What the teachers and the students do and how they interact

A comparison of special education teaching and ordinary teaching in mathematics

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In this article, I compare three teaching situations: ordinary mathematics teaching, special education teaching in mathematics located within the ordinary class, and special education teaching in mathematics located outside the ordinary class, in order to find the main differences between them with respect to what the teacher and the students do. The findings are discussed in light of various aspects of the inclusion concept. The empirical material has been collected in the SPEED-project and consists of observations throughout an entire school day of 108 individual students, their teachers and the classes they belong to. The discussion reveals that the special education teaching is more individual, the student is more frequently engaged in subject-related activities and in communication with the teacher, and that each of the two different organizational forms of the special education teaching in mathematics separately seem to fulfil different aspects of the concept of inclusion in a best way.

Special needs education in Norway

In order to make it easier for the reader to understand the field of practice this study covers, I will first give a brief historical review of special needs education in Norway. From 1881, the special education service was organized in a separate school system, i.e. as planned and deliberate segregation (Markussen et al., 2007). After increasing criticism of the special school system, (Egelund et al., 2006), a new Education Act with joint provisions for both the special schools and the elementary school, "A school for everyone", was adopted in 1975. Students who had previously been in special schools were now to be integrated into the ordinary, local school in their home municipality. The integration concept was in practice

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perceived as a matter of the physical placement of students, more than an aspect of the quality of the education offered to students (Haug, 2014). From the beginning of the 1990's, the special schools were closed down or reorganized as "centres of expertise". The inclusion concept was introduced in the curriculum for the elementary school in 1997 (KUF, 1996), but in a way that many regarded as just a change in the wording, from integration to inclusion (Markussen et al., 2007).

Students who do not derive, or who cannot obtain, satisfactory benefit from the ordinary teaching, are entitled to special education (Opplæringslova, 2005, pp. §5–1) [Education Act]. In the school year 2018–2019, 7.8 % of all primary school students received special education on the basis of individual decisions. In Norway today, 0.7 % of all students receive special needs education organized either in permanent groups or in special classes in the ordinary school system, or in special schools (Utdanningsdirektoratet, 2018) [Norwegian Directorate for Education and Training]. Opinions vary about whether, and to what extent, special education is or should be something other than the ordinary teaching (Haug, 2015; Lunde, 2010).

Inclusion

Asp-Onsjö (2006) has presented an interpretation and classification of the inclusion concept, where she defines three aspects: spatial, social and didactical inclusion. Spatial inclusion refers to what extent the student is located in the same room as his/her classmates. Social inclusion refers to what extent the student is participating in a social relationship with classmates and staff. Didactical inclusion refers to the extent to which the didactical conditions are adapted to develop the students' learning (Asp-Onsjö, 2006, pp. 190–191).

Florian & Rouse (2001) have identified some successful inclusive strategies, which among others embrace the use of appropriate differentiation strategies, cooperative learning strategies and classroom management strategies. Whitty & Clarke (2012) refer to other research, stating that the use of group and pair work, the use of ICT, combining self-regulated learning strategies with explicit instruction and peer tutoring are all important ways to promote student learning in inclusive mathematics classrooms. A broad understanding of inclusion (Haug, 2017a), incorporates all students and marginalized groups, not exclusively those with disabilities, in line with the Salamanca Declaration (UNESCO, 1994) from 1994.

Didactical models

The didactic triangle (Klafki, 2001) is a theoretical model that is useful in analysing different teaching situations. This model focuses on the student, the content and the teacher, and on the relationships between these three elements. That means the selection and facilitation of the subject matter that is to be taught/learnt (representation axis), how the student works with this subject matter (learning axis) and what help or support the student gets from the teacher or other students in the learning process (interaction axis).

Shulman (2005) introduces the concept of "signature pedagogy" to locate what characterizes teaching and learning within different disciplines and educational areas. He divides this signature into three dimensions: "the surface structure", which is the concrete, operational acts of teaching and learning; "the deep structure", questioning how to best employ and impart relevant knowledge; and "the implicit structure", a moral dimension that comprises beliefs about professional attitudes and values (Shulman, 2005, pp. 54–55).

Ordinary mathematics teaching

From previous studies, we know that both organization forms and working methods in ordinary mathematics teaching differ from other subjects in several ways. In previous research we have found that the subject of mathematics is characterized by more frequent use of individual work and less class teaching compared to the mean value for all school-subjects (Skorpen, 2006). "Silent work on tasks" has been the most widespread working method in mathematics (Skorpen, 2009), and "task-discourse" directs/governs much of the work in mathematics lessons (Mellin-Olsen, 1996a; Niss, 2007). The students are only to a small extent stimulated to verbalize their thinking, and get relatively little practice in "expressing themselves orally in mathematics", which is one of the "basic skills" in LK06[1] (2006), and an important part of communication competence (Niss & Højgaard Jensen, 2002).

Topphol (2012) has compiled and compared "lesson-signatures" ("pattern of teaching", Stigler & Hiebert, 1999) for mathematics and science, and found that the mathematics lessons are characterized by a brief introduction by the teacher, after which activity quickly turns to individual work on tasks. In the first part of the lesson, the teacher's attention is on the class as a whole, while for the remainder, and greater part of the lesson, the teacher's attention is on individual students, mostly guiding them in their individual work on tasks.

Special needs education

Haug (2015) has previously studied what characterizes special education in relation to ordinary teaching, and he found that special education differed from the ordinary teaching in some specific ways. The special needs teaching is segregated and individualized. The students are more active in the special teaching compared to ordinary teaching, and the amount of individual work is larger than in ordinary teaching. In that study, he looked at all kinds of special education, regardless of in which subject the special education was given, or how the special education was organized.

Nordahl and Hausstätter (2009) found that students in special needs education were less motivated, less happy and had poorer relations to other students, compared to students in ordinary teaching. They also found that the assistant had a prominent role in the teaching of the students in the special needs education.

Aim

From the studies mentioned above, we know a good deal about ordinary mathematics teaching, non-subject-specific special education teaching, and about the relationship between ordinary teaching and special education teaching at a non-subject-specific level. The aim of this article is to study differences in teacher activity and student activity in the three different teaching situations: ordinary mathematics teaching, special education teaching in mathematics located either inside or outside the ordinary classroom and to see how they harmonize with different inclusion perspectives. I will use the didactic triangle (Klafki, 2001) in the structuring of the results and the discussion. In the use of the didactic triangle, the main focus will be on the teacher, the student and the relationship between them, and on the relation between the student and the content. The research question is:

> What are the main differences between what the teacher and the students do in these three different teaching situations: ordinary mathematics teaching, special education teaching in mathematics within the ordinary classroom and special education teaching in mathematics outside the ordinary classroom?

Based on the empirical results of the research question, implications for the special teaching will be discussed in an inclusive perspective.

Methods and sample

This article is based on empirical data collected in the project "The function of special education", (Haug, 2017b; SPEED, 2013). As part of this project, observations were carried out at 29 schools in two medium-sized towns in Norway in the autumn of 2013. Students with an individual decision entitling them to special education in one or more subjects were observed throughout an entire school day, both when they had ordinary teaching and when they had special teaching. The observations were performed by master's degree students and researchers from Hedmark University College and Volda University College using a standardized observation form. The observation form is a further development of forms that we have used in two previous studies (Haug, 2006, 2012), and is based on a form originally developed by Klette (2003). Consequently, the data set has been collected employing a well-tried methodology.

The observation form has two pages. Page one contains general information about time, date, place, demographic data for the student and for the teacher responsible for the lesson, kind of teaching (ordinary teaching, special education teaching in the ordinary class or special education teaching apart from the class) and assessment of the lesson. Page two contains 66 observation variables focusing on what the teacher, the student and the class does, as well as which subject is being taught. We used one observation form per lesson. Some parts of the registrations on page one could be done before the lesson started, while other parts had to wait until after the end of the lesson. Each fifth minute, the activity in the classroom was registered on page 2 of the observation form, marking one or more of the 66 observation variables. This method is called "momentary time sampling" (Powell et al., 1975), and provides information on the time-usage for different observation categories. The data set contains information about 861 teaching sessions/lessons, with a total of 7673 observation times, which corresponds to 639 hours (Topphol et al., 2017). In total, 165 individual students in grades 6, 7, 9 and 10 were observed throughout an entire school day, both in ordinary teaching and in special education teaching.

This analysis is based exclusively on mathematics lessons, including 874 observation-times and 108 individual students. This study covers only students who were part of an ordinary class in parts of the school-day. Consequently, students in separate special education schools, or other permanently organized special education groups at ordinary schools, are not included in this study.

In the following we are going to study mathematics teaching in three different situations. One category is where the observed student

received special education teaching in the ordinary class (STIC). This category comprises 17 individual students. A second category is where the observed student received special education teaching apart from the ordinary class (STAC). 49 individual students belong to this category. Altogether, 66 students were observed when they received special education teaching in mathematics. In the third category, all students received ordinary mathematics teaching (OT). Some of these students received special education in other subjects, but since the focus here is on mathematics, they are considered as receiving OT. This is the largest category and includes 56 individual students. This adds up to 122 student registrations. However, 12 of the students are registered in both OT and STAC and two of the students are registered in STIC and STAC, resulting in 108 individual participating students. When a student has participated in two of the organizational groups that have occurred at different times, the registrations have been carried out using different observation forms. Consequently, this does not give rise to problems for the independence assumptions between the three organizational groups in the statistical analyses in this study.

I have compared these three groups (OT, STIC and STAC) in terms of three assessment-variables using one-way independent ANOVA with the group identity being the independent variable. For each of the variables, I have tested the homogeneity of variance using Levene's test. For the variables presented here, the three groups' variance is unequal according to Levene's test. Consequently, I have used Welch's F, which is a robust test of equality of means (Field, 2018), and the Games-Howell procedure for the multiple comparison post hoc analysis. I have calculated the effect sizes of the differences using Cohen's d (Cohen, 1988).

For the 16 selected categorical observation variables, with only two alternatives for each observation point, observed or not observed, I tested for significant differences between the three organizational groups using Pearson's chi-square test at an overall level, and separate chi-square tests for differences between each pair of the three groups. Cohen's h was used to calculate the effect sizes for these categorical variables (Cohen, 1988, pp. 179–181). In the interpretation of the effect sizes, I used Hattie's (2009, p. 9) limits: 0.2 = small, 0.4 = medium and 0.6 = large. The ANOVA-results and chi-square test-results presented below were calculated using SPSS 25.

The results presented below are selected on the basis of two criteria: That there is a significant difference between at least two of the organizational forms for the actual observation variables, and/or that the variables are relevant in an inclusion perspective.

Results

The special teaching in mathematics was located in the ordinary classroom (STIC) for 31 % of the time, and away from the ordinary classroom (STAC) for 69 % of the time. Table 1 shows that there are roughly three times as many students from grade 6 compared to grade 9, and twice as many from grade 7 compared to grade 10. In this study, 35 % of the students are girls, which corresponds to the percentage of the girls in special needs education at national level (32.3 %) (Utdanningsdirektoratet, 2018). The girls constitute a larger part of the students in STAC than in STIC and OT. In OT and STAC, the largest part of the observations are from grade 6 and 7, and from grade 9 and 10 in STIC.

Table 1. *Number of students observed, percentages of female students and percentages of observations in the different teaching situations and in different grades*

Grade	Number of students observed				Percentage of the observations		
	OT	STIC	STAC	TOTAL	OT	STIC	STAC
6th	23 [17][a]	4	19 [18]	46 [39]	39	26	37
7th	21 [15]	2	16	39 [33]	35	9	30
9th	6	5 [4]	4	15 [14]	13	34	11
10th	5	5	10	20	14	31	22
Total	55[b] (56)[d] [43[b]]	16[b] (17)[d] [15[b]]	49 [48]	120[c] (122)[d] [106[c] (108)[d]]	101[e]	100	100
Female students	26 %	31 %	48 %	35 %			

Notes. a Figures in [ ]-brackets represent number of students observed, corrected for participation in two of the groups.
b Grade information was lacking for one student.
c Grade information was lacking for two students.
d Figures in ( )-brackets include two students for whom grade information was lacking.
e The percentages add up to 101, due to rounding errors.

The roles of different occupational groups in the special teaching

Table 2 shows that in STIC, the subject teacher is the main teacher for 49 %, the contact teacher[2] for 33 % and the special pedagogue[3] for 11 % of the time, and there is more than one adult in the classroom for more than 90 % of the time (special pedagogue 15 %, second teacher 27 % and assistant 50 % of the time). In STAC, the special pedagogue is the responsible teacher for 50 % of the total time, the subject teacher 24 % and the

Table 2. *Who is the responsible teacher and which occupational groups are present in the classroom in percentage of the total teaching time in mathematics*

	OT	STIC	STAC
Who is the responsible teacher[5]			
Contact teacher[2]	57	33	18
Special pedagogue[3]	0	11	50
Subject teacher	35	49	24
Assistant[4]	2	0	5
Substitute teacher	6	0	3
Occupational groups present in the classroom			
Second teacher	15	27	0
Special pedagogue	11	15	0
Assistant	19	50	7
Milieu therapist	3	0	2
Others	5	0	0
More than one adult present	53	92	9

contact teacher for 18 % of the time. There was seldom more than one adult in the room at the same time. In OT, the contact teacher is the responsible teacher for 57 % of the total time, the subject teacher for 35 % of the time, and there are other adults present for 53 % of the time (the assistant[4] for 19 %, the second teacher for 15 %, and the special pedagogue for 11 % of the time).

The observers' assessment of the teaching

At the end of a lesson, the observers gave their assessment of the observed lesson. Table 3 shows the mean value of these assessments given on a scale from 1 to 4, where 4 = *to a very large extent*, 3 = *largely*, 2 = *to some degree* and 1 = *to a small degree*. The OT was experienced as the least varied, and STIC as the most varied. There was a significant overall difference in how varied the observers experienced the teaching to be between the three organization forms, Welch's $F(2, 386.83) = 11.73$, $p < 0.001$. Games-Howell's post hoc procedure shows that the differences between OT and STIC and between OT and STAC are significant ($p = 0.001$ and $p < 0.001$ respectively). The effect sizes of these differences are medium. There is no significant difference between STIC and STAC ($p = 0.725$)

The observers experienced classroom management generally as relatively clear, and clearest in STIC. There is a significant difference between

Table 3. *Means and standard deviations of observers' assessment of the three organizational forms of mathematics teaching, results of ANOVA and the effect sizes of the differences between the three forms*

	Number of observations, Group mean and (SD)				Multiple comparisons Games-Howell sig.		
	OT	STIC	STAC	Welch's F	Cohen's $d_{\text{OT-STIC}}$	Cohen's $d_{\text{OT-STAC}}$	Cohen's $d_{\text{STIC-STAC}}$
To what extent the teaching was experienced as varied	366 2.06 (0.88)	149 2.41 (0.97)	310 2.34 (0.83)	$F(2, 386.83) = 11.73$ $p < 0.001$	$p = 0.001$ -0.38	$p < 0.001$ -0.32	$p = 0.725$ 0.08
To what extent the classroom management was experienced as clear	392 3.28 (0.74)	149 3.51 (0.60)	300 3.41 (0.68)	$F(2, 427.15) = 6.73$ $p = 0.001$	$p = 0.001$ -0.31	$p = 0.073$ -0.17	$p = 0.227$ 0.16
To what extent the classroom environment was experienced as supportive	391 2.78 (0.80)	149 3.14 (0.74)	279 3.29 (0.87)	$F(2, 402.96) = 33.33$ $p < 0.001$	$p < 0.001$ -0.46	$p < 0.001$ -0.62	$p = 0.138$ -0.18

the three organization forms, Welch's $F(2, 427.15) = 6.73$, $p = 0.001$. The difference between the OT and STIC is significant ($p = 0.001$) and of medium effect size. There were no significant differences between OT and STAC or between STIC and STAC ($p = 0.073$ and $p = 0.227$ respectively).

Observers experienced the classroom environment as most supportive in STAC, and least supportive in OT. Generally, the class environment was considered to be more supportive in the special education teaching than in the ordinary teaching in mathematics. Welch's $F(2, 402.96) = 33.33$, $p < 0.001$ indicating that there is a significant overall difference between the three organizational forms with respect to how clear the observers experienced the classroom management to be. There are significant differences between OT and STIC and between OT and STAC ($p < 0.001$). The corresponding effect sizes are medium and large. There is no significant difference between STIC and STAC.

What the teacher does

For all the variables in table 4, describing what the teacher does, the results from Pearson's χ^2-test show that the overall differences between the three organizational forms are significant ($p \leq 0.005$, $\chi^2 > 10.5$) for each of the variables. The results from separate χ^2-tests of the differences between each pair of the three groups show that for the first four variables in table 4, there are no significant differences in the teacher's behaviour between OT and STIC. On the other hand, there are significant differences between OT and STAC ($p < 0.003$) for all the variables in table 4, and the corresponding effect sizes measured in Cohens' h

Table 4. *What the teacher does in percentages of the total teaching time in mathematics, and results from chi-square tests and effect sizes of the differences between the three organizational groups*

	Group mean and (SD)				Separate χ^2 -tests of the significance of differences between the three groups.		
	OT $n=397$	STIC $n=149$	STAC $n=328$	Pearson's χ^2	Cohen's $h_{\text{OT-STIC}}$	Cohen's $h_{\text{OT-STAC}}$	Cohen's $h_{\text{STIC-STAC}}$
Teaching the whole class[a]	33.5 (47.3)	28.9 (45.5)	22.6[b] (41.9)	$\chi^2(2) = 10.53$ $p = 0.005$	$p=0.301$ 0.10	$p=0.001$ 0.24	$p=0.138$ 0.14
Teaching individual students	38.0 (48.6)	38.9 (48.9)	52.7 (50.0)	$\chi^2(2) = 17.46$ $p < 0.001$	$p=0.849$ -0.02	$p<0.001$ -0.30	$p=0.005$ -0.28
Non-teaching activity	7.6 (26.4)	4.0 (19.7)	1.5 (12.3)	$\chi^2(2) = 14.80$ $p = 0.001$	$p=0.139$ 0.15	$p<0.001$ 0.31	$p=0.091$[c] 0.16
Listening to a student[d]	12.6 (33.2)	7.4 (26.2)	21.3 (41.0)	$\chi^2(2) = 18.94$ $p < 0.001$	$p=0.085$ 0.18	$p=0.002$ -0.23	$p<0.001$ -0.41
Motivating/ inspiring/ encouraging	7.8 (26.8)	16.1 (36.9)	25.9 (43.9)	$\chi^2(2) = 43.77$ $p < 0.001$	$p=0.004$ -0.26	$p<0.001$ -0.50	$p=0.018$ -0.24

Notes. a In STAC, the concept "class" is defined as the group the observed student belongs to in this lesson.
b These percentages are uncertain. The student is alone with the teacher for approx. 30 % of the time.
c This value is uncertain due to an expected frequency less than 5 in one cell in the χ^2-test, according to SPSS.
d This variable can be a random student, not explicitly the observed student.

vary from small to medium for all these variables. Comparing STIC with STAC, we see from table 4 that there is no significant difference in how much time the teacher spends on teaching the whole class or how much time the teacher spends on non-teaching activities. In STAC, the teacher spends significantly more time on teaching individual students ($p=0.005$) compared to STIC, but the effect size of this difference is small. The teacher listens significantly more frequently to a student ($p<0.001$) in STAC compared to STIC, and the effect size of this difference is medium.

The teacher more frequently motivates, inspires or encourages the students in the special education teaching compared to the ordinary teaching in mathematics, and most frequently when the special teaching is organized as STAC. The differences for this variable are significant ($p<0.02$) between each pair of the three organizational forms. The effect sizes for these differences are small between OT and STIC and between STIC and STAC, but medium between OT and STAC.

The teacher spends relatively much time supervising individual students or groups of students in all kinds of mathematics teaching, but the

differences between the organizational forms are not significant (not displayed in table 4).

Who gives support to the observed student?

In table 5, the χ^2-test result shows a significant overall difference between the three organizational forms with respect to from whom the observed student[6] receives support. The special pedagogue has a significantly ($p<0.01$) more prominent role in assisting the student in STIC and STAC compared to OT. The effect sizes of these differences are of medium size. There is no significant difference between STIC and STAC in the amount of time the special pedagogue gives support to the observed student.

The assistant supports the observed student for approx. 20 % of the time in STIC, 5 % of the time in OT and 3 % of the time in STAC. The effect sizes of the significant differences ($p<0.001$) between OT and STIC are medium, and between STIC and STAC are large. There is no significant difference between OT and STAC in the time the student receives support from the assistant.

There is no significant difference in the amount of time the student receives support from the teacher (not displayed table 5).

Table 5. *Whom the observed student receives support from in percentages of the total teaching time in mathematics, and results from chi-square tests and effect sizes of the differences between the three organizational groups*

	Group mean and (SD)				Separate χ^2-tests of the significance of differences between the three groups.		
	OT $n=397$	STIC $n=149$	STAC $n=328$	Pearson's χ^2	Cohen's $h_{\text{OT-STIC}}$	Cohen's $h_{\text{OT-STAC}}$	Cohen's $h_{\text{STIC-STAC}}$
Special pedagogue	0.8 (8.7)	10.1 (30.2)	10.7 (30.9)	$\chi^2(2)=36.05$ $p<0.001$	$p<0.001$ -0.47	$p<0.001$ -0.49	$p=0.842$ -0.02
Assistant	4.8 (21.4)	19.5 (39.7)	3.4 (18.0)	$\chi^2(2)=46.70$ $p<0.001$	$p<0.001$ -0.47	$p=0.335$ 0.07	$p<0.001$ 0.55

What the student does

From table 6, the results from Pearson's χ^2-test show that there are overall significant differences between the three organizational forms for each of the variables ($p\leq 0.002$ and $\chi^2>12.6$ for each of the variables). The results from separate χ^2-tests of the differences between each pair of the three groups show that for the first three variables, there are no significant differences between OT and STIC, but the differences between OT and STAC and between STIC and STAC are significant ($p<0.008$).

Table 6. *What the observed student does in percentages of the total teaching time in mathematics, and results from chi-square tests and effect sizes of the differences between the three organizational groups*

	Group mean and (SD)				Separate χ^2-tests of the significance of differences between the three groups.		
	OT $n=397$	STIC $n=149$	STAC $n=328$	Pearson's χ^2	Cohen's $h_{\text{OT-STIC}}$	Cohen's $h_{\text{OT-STAC}}$	Cohen's $h_{\text{STIC-STAC}}$
Listens to the teacher	31.5 (46.5)	24.2 (43.0)	41.2 (49.3)	$\chi^2(2) = 15.06$ $p=0.001$	$p=0.095$ 0.16	$p=0.007$ -0.20	$p<0.001$ -0.37
Subject related oral activity	5.3 (22.4)	5.4 (22.6)	22.9 (42.1)	$\chi^2(2) = 60.23$ $p<0.001$	$p=0.971$ 0.00	$p<0.001$ -0.53	$p<0.001$ -0.53
Unfocused/ inactive	17.6 (38.2)	12.8 (33.5)	3.7 (18.8)	$\chi^2(2) = 34.57$ $p<0.001$	$p=0.169$ 0.14	$p<0.001$ 0.48	$p<0.001$ 0.35
Working on common tasks	41.6 (49.3)	26.2 (44.1)	22.6 (41.9)	$\chi^2(2) = 32.52$ $p<0.001$	$p=0.001$ 0.33	$p<0.001$ 0.41	$p=0.390$ 0.08
Working on specially adapted tasks	10.3 (30.5)	18.8 (39.2)	42.4 (49.5)	$\chi^2(2) = 104.22$ $p<0.001$	$p=0.008$ -0.24	$p<0.001$ -0.76	$p<0.001$ -0.52
Using specially adapted teaching material	2.0 (14.1)	3.4 (18.1)	8.2 (27.5)	$\chi^2(2) = 16.51$ $p<0.001$	$p=0.360$ -0.08	$p<0.001$ -0.30	$p=0.049$ -0.21
Using ICT-equipment	7.1 (25.6)	0.0 (0.0)	4.0 (19.5)	$\chi^2(2) = 12.68$ $p=0.002$	$p=0.001$ 0.54	$p=0.073$ 0.14	$p=0.014$[a] -0.40

Note. a This value is uncertain due to an expected frequency less than 5 in one cell in the χ^2-test, according to SPSS

The effect sizes of the differences vary from small to large. The observed student most frequently listens to the teacher in STAC and most seldom in STIC, and the student is most frequently engaged in oral activity in STAC compared to OT and to STIC. The time the observed student is unfocused or inactive is less in STAC compared to STIC.

From the lower part of table 6 we can see that the observed student works significantly more on common tasks in OT than in STIC and in STAC, and the difference between STIC and STAC is not significant. The student works significantly more on specially adapted tasks in STIC and STAC than in OT, and significantly more in STAC than in STIC. The student uses significantly more specially adapted teaching material in STAC compared to OT and STIC. The use of ICT-equipment is most frequent in OT, and totally absent in STIC. The differences between OT and STIC and between STIC and STAC are significant. The effect sizes vary from small to large for all the variables in the lower part of table 6.

Discussion

In the following, I will discuss the results in light of the knowledge presented in the introductory section and the discussion will be structured on the basis of the didactic triangle.

Who teaches?

The roles of the different professional staff members seem to depend on the way the teaching is organized. Table 2 shows that the contact teacher and the subject teacher most frequently were responsible for the teaching in OT. In STIC, the subject teacher and the special pedagogue more often, and the contact teacher more rarely, are those primarily responsible for the teaching, compared to OT. In STAC, the special pedagogue has a much more prominent role and is primarily responsible for 50 % of the teaching time. But in spite of this, we saw from table 5 that there was no significant difference between STIC and STAC in the time the student received support from the special pedagogue. The assistants seem to have a less prominent role in our study than found in previous research, e.g. (Nordahl & Hausstätter, 2009, pp. 118–121). It is important to notice that our data shows who is primarily responsible for the teaching (table 2). In STIC, the assistants are present for 50 % of the total teaching time. It is likely that in many situations it is the assistant that teaches and supports the student in special needs education, even though it is the qualified teacher who has overall responsibility for the teaching. Table 5 shows that the observed student gets support from the assistant for 20 % of the total teaching time in STIC. If we instead relate this number to the percentage of the time the student gets support from an adult, the assistant's share is 54 %, the special pedagogue's share is 28 % and the teacher's contribution is 18 %. From this point of view, the assistant's role in the teaching is more in accordance with findings from other research (Nordahl & Hausstätter, 2009). In STAC, there is only one adult present in the room most of the time, and the student gets support from an adult for 24 % of the total teaching time. In STIC, there are two or more adults present in the classroom for 92 % of the time. This means that the teacher, special pedagogue and assistant might be present in the classroom at the same time, and the student gets support from one of them for 36 % of the total teaching time.

The teacher, the student and the interaction between them

The activities involving interaction between the teacher and the student are much the same in STIC as in OT (table 4 and 6). The only significant differences between them are that the teacher spends more time on

motivating, inspiring or encouraging the student in STIC. Even though there are not significant differences between OT and STIC for most of the variables describing what the teacher and the student do, this apparent equality might be only at a surface level (Shulman, 2005). There might be qualitative differences at a deeper level than our quantitative observation variables are able to capture. We get an indication that this might be the case from the observers' assessment of the teaching. From the assessment variables we see that the observers experienced the teaching in STIC as more varied, the classroom management as clearer and the class environment as being more supportive compared to OT.

There are significant differences between OT and STAC for all the teacher's and the student's interrelated activities in table 4 and 6. All the differences point in the same direction: More communication and more subject-related activity. The teacher directs more of his/her activity and focus towards the individual student and spends more time on motivating, inspiring or encouraging the student in STAC. The student listens more often to the teacher, is more often engaged in subject-related oral activity and spends less time being unfocused/inactive in STAC compared to OT. These differences between OT and STAC correspond to a large extent to what Haug (2015) found as a characteristic difference between ordinary teaching and special education teaching at a not subject-specific level: The student is more active and the amount of individual work is greater in special education teaching compared to ordinary teaching.

A comparison of STIC and STAC shows that the differences in what the teacher and the student do follow much the same patterns as between OT and STAC, with a few exceptions: There is no significant difference in how much time the teacher spends on teaching the whole class and in "non-teaching-activities".

The results from activities involving interaction between the teacher and the student (table 4 and 6), correspond partly to what we have found for ordinary mathematics teaching in previous studies. There we found that the teaching was characterized by relatively large amounts of individual work, with great emphasis on silent work on tasks (Skorpen, 2006; Topphol, 2012). The students were only to a small extent stimulated to verbalize their thinking and got relatively little practice in "expressing themselves orally in mathematics". The picture drawn here can to a large extend describe the findings for OT and STIC, but for STAC, we see that there is significantly more oral activity between the student and the teacher, compared to OT and STIC.

The fact that the teacher spends more time motivating/inspiring/encouraging the student in STIC and STAC, compared to OT, seems to be a natural thing to do in light of Nordahl and Hausstätter's (2009) find-

ings that students in special needs education are generally less motivated and less contented, compared to students in ordinary teaching.

The student, the content and the connections between them

In all three of the organizational forms, the students' work on tasks occupies a large part of the total time. This corresponds to results from research in ordinary mathematics teaching, where the "task discourse" (Mellin-Olsen, 1996b) directs much of the work in mathematics lessons (Topphol, 2012). The picture that tables 4 and 6 draw of the ordinary teaching in mathematics, largely corresponds to prior findings of similar studies (Eikrem et al., 2012; Skorpen, 2009). A closer look at table 6 reveals that there are significant differences between the three organizational forms in what kind of tasks the students work on and how this work is organized. Comparing OT and STIC, the student spends significantly more time working on common tasks and using ICT-equipment in OT, and on specially adapted tasks in STIC. There is no significant difference in the time the student is inactive or the time the student is using specially adapted teaching material.

Between OT and STAC, there are significant differences in all the variables concerning the student's work with the subject content, except the amount of time the student is using ICT-equipment. The student spends significantly less time being unfocused or inactive and significantly more time working on specially adapted tasks, using specially adapted teaching material and using ICT-equipment in STAC compared to STIC.

The ordinary mathematics teaching was perceived by the observers as showing relatively little variation. Viewed from the outside, the way of working, with a great emphasis on individual work on tasks, can naturally be regarded by the observers as showing little variation. This can be the case with respect to the external traits, the surface structure (Shulman, 2005), of teaching. Focusing on the deep structure (Shulman, 2005), the internal variation in type of tasks, workload and level can be greater than the observers were able to perceive.

Special teaching in an inclusive perspective

In our material, 69 % of the special teaching was organized in such a way that the student was segregated from the rest of the ordinary class. The remaining 31 % of the special teaching was organized in such a way that, if we focus on the surface structure of the pedagogical signature (Shulman, 2005), the student can be described as being included in the ordinary class. The student was spatially included (Asp-Onsjö, 2006),

but if we add a deeper interpretation of the concept of inclusion, and move towards the deep structure (Shulman, 2005), we obtain a more nuanced picture of the situation. To what extent was the student socially included? When comparing STIC with OT, we see a gentle turn towards more individual work and less use of collective work methods. In STAC, the teaching to an even stronger degree can be characterized by an individual perspective and to a lesser extent a collective perspective, compared to OT. This would seem to point in the direction of poorer social inclusion in special teaching, compared to ordinary mathematics teaching. On the other hand, the learning environment was perceived as more supportive in STIC, and far more supportive in STAC, compared to ordinary mathematics teaching. A supportive learning environment is an important part of a social inclusion perspective.

The differences between STIC and OT are associated with factors that can be important within didactic integration. For example, this involves more use of differentiated and specially adapted tasks and ICT teaching aids; the student is more often in contact with an adult in the form of getting support more often from a special pedagogue and assistant; the teaching is more varied, the class management is perceived as clearer and the teacher motivates, inspires and encourages the students more frequently in STIC, compared to OT. The same applies to an even greater degree to most of these areas in STAC, compared to OT: The teachers listen more to students, spend a greater part of their time motivating, inspiring and encouraging students; the student who receives special education listens actively to the teacher, is more orally active, uses specially adapted teaching materials, and works on specially adapted tasks for a larger part of the time, and works on common tasks for a minor part of the time. Furthermore, the student spends less time being unconcentrated or inactive, and the student receives support from a special pedagogue for a larger part of the time. All in all, the observers experienced the teaching as being more varied and with a clearer classroom management, compared to OT. We recognize several of these factors as favourable inclusion strategies (Florian & Rouse, 2001) and as conditions that will promote learning in inclusive classrooms (Whitty & Clarke, 2012). Most of these factors will generally be expected to positively affect students' learning outcomes, cf. (Hattie, 2009). The consequence of this is that the circumstances for didactic integration seem to be better in both STIC and STAC, compared to OT.

The most obvious difference between the two forms of special teaching, STIC and STAC, in an inclusive perspective, would be that the special teaching in the class meets the condition of physical inclusion. Differences in conditions for social inclusion are not that clear. On the one

hand, there are fewer common activities and more emphasis on individual activities, but on the other hand, the class environment was perceived as more supportive, and the student has more contact with the staff in STAC than in STIC.

When it comes to didactic inclusion, most results appear to favour STAC. There is more oral activity both among the students and with the teacher, and the students are engaged in learning-promoting activities for a larger part of the time, compared to STIC. The fact that the students have a greater ability to express themselves orally in mathematics is important for developing communication skills (Niss & Højgaard Jensen, 2002), and is emphasized as one of the "basic skills" in the curriculum (LK06, 2006).

It is important to emphasize that these results are based on quantitative data, and thus do not provide information about the quality of the different situations. When it is regarded as positive that the student to a greater extent receives specially adapted tasks, this is based on the premise that these adaptations are in fact in the student's best interest, and that they are not too simple, or that they e.g. simply focus on facts and skills, and not understanding. The same applies to the use of specially adapted learning material, ICT, etc. A positive view of the fact that the student to a greater extent receives support from the teacher, and to a lesser extent from the assistant, is based on the assumption that the teacher can be expected to have higher professional and subject-didactic competence than the assistant.

Brief summary

In all three types of teaching, for a relatively large amount of the time the student is engaged in individual work on tasks, but mostly in STAC. In OT, the student works mostly on common tasks, while in STAC the student spends most time working on specially adapted tasks and other specially adapted teaching materials. There is most oral activity for both the teacher and the student, the student is least unfocused or passive and gets the closest follow-up from the special pedagogue, and the classroom environment is perceived as being most supportive in STAC. The teaching is perceived as most varied and the classroom management as clearest in STIC. Based on general subject didactic considerations, the potential for academic development appears to be greatest in STAC, but the student then misses being included in the class community. STIC fulfils the physical aspect of the inclusion concept, STIC and STAC each appear to best meet different parts of the social aspect of the concept of

inclusion, while the didactic aspect of the inclusion concept appears to be best addressed by STAC.

Limitations

All the results from the observations are based on data collected by the time sampling method (Powell et al., 1975). The most obvious limitation of this method is that it is just what happens at the exact time for observation that is being registered. Everything that happens in the five-minute intervals between the observation times is ignored by this method. This means that activities that last for a short time are less likely to be registered than activities that last for a longer time. The effect of this error will decrease as the number of observations increases. This study is based on quantitative data, focusing on differences in the students' and teachers' activities in three different organizational forms. It would have been of interest to know more about the quality of the activities in each of the three forms. In order to be able to find out more about that, it will be necessary to collect a new set of qualitative data.

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Notes

1 The curriculum for knowledge promotion in primary and secondary education and training.

2 The contact teacher is the teacher who is primarily responsible for the practical, administrative and social pedagogical tasks for the students in a class or a basic group.

3 In Norway, the title "special pedagogue" is used by a professional who has formal competence in special pedagogy, and comprises the functions of what in other Nordic countries are separated in the special educator's and the special education teacher's roles.

4 An assistant is a professional that assists students, teachers and other staff in the school. There are no pedagogical or other formal qualification requirements for school assistants.

5 For 7 % of the time, it was not stated who was the responsible/main teacher.

6 The observed student is the student who received special teaching, and whom the observer followed throughout the entire day, when the student received special teaching as well as in ordinary teaching.

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