17/2009 from Faculty of Education, Åbo Akademi University.

- Lunde, O. & Wahl Andersen, M. (2002). *Rummelighed i matematik*. [Bind] A : Om elevens vanskeligheder i matematik. (1. udgave ed.) Albertslund: Malling Beck.
- Magne, O. (1998). *Att lyckas med matematik i grundskolan*. Lund: Studentlitteratur.
- Magne, O. (2001). *Literature on special educational needs in mathematics. A bibliography with some comments*. Malmö: Department of Educational and Psychological Research, School of Education, Malmö University. Available at <http://www.lut.mah.se/pedinst/specialped.html>
- Magne, O. (2002). Den nye specialpedagogiske tenkningen innen matematikundervisningen. In G.Malmer, O. Magne, & O. Lunde (Eds.), *"En matematikk for alle i en skole for alle"*. Rapport fra det 1.nordiske forskerseminar om matematikkvansker (pp. 25-39). Kristiansand: Forum for matematikkvansker.
- Magne, O. (2003). *Fem föredrag om den nya undervisningen för elever med särskilda utbildningsbehov i matematik*. Klepp stasjon: Info vest forlag.
- Magne, O. (2006). Historical aspects on special education in mathematics. *NOMAD - Nordic Studies in Mathematics Education*, 11(4), 7-36.
- Malmer, G. (2002). *Bra matematik för alla. nödvändig för elever med inlärningsvårigheter*. (2. [omarb.] uppl. ed.) Lund: Studentlitteratur.
- Malmer, G., Magne, O., & Lunde, O. (2002). *"En matematikk for alle i en skole for alle"*. Rapport fra det 1. nordiska forskerseminar om matematikkvansker. Kristiansand: Forum for matematikkvansker.

- Mejding, J. (2004). *PISA 2003. Danske unge i en international sammenligning*. (1. udgave ed.) Kbh.: Danmarks Pædagogiske Universitet.
- Morrow, V. & Richards, M. (1996). The ethics of social research with children: An overview. *Children & Society*, 10(2), 90-105. <http://search.epnet.com/login.aspx?direct=true&db=afh&an=14142597>
- Niss, M. (1996). Goals of mathematics teaching. In A.J.Bishop, K. Clement, C. Keitel, J. Kilpatrick, & C. Laborde (Eds.), *International handbook of mathematics education* (pp. 11-47). Dordrecht: Kluwer.
- Niss, M. & Højgård Jensen, T. (2002). *Kompetencer og matematiklæring. Ideer og inspiration til udvikling af matematikundervisning i Danmark*. (1. udgave ed.) [Kbh.]: Undervisningsministeriet.
- OECD (2004). *Learning for tomorrow's world. First results from PISA 2003*. OECD.
- Olsen, H. (2002). *Kvalitative kvaler. Kvalitative metoder og danske kvalitative interviewundersøgelers kvalitet*. [Kbh.]: Akademisk.
- Pérez Prieto, H. (2000). *Historien om räven och andra berättelser. Om klasskamrater och skolan på en liten ort - ur ett skol- och livsberättelsesperspektiv*. Uppsala: Uppsala universitet. Pedagogisk Forskning i Uppsala, nr 37.
- Prieur, A. (2002a). At sætte sig i en andens sted. En diskussion af nærhed, afstand og feltarbejde. In M.H.Jacobsen, S. Kristiansen, & A. Prieur (Eds.), *Liv, fortælling, tekst. Strejftog i kvalitativ sociologi* (pp. 135-155). Aalborg: Aalborg Universitetsforlag.
- Prieur, A. (2002b). Objektivisering og refleksivitet - om Pierre Bourdieus perspektiv på design og interview. In M.H.Jacobsen, S. Kristiansen, & A. Prieur (Eds.), *Liv, fortælling,*

tekst. *Strejftog i kvalitativ sociologi* (pp. 109-132). Aalborg: Aalborg Universitetsforlag.

Reed-Danahay, D. (2005). *Locating Bourdieu*. Bloomington: Indiana University Press.

Scherer, P. (2008). Activities and programme for students with special needs (Report from Topic Study Group 5). In M. Niss & E. Emborg (Eds.), *Proceedings of the 10th International Congress on Mathematics Education, 4-11 July, 2004*. Roskilde: IMFUFA, Department of Science, Systems and Models, Roskilde University, Denmark.

Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher*, 34(4), 14-22. Retrieved 25 Oct 2005, from

Skovsmose, O. (2005). Foreground and politics of learning obstacles. *For the Learning of Mathematics*, 25(1), 4-10.

Thejsen, T. & Hvid, M. (1999). Jagten på den effektive læring. *Folkeskolen*, (38), 10-12.

Undervisningsministeriet (2003). *Fælles mål - matematik*. [Kbh.]: Undervisningsministeriet, Område for Grundskolen.

Undervisningsministeriet (2006). *Fremtidens matematik i folkeskolen. Rapport fra Udvalget til forberedelse af en handlingsplan for matematik i folkeskolen*. Retrieved 3 Mar. 2006, from <http://www.uvm.dk/06/documents/mat.pdf>

UNESCO (1997). *Salamanca Erklæringen og Handlingsprogrammet for Specialundervisning*. Retrieved 11 Apr. 2005, from <http://www.uvm.dk/gammel/salam.htm>

Valero, P. (2002). *Reform, democracy, and mathematics education. Towards a socio-political frame for understanding change in the organization*

of secondary school mathematics. Copenhagen: Department of Curriculum Research, The Danish University of Education,

Valero, P. & Zevenbergen, R. Eds. (ed.) (2004). *Researching the socio-political dimensions of mathematics education. Issues of power in theory and methodology*. Boston, Mass.: Kluwer Academic Publishing.

Wenger, E. (1998). *Communities of practice : Learning, meaning, and identity*. Cambridge: Cambridge University Press.

William, D., Bartholomew, H., & Reay, D. (2004). Assessment, learning and identity. In P.Valero & R. Zevenbergen (Eds.), *Researching the socio-political dimensions of mathematics education. Issues of power in theory and methodology* (pp. 43-61). Boston, Mass.: Kluwer Academic Publishing.

Appendices

A Letters to schools, teachers, parents, consent form

- A1 Information for parents for Pilot Study at School A January 2005
- A2 Email to principal at School A May 2006
- A3 Letter to parents at School A September 2006
- A4 Consent form for children at School A September 2006
- A5 Letter to parents at School B September 2006
- A6 Consent form for children at School B February 2007

B Interview guides, questionnaire

- B1 Interview guide for pilot study, January 2005
- B2 Interview guide for group interview School A September 2006
- B3 Questionnaire: How do you like the subjects at school? September 2006
- B4 Interview guide for pair interviews School A October 2006
- B5 Interview guide for pair interviews School A and B May 2007
- B6 Interview guide for interview with teachers School A and B May 2007

Information til forældre

Jeg er i gang med et forskningsprojekt der har til formål at undersøge hvordan elever oplever deres matematikundervisning.

Derfor vil jeg gerne interviewe jeres barn om hvordan han eller hun oplever og tænker om matematik og om at lære matematik.

Jeg vil optage interviewet på bånd. Bagefter vil jeg analysere det for at forsøge at øge vores forståelse af hvordan børn lærer matematik. I min brug af interviewet er barnet garanteret fuld anonymitet.

I er velkomne til at henvende jer til mig for at få flere oplysninger.

Såfremt jeg ikke hører fra jer vil jeg betragte det som accept. Jeg kan kontaktes på telefon 6167 6225 eller ved at give skolen besked.

Med venlig hilsen

Troels Lange

Lektor

Skive Seminarium

januar 2005

Troels Lange (TRLA)

Fra: Troels Lange
Sendt: 23. maj 2006 21:14
Til: 'hee@skivekommune.dk'
Emne: Samtaler med lærere i uge 23 om observationer

Kære Henning

Tak for samtalen dd.

Som vi talte om vil det være rigtig fint hvis du kunne arrangere en samtale med lærerne i ugen efter pinse (6. – 9. juni). Jeg kan hele dagen alle dage undtagen torsdag.

Jeg har indsat en kort beskrivelse af mit ærinde nedenfor.

Mvh

Troels

NB Ny mail-adresse: tl@cvumidtvst.dk

Mit ærinde er at jeg vil undersøge noget. Børnene ved noget som jeg ikke ved. De ved hvordan det er at være 10-13 år, gå i skole, lære matematik, møde modstand i deres læringsbestrebelse – og jeg vil gerne have dem til at fortælle mig om det. Mit ærinde er ikke at vurdere hverken børnenes matematikundskaber, faglige præstationer m.v. eller lærerens undervisning. Mit fokus er børnene, deres oplevelser og tanker.

Observationerne har børns oplevelser af matematikundervisning som fokus. Jeg er interesseret i børns læringshistorier om matematik. Hvordan oplever børn at lære matematik? Hvilken mening og betydning tillægger de matematik, matematikundervisning og matematiklæring? Hvordan indgår skolens matematikundervisning og deres matematiklæring i deres ”verdensbillede” og deres opfattelse af sig selv? Hvilke mønstre af mening og betydning danner de? I lyset af at matematik er et vigtigt skolefag, er jeg specielt interesseret i hvordan børn oplever vanskeligheder med at lære matematik.

Udover at lave observationer vil jeg foretage interviews med børnene i klassen. Børnene kan selvfølgelig sige fra i forhold til interviewene, og alle observationer og udtalelser vil blive anonymiseret.

Mine data fra observationer og interviews skal anvendes i forhold til mit ph.d.-projekt som jeg nu er halvvejs igennem.

September 2006

Kære forældre til børnene i 4. på [redacted] skolen!

I de kommende måneder vil jeg opholde mig nogle timer om ugen i jeres barns klasse. Jeg er ansat på Skive Seminarium, CVU Midt-Vest, og er i gang med et forskningsprojekt om børns oplevelser af matematikundervisning. Jeg interesserer mig for hvordan børn oplever at lære matematik, og hvad de tænker om matematik. De fleste børn oplever indimellem at det kan være svært at lære matematik. Jeg er især interesseret i hvordan børn oplever det, når det er svært at lære matematik.

Jeg vil observere klassens arbejde og interviewe børnene. Interviewene vil finde sted på skolen. Jeg vil fastholde mine observationer og samtaler med lydoptagelser, billeder og videooptagelser. Disse optagelser er kun til brug i mit arbejde og vil ikke blive offentliggjort.

Min forskningsafhandling vil bygge på det materiale som jeg indsamler. Alle iagttagelser, udtalelser, navne og personoplysninger vil blive gjort anonyme. Børnene kan selvfølgelig sige nej til at deltage i interview eller blive fotograferet og video-filmet.

Jeg håber I vil lade jeres barn deltage. Hvis I *ikke* ønsker at jeres barn deltager i interviews eller er med på billeder eller video, bedes I give klasselæreren besked herom. Hvis I har lyst til at høre nærmere om mit projekt, er I meget velkomne til at kontakte mig.

Med venlig hilsen

Troels Lange

Skive Seminarium, CVU Midt-Vest
Lektor & ph.d.-studerende
Telefon 61 67 62 25 (dag) eller 86 67 62 25 (aften)
E-mail tl@cvumidtvest.dk



Udviklings- og Forskningsafdelingen
 Dalgas Allé 20
 DK 7800 Skive
 Tlf.: 7023 9723
 Fax: 7023 9823

September 2006

Kære børn i 4. på [redacted] skolen!

Jeg inviterer dig til at deltage i et særligt projekt som jeg laver på Skive Seminarium og Aalborg Universitet.

Jeg interesser mig for hvordan børn oplever at lære matematik, og hvad de tænker om matematik. Jeg er især interesseret i hvordan børn oplever det, når det er svært at lære matematik. Det er noget de fleste børn oplever indimellem.

Når jeg er i klassen, vil jeg optage med en diktafon eller et videokamera hvad I siger. Jeg vil også optage mine samtaler og interview med jer. Det gør jeg for at kunne skrive ned hvad I siger. Der er kun mig og min vejleder der vil høre eller se optagelserne.

Når jeg skriver om, hvad du fortæller mig, vil jeg ikke bruge dit rigtige navn. Ingen vil derfor få at vide at det er dig der har sagt det.

Du behøver ikke at deltage hvis du ikke har lyst. Hvis du har sagt ja, men skifter mening, skal du bare sige det til mig, så vil du ikke mere deltage i projektet.

Med venlig hilsen
 Troels Lange

✂-----

Samtykkeerklæring for børn

Troels har fortalt mig at:

- jeg ikke behøver at deltage i projektet hvis jeg ikke har lyst,
- jeg kan skifte mening når som helst.

Mine forældre har fortalt mig at jeg gerne må deltage i projektet.

Jeg er indforstået med at Troels optager lyd og video med mig.

Min underskrift

Dato



Udviklings- og Forskningsafdelingen
 Dalgas Allé 20
 DK 7800 Skive
 Tlf.: 7023 9723
 Fax: 7023 9823

September 2006

Kære forældre til børnene i 4. på [redacted] skole!

I de kommende måneder vil jeg opholde mig nogle timer om ugen i jeres barns klasse. Jeg er ansat på Skive Seminarium, CVU Midt-Vest, ph.d. student ved Aalborg Universitet og er i gang med et forskningsprojekt om børns oplevelser af matematikundervisning. Jeg interesser mig for hvordan børn oplever at lære matematik, og hvad de tænker om matematik. Jeg er især interesseret i hvordan børn oplever det, når det er svært at lære matematik, hvilket er noget de fleste børn oplever indimellem.

Jeg vil observere klassens arbejde og interviewe børnene. Interviewene vil finde sted på skolen. Jeg vil fastholde mine observationer og samtaler med lydoptagelser og videooptagelser. Disse optagelser er kun til brug i mit forskningsprojekt og vil ikke blive offentliggjort.

Min forskningsafhandling vil bygge på det materiale som jeg indsamler. Alle iagttagelser, udtalelser, navne og personoplysninger vil blive gjort anonyme. Børnene kan selvfølgelig på ethvert tidspunkt sige nej til at deltage i projektet.

Jeg håber I vil lade jeres barn deltage og udfylde nedenstående seddel. Hvis I ønsker mere information om mit projekt, er I meget velkomne til at kontakte mig.

Med venlig hilsen
 Troels Lange

Skive Seminarium, CVU Midt-Vest
 Lektor & ph.d.-studerende
 Telefon 61 67 62 25 (dag) eller 86 67 62 25 (aften)
 E-mail tl@cvumidtvest.dk

✂-----

Samtykkeerklæring

Undertegnede indvilger hermed i at _____ (barnets navn) deltager i Troels Langes forskningsprojekt, dvs. deltager i samtaler og interviews som lyd- og/eller videooptages. Optagelserne er kun til arbejdsbrug og vil ikke blive offentliggjort.

Dato: _____ Underskrift: _____

(Sedlen afleveres til matematiklæreren)



Udviklings- og Forskningsafdelingen
 Dalgas Allé 20
 DK 7800 Skive
 Tlf.: 7023 9723
 Fax: 7023 9823

Februar 2007

Kære børn i 4. på [redacted] skole!

Jeg inviterer dig til at deltage i et særligt projekt som jeg laver på Skive Seminarium og Aalborg Universitet.

Jeg interesser mig for hvordan børn oplever at lære matematik, og hvad børn tænker om matematik. Jeg er især interesseret i hvordan børn oplever det, når det er svært at lære matematik. Det er noget de fleste børn oplever indimellem.

Når jeg er i klassen, vil jeg optage hvad I siger. Det gør jeg for at kunne skrive det ned. Det er kun mig og min vejleder der vil høre optagelserne.

Når jeg skriver om, hvad du fortæller mig, vil jeg ikke bruge dit rigtige navn. Ingen vil derfor få at vide at det er dig der har sagt det.

Du behøver ikke at deltage hvis du ikke har lyst. Hvis du har sagt ja, men skifter mening, skal du bare sige det til mig. Så vil du ikke mere deltage i projektet.

Med venlig hilsen
 Troels Lange

✂-----

Samtykkeerklæring for børn

Troels har fortalt mig at:

- jeg ikke behøver at deltage i projektet hvis jeg ikke har lyst,
- jeg kan skifte mening når som helst.

Mine forældre har fortalt mig at jeg gerne må deltage i projektet.

Jeg er indforstået med at Troels optager lyd med mig.

 Min underskrift

 Dato

Jeg vil ikke deltage __ (sæt kryds)

Interviewguide 1

Et fokuseret livshistorieinterview: positionen eller "professionen" elev.

Overordnet spørgsmål: Hvordan oplever elever matematik og matematikundervisning, hvilken sammenhæng indgår de i for dem, hvilken mening tilskriver de den?

Åbningsspørgsmål: Jeg er interesseret i at høre jer fortælle om hvordan det er at gå i skole for jer. Når jeg stiller spørgsmål er det for at få jer til at fortælle. Der er ikke rigtige eller forkerte svar?

Konkrete spørgsmål retter sig mod **beskrivelser** eller **forskelle**^{*)}.

- Hvad har du lavet i dag? Fortæl mig om din dag i dag/går.
 - o Hvad fik du til morgenmad?
- Hvad laver du i skolen? SFO'en? Derhjemme?
- Hvem er dine bedste venner? Må du være sammen med dem i timerne?
- Spiller du fodbold, computerspil, ...
- Hvad kan du bedst/mindst lide i skolen?
 - o Hvilke lærere har du? Hvor synes du det er sjovest at være: hos (matematiklærers navn) eller hos (dansk lærers navn)?
- Hvad af det I laver i Gritts timer som du godt/ikke kan lide?
 - o Hvilken slags opgaver kan du bedst/mindst lide? ...
- Sker det tit at du ikke forstår hvad læreren beder om?
 - o Hvornår kan du godt/ikke finde ud af hvad du skal gøre?
 - o Hvordan finder du ud af hvad du skal gøre ...
- Hvem er god til at hjælpe? Hvordan hjælper vedkommende?
 - o Hvad gør du hvis du ikke har forstået?
 - o Hvad gør du når du finder ud af ...
- Hvad tror du lærerne/kammeraterne tænker om ...
- Er der mange/nogen der godt/ikke kan lide ...

*)

Mere – mindre

Godt – skidt/dårligt

Sjov - kedelig

Let – svært

God til – ikke god til

Dejlig – træls

Glad – sur/ked af det

Guide til fokusgruppeinterview

Overordnet spørgsmål: Hvordan oplever børn matematik og matematikundervisning, hvilken sammenhæng indgår de i for dem, hvilken mening tilskriver de den? Oplevelser, sammenhænge og mening er narrative.

Indledning:

Når jeg gerne vil tale med jer er for at I kan fortælle (lære) mig om hvordan det er at gå i skole og lære matematik. Det er ikke rigtige og forkerte svar. Jeg er interesseret i jeres tanker og oplevelser. De er jeres egne, lige gode, behøver ikke at være enige.

Åbningsspørgsmål:

Forskelle

Hvilke fag kan I bedst/mindst lide?

Hvad er det gode/dårlige?

Har det altid været sådan?

Fortæl mig om dengang I begyndte i 1. klasse og begyndte at lære matematik.

Tænker du på en anden måde nu end dengang?

Hvad er forskellen på (bøgerne i) dansk og matematik?

[Billedkunst, dansk, engelsk, gymnastik, historie, håndarbejde, idræt, kristendomskundskab, matematik, musik, natur og teknik svømning]

Beskrivelser

Fortæl mig om en rigtig god og en rigtig dårlig oplevelse med at lære matematik

Fortæl mig om noget du har lært i matematik?

Hvad er det vigtigste i matematik?

Hvad kan du bedst/mindst lide ved matematik?

Hvordan føles det når det er svært at lære matematik? – når det er let?

Er det vigtigt at være god til matematik eller er det lige meget?

Relationer

Hvorfor tror I at de voksne har bestemt at børn skal lære matematik i skolen?

Hvad synes du er vigtigst for børn i matematik?

Hvorfor tror I at voksne har bestemt at børn skal gå i skole?

Hvad skulle laves om i skolen / matematik hvis I skulle bestemme?

Hvad synes du om fagene i skolen?

Sæt kryds ved det du synes passer bedst.

	😊	😐	☹️	Ved ikke
Billedkunst				
Dansk				
Engelsk				
Gymnastik				
Historie				
Håndarbejde				
Idræt				
Kristendomskundskab				
Matematik				
Musik				
Natur og teknik				
Svømning				

Mit navn:

Guide til parinterview

Overordnet spørgsmål: Hvordan oplever børn matematik og matematikundervisning, hvilken sammenhæng indgår de i for dem, hvilken mening tilskriver de den? Oplevelser, sammenhænge og mening er narrative.

Indledning:

Når jeg gerne vil tale med jer er for at I kan fortælle (lære) mig om hvordan det er at gå i skole og lære matematik. Det er ikke rigtige og forkerte svar. Jeg er interesseret i jeres tanker og oplevelser. De er jeres egne, lige gode, behøver ikke at være enige.

Spilleregler:

Åbningsspørgsmål:

Beskrivelser

Fortæl mig hvad du har lavet i dag/går? Hvad var det bedste/værste?

Hvem leger I mest med i skolen, derhjemme, i klubben? Er der nogen du ikke leger med? –
Hvad leger I?

Fortæl mig om dengang I begyndte i 1. klasse og begyndte at lære matematik. Tænker du på en anden måde nu end dengang?

Fortæl mig om en rigtig god og en rigtig dårlig oplevelse med at lære matematik

Fortæl mig om noget du har lært i matematik?

Fortæl mig hvordan du gør når du lærer matematik. Hvordan føles det når det er svært at lære matematik? – når det er let?

Forskelle

Hvilke fag kan I bedst/mindst lide? Hvad er det gode/dårlige? Har det altid været sådan?

Hvad er forskellen på (bøgerne i) dansk og matematik?

Hvorfor tror du at der er nogle fag som næsten alle børn godt kan lide (Hå, Gy/Id/Sv, Bi) mens det er meget forskelligt for andre fag (Mu, Hi, Da, En, Ma, NT)?

Hvad er det bedste/værste/vigtigste i matematik? Hvad kan du bedst/mindst lide ved matematik?

Hvordan skal en god matematiklærer være/gøre?

Relationer

Hvorfor tror I at de voksne har bestemt at børn skal lære matematik i skolen?

Hvad synes du er vigtigst for børn i matematik?

Hvorfor tror I at voksne har bestemt at børn skal gå i skole?

Hvad skulle laves om i skolen / matematik hvis I skulle bestemme?

Hvad bestemmer børn i matematik? Er det andet/mere/mindre end i andre fag?

Er det vigtigt at være god til matematik eller er det lige meget?

Guide til parinterview

Overordnet spørgsmål: Hvordan oplever børn matematik og matematikundervisning, hvilken sammenhæng indgår de i for dem, hvilken mening tilskriver de den? Oplevelser, sammenhænge og mening er narrative.

Indledning:

Når jeg gerne vil tale med jer er for at I kan fortælle (lære) mig om hvordan det er at gå i skole og lære matematik. Det er ikke rigtige og forkerte svar. Jeg er interesseret i jeres tanker og oplevelser. De er jeres egne, lige gode, behøver ikke at være enige.

Jeg optager hvad I siger og skriver om det, men nævner ingen (rigtige) navne.

Åbningsspørgsmål:

Beskrivelser

- Fortæl mig hvad du har lavet i dag/går? Hvad var det bedste/værste?
 - Hvem leger I mest med i skolen, derhjemme, i klubben? Er der nogen du ikke leger med? – Hvad leger I?
- Vil du vise mig noget i din bog som du (ikke) kunne lide?
 - Kan vise mig noget der er let / svært?
 - Kan du vise mig noget i dit hæfte som du er glad for eller ked af?
- Fortæl mig hvordan du gør når du lærer matematik. Hvordan føles det når det er svært at lære matematik? – når det er let?
 - Hvad er det mest spændende ved matematik? – det kedeligste?
 - Fortæl mig om en rigtig god og en rigtig dårlig oplevelse med at lære matematik
- Fortæl mig om noget du har lært i matematik?

- Hvad bruger I matematik til udenfor skolen?
- Er der nogen der hjælper dig med matematik derhjemme?
 - Hvad syntes din mor og far om at gå i skole da de var børn?
 - Hvad synes din mor og far om matematik?
 - Hvad laver din mor og din far?
- Fortæl mig om dengang I begyndte i 1. klasse og begyndte at lære matematik.

Forskelle

Hvilke fag kan I bedst/mindst lide? Hvad er det gode/dårlige? Har det altid været sådan?

Hvad er forskellen på (bøgerne i) dansk og matematik?

Hvad er det bedste/værste/vigtigste i matematik? Hvad kan du bedst/mindst lide ved matematik?

Hvordan skal en god matematiklærer være/gøre?

Er der forskel på hvad børnene må bestemme de forskellige fag?

Hvad er forskellen på specialundervisning og almindelig undervisning?

Relationer

Hvilke fag er de vigtigste i skolen?

Hvorfor tror I at de voksne har bestemt at børn skal lære matematik i skolen?

Hvad synes du er vigtigst for børn i matematik?

Hvorfor tror I at voksne har bestemt at børn skal gå i skole?

Hvad skulle laves om i skolen / matematik hvis I skulle bestemme?

Hvad bestemmer børn i matematik? Er det andet/mere/mindre end i andre fag?

Er det vigtigt at være god til matematik eller er det lige meget?

Hvad vil I gerne lave når I bliver store? (hvilken uddannelse?)

Interviewguide til lærerinterview

1. Hvad tror du at børnene oplever som en god matematiktime?
 - a. Tror du de lærer matematik godt på den måde?
 - b. Er der forskel for børnene på matematik og andre fag?
 - c. Hvad tror du er vigtigst for børn i matematik?
 - d. Hvordan tror du at de synes en matematiklærer skal være?

2. Hvordan ville du inddele børnene efter deres matematiske kunnen i tre grupper? (Hav brikker med børnenes navne)
 - a. Hvordan vurderer du de enkelte børn
 - i. i matematikundervisningen?
 - ii. i klassen?
 - iii. i skolen generelt?
 - iv. din kontakt med dem
 - b. Hvad karakteriserer en god / middel / dårlig elev?

3. Hvorfor tror du at den dårligste trediedel ikke har lært så let som de andre børn?
 - a. Hvordan tænker du om elever i vanskeligheder i matematik?
 - b. Hvoraf kommer de?
 - c. Hvordan kan de afhjælpes?
 - d. Kan alle lære matematik?

4. Tror du at børnenes baggrund har betydning for deres evne til at lære matematik?
 - a. Køn
 - b. Etnicitet/kultur
 - c. Social baggrund / Forældreressourcer

5. Hvordan vil du kommentere følgende udsagn fra børnene (frit gengivet)?
 - a. Børnene er ret enige om at dansk, matematik og engelsk er de vigtigste fag i skolen. De fag børnene bedst kan lide er håndarbejde, idræt, svømning fordi de selv må bestemme, kan bruge deres fantasi, lege eller bevæge sig.
 - b. I dansk lærer vi om noget. I matematik regner vi bare (flere) opgaver.
 - c. Giv hende fem kort med udsagn og spørg om der er nogle hun havde lyst til at tale om.

6. Hvis du kunne lave noget om i skolen af særlig betydning for matematikundervisningen, hvad skulle det så være?
 - a. Hvilke forhindringer er der for det du helst ville gøre?

Test nov	Piger	Drenge
'Arabiske'		
'Danske'		