Inclusion and standards achievement: the presence of pupils identified as having special needs as a moderating effect on the national mathematics standards achievements of their classmates

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\textbf{ABSTRACT}
This article investigates the relationship between the achievement level of students in classes and the presence of students identified as having special needs in inclusive settings. In particular, it examines whether the presence of students with special educational needs in inclusive classrooms has an effect on the national mathematics standards achievement of their fellow students. In order to do so, the national standard scores of approximately 75,000 fourth graders in mathematics were used as dependent variable in multi-level regression modelling. As independent variables at class level the number of students with special needs and at the individual level socio-economic, cultural and ethnic background variables were used together with gender and age. Results show only a very small effect of the presence of students with special needs on the national mathematics standard scores of their classmates. The effect can be either positive or negative depending on further class conditions.

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1. Introduction: Inclusion and achievement

Over the past 30 years, and in particular with the ratification of the UN-Convention on the Rights of Persons with Disabilities (CRPD) in 2006, educational systems all over the world have been realigned to place children with disabilities in a mainstream school environment, often referred as inclusive school environment (Kalambouka et al. 2007). In this regard, inclusive education is an internationally often used approach or educational framework to serve children with disabilities or other special educational needs (SEN) in general education settings (Ainscow et al. 2012; Booth and Ainscow 2002). However, this changed considerably during recent years. Inclusive education nowadays, often is seen more broadly as a reform, that supports and welcome diversity amongst all learners (Ainscow et al. 2012; UNESCO 2016).

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Although inclusive schooling has been accepted as a desirable pathway of development of educational systems on a formal level, inclusion remains a controversial issue and topic of one of the most predominant debates in educational policy (Ruijs 2017).

Proponents of inclusive education often formulate their arguments from a human rights perspective, claiming the right for all students to be educated in regular schools (Ruijs 2017). From a more philosophical and theoretical point of view, this strand of thought contends that the transformation process to inclusive schooling should lead to a school system which fully ensures the development of each student’s potentials, regardless of his or her individual needs (Ainscow 2015; Black-Hawkins, Florian, and Rouse 2007; Persson 2013).

On the other hand, advocates of a segregational approach often mention that including students identified as having SEN may have a negative effect on their fellow students (Ruijs 2017). These authors assume that regular students get distracted by the behaviour of students with SEN, and the academic level in class decreases as a consequence of the presence of students with SEN (Ruijs 2017; Wild et al. 2015).

From an empirical point of view, the discussion on the effects of inclusion on students with SEN in regular classrooms seems to be less controversial. The positive effects of inclusive schooling for students with SEN are well documented. This applies for their academic achievement (Cosier, Causton-Theoharis, and Theoharis 2013; Dessemontet, Bless, and Morin 2007) as well as their social and emotional development (Kalambouka et al. 2007). However, the research base regarding the socio-emotional and, particularly, the academic development of students without SEN in inclusive classrooms appears to be less clear, adding fuel to the controversial debate at the policy level.

Recent research on the social and emotional development of students without SEN in inclusive classrooms reports mainly positive outcomes. This encompasses, among other things, better empathetic abilities, increased social awareness and raised levels of tolerance (Kalambouka et al. 2007; Peltier 1997). On the other hand, however, there are studies which outline the negative effects of the presence of students with SEN in inclusive classrooms on the social-emotional development of their peers without SEN when the SEN-classification is based on behavioural disorders (Carrell and Hoekstra 2010; Figlio 2007; Fletcher 2010; Neidell and Waldfogel 2010; Ruijs 2017).

Regarding the achievement level of students without SEN in inclusive classrooms, contemporary research shows an even more contradictory picture. Hanushek, Kain, and Rivkin (2002), for example, found positive effects on the achievement level (i.e. mathematics and reading) of children without SEN in inclusive classrooms. That being said, Friesen, Hickey, and Krauth (2010) and Hanushek, Kain, and Rivkin (2002) found no significant effect of the presence of children with behavioural disorders in inclusive classrooms. In this regard, Ruijs (2017), moreover, Ruijs, Van Der Veen, and Peetsma (2010) and Farrell et al. (2007) found no statistically significant effect of the presence of students with SEN on the academic achievement level of their classmates without SEN. On the other hand, Kristofferson et al. (2015) pointed out that the presence of students with behavioural disorders has a negative effect of one standard deviation on the achievement level in mathematics of their peers without SEN. Similar weak negative results for the presence of students with SEN on the achievement of their peers were recently reported by a group of researchers for a longitudinal study of a large Finnish sample (Hienonen et al. 2018).
As can be seen, the empirical picture is not very clear. This could be due to the fact that – with the exception of the studies from Hienonen et al. (2018), Kristoffersen et al. (2015) and Ruijs (2017, 2010) – most of the above-mentioned studies were conducted with a relatively small scale. Furthermore, authors often do not outline how inclusion is implemented in the researched educational context. It is obvious that disparate philosophies and implementations of inclusion in different educational systems lead to different structures and practices which will generate dissimilar effects and outcomes.

Another drawback of recent research is that most publications restrict their focus to the situation in the United States (U.S.). In this regard, international studies aren’t as prevalent as studies from the U.S. Furthermore, although authors have highlighted the strong relationship between SEN-labeling of learning disabilities and the socio-economic background of these children who receive this label (Shifrer, Muller, and Callahan 2011), most research does not consider this type of composition effects (Ruijs 2017).

A comprehensive knowledge base exists on the effects of the composition of student’s socio-economic backgrounds within a certain classroom on the achievement level of the students. Regarding reading comprehension, for example, Groeneveld and Knigge (2015) showed that almost 20% of the variance of the level of reading comprehension of sixth graders can be explained through socio-economic composition effects within classes. Slightly smaller effect sizes were reported for mathematics. According to the – Trends in International Mathematics and Science Study (TIMSS) – 12.9–18% of the variance regarding mathematics achievement in the fourth grade can be explained through socio-economic composition effects within classes in German speaking countries (Stubbe, Schwippert, and Wendt 2016). Moreover, Sirin (2005) pointed to a medium to strong relationship between the socio-economic background of the students within the class and their academic achievement (reading as well as mathematics).

### 1.1. Inclusion in Austria

Politically engaged parents of children with disabilities initiated the beginning of inclusion in Austria. Groups of parents pursued the goal of giving their children the possibility to learn together with their peers from kindergarten, to be able to remain in their place of residence and to attend the local public schools in their neighbourhood. In the beginning, the Austrian government only allowed inclusion to take place in a few model-schools. The number of model-schools and classes, however, soon exploded due to parent demand. By 1993, the government was forced to issue a new law that gave the right to all parents to choose between special schooling and inclusive schooling in general classes at a nearby public school (Gebhardt, Krammer, and Rossmann 2013).

This law was first put into effect in primary schools and then, in 1996, into secondary schools. Among other measures, chosen schools had to provide adequate learning environments and resources (Gebhardt, Krammer, and Rossmann 2013; Holzinger and Wohlhart 2009). This law allowed the percentage of pupils in inclusive classes to increase rapidly over the years. In the last years, however, this percentage has begun to stagnate (or even decrease) in some Austrian federal states. One of the reasons for this is that parents of severely handicapped children are concerned that their children are not getting the same attention and support in inclusive education as they would in special schools.
Currently, approximately two thirds of pupils identified as having SEN attend general schools in Austria. According to Statistik Austria (2017), in the 2015/16 school year, there were 30,701 pupils with special educational needs (SEN), 10,984 of whom attended special school classes and 19,717 of whom attended general classes. Furthermore, out of the total of 740,000 Austrian pupils in primary (grade 1 to grade 4) and lower secondary (grade 5 to grade 8) education, 128,000 were taught in classes with at least one student with special educational needs. In other words, almost every sixth child in Austria without SEN attends a class with children with special educational needs (Bruneforth et al. 2015).

Although this overall rate is high, there are still great differences between the Austrian federal states. In Styria, for example, about 80% of students identified as having SEN attend mainstream classes while this percentage is only 42% and 48% in Tyrol and Lower Austria (Bruneforth et al. 2015). Put differently, the chance to be educated together with a peer with SEN is approximately twice as high in Styria than in Tyrol. Moreover, there are also major differences between school types. Primary schools are, in general, open and well prepared for inclusive education. In lower-secondary schools, though, the possibilities for the inclusion of students are less developed. Especially in upper-secondary schools, moreover, only a few individual schools offer the possibility for inclusive education.

With the ratification of the UN Convention on the Rights of Persons with Disabilities in 2008, Austria has committed to promoting the implementation of an inclusive school system nationwide. The convention was the basis for the National Disability Action Plan 2012–2020 (BMASK 2012), which describes inclusive model regions. The Guidelines for the Nationwide Implementation of Inclusive Model Regions (BMBF 2015) describes their principles and goals. The aim is ‘to raise the pedagogical quality and the support at regular schools in such a way that no separate institutions are needed’ (BMBF 2015, 2). These guidelines introduce a broader understanding of inclusion with respect to other areas of diversity, such as language, nationality or gender, and open the perspective for a school system without barriers and adequate support for all pupils. This idea is also represented in the Austrian general strategy for school quality development (SQA) (BMBF 2015; Schratz et al. 2015), which makes the development of inclusive settings a compulsory task for all schools.

1.2. Educational standards testing in Austria

Educational standards testing in Austria is based on a law that describes competence models and Standards Tests for the subjects of Mathematics (BIST-M4), German, Reading and Writing (BIST-D4) in primary schools, as well as Mathematics (BIST-M8), German (BIST-D8) and English (BIST-E8) in secondary schools (BMBF 2009). Tests are applied in regular succession to all fourth grade pupils in primary school and to all eighth grade students in secondary schools. The first testing cycle began in 2012 with BIST-M8, 2012: M8, 2013: M4 & E8, 2015: D4, 2016: D8. The second cycle is currently taking place: 2017: M8, 2018: M4, 2019: E8, 2020: D4, 2012: D8. The data of the present study were collected in the BIST-M4 test series 2013.

All pupils are obliged to take part in testing except pupils identified as having SEN and so-called ‘irregular’ students, who are typically language learners without sufficient
competence in the German language. Teachers must document the reason for a child not taking the test. This documentation is an important source for this study.

The main part of the standards test consists of subject specific tasks related to the competence model. To be able to contextualize the outcomes, there are four additional questionnaires. Parents or caregivers are, among other questions, asked about their country of birth, the first language of the child, the languages spoken at home, their educational level, their vocational status and the number of books at home. Students are asked about the test and the difficulty of the tasks, about their parents’ jobs, the number of books at home, their education related activities, their country of birth, their native language, their subject related self-concept, their learning experiences and their well-being in school. Teachers are asked about the composition of their class, their subject specific teaching experience, the supporting experts and team teachers in the class and about their subject specific teaching. Finally, school headmasters answer questions relating to the size and structure of their school, the school-specific support for pupils and they are asked to provide information about the classes participating in the test. These context questionnaires make it possible to do multi-level regression analyses on the school, class and individual level. The applied methods are documented by Breit and Schreiner (2016).

Test data are collected and evaluated by BIFIE (Bundesinstitut für Bildungsforschung, Innovation & Entwicklung des österreichischen Schulwesens), the federal institute for research and development in education in Austria. A report on the overall results is published. The report on the data of the present study was issued by Breit and Schreiner (2016). Schools get their results and have to inform parents about the outcomes. Moreover, the schools must take the results into account when working on their next plans for school development. Researchers can obtain an anonymized data set from BIFIE for further analysis (e.g. the present study).

The data of the present study stem from a complete evaluation of the National Standards Tests (BIST M4 2013) of all Austrian primary schools. These schools (Volksschulen) are comprehensive schools comprising four grades (ISCED Level 1) and an optional preschool level (ISCED Level 0). Typically, they are small schools with an average of six classes and some hundred pupils per school. In most cases, a single teacher teaches all subjects for the whole class. If there are a certain number of pupils with SEN, a second teacher can be present full time. This number varies based on available resources and the concrete demand (Schwab et al. 2015).

2. Research questions and aims

This paper investigates the effect of the presence of students identified as having SEN on the standards achievement of their classmates without SEN in inclusive classrooms. For this purpose, the Austrian national educational standards data set in mathematics for fourth grade BIST-M4-2013 was explored to outline possible relationships between the attendance of students with SEN as a class-composition characteristic and the educational standards achievements in mathematics of their classmates. The formulation of directed hypotheses was not carried out for two reasons: First, the existing empirical findings are too contradictory to suggest a directed hypothesis, whatever direction. Second, and from a theoretical point of view, positive relationships, as well as negative ones, would be justifiable. A positive direction could be deduced from social-cognitive theories: we
assume that the interaction between students with and without SEN may lead to higher self-efficacy expectations of the students without SEN, because they perceive themselves as being able to solve specific problems. We could assume, moreover, that institutional transformation processes towards inclusive schooling would lead to higher quality instruction and learning from which all students would benefit (Ainscow 2015). A negative direction could be assumed, however, by taking into account a classroom management perspective: deviant behaviour of students with SEN, in particular of students with behavioural problems, may lead to a reduced level of attention of their fellow students and hence to significantly lower learning gains in mathematics (Ruijs 2017).

Therefore, this paper examines data-driven following questions:

- Does a positive or negative relationship exists between the number of students with SEN and the educational standard achievements of their classmates without SEN in a specific classroom?
- In particular, this paper investigates whether a linear relationship (positive as well as negative) exists that can be compared to class composition effects based on socio-economic differences.
- Moreover, are there any gender-specific differences in attaining the standards that correlate with the presence of students with SEN in a classroom?
- Are there any differences on the standards attainment measureable between weak-performing students and high-performing students?
- Does adequate pedagogical support by a special education teacher has an effect on the education standards scores of the students without SEN?

In this regard, it is important to keep in mind that all calculation models in this research also control for the socio-economic and cultural background of the students because, as pointed out in the introduction, this is a relevant parameter.

3. Methodology

In order to answer these research questions, multi-level modelling was used. The Austrian educational standards examination in Mathematics for the year 2013 acted as the underlying data for this paper’s calculations. All calculations were carried out with the BIFIE-Survey Package in the R environment.

3.1. Sample

Altogether, 73,655 students participated in the educational standards examination in Mathematics in 2013, which was carried out by the BIFIE (State Department for Educational Research, Testing and Development). The underlying data used for the calculation is an Austrian-wide total survey of all fourth graders in the country in 2013. The students in this calculation attended 4904 classes at 3048 primary schools in all 9 federal states of Austria; 50.9% of the students were female. The average age of the students participating in the survey was 10.34 years (SD: 0.45).

Resampling methods and multiple imputations were used to estimate sampling variance. Multiple imputations procedures were used to estimate missing values. For a
detailed description of the Austrian educational core standards and the assessment, please see the documentation of the standard assessment in mathematics and the technical documentation of the survey at BIFIE (2013).

3.2. Variables used in the regression model

As a dependent variable, the education standards attainment scores in mathematics were used as plausible values (pv). The Austrian educational standard testing in mathematics is based on an item-response based standard setting which is basically a competence-model encompassing three different levels (From Level 1, educational standards only partly achieved, to Level 3, educational standards surpassed). In total, the competence level encompass eight different mathematical competences: working with numbers, operations, sizes, plane and space as content related mathematical competences and modelling, operating, communication and problem solving as general mathematical competences (BIFIE 2013). The educational standard score can be described as normally distributed data with a mean of 533.17 (SD: 99.89). The interquartile-range arrays from 464 to 603 score point. About 50% of the students are located in this bandwidth. Twenty-five per cent of the students score below that range and 25% above. It is important to note, though, that only students not identified as having SEN took part at the educational standard examination. Students identified with SEN, along with students with insufficient German language skills, were excluded.

The following independent variables at the class level were used: the number of students identified as having SEN (CT_SEN), the number of students with another first language than German (CT_first language) and the classroom teacher’s estimation that sufficient special educational support was available. The information regarding the number of students with SEN was obtained from the classroom teachers’ questionnaire. This variable has a range from 0 to 30. A closer look at the frequencies distribution shows that over 98% of the tested students attend classes in which between 0 and 5 students identified as having SEN were educated. In fact, 75.4% of the tested students attend a class were no children identified as having SEN were educated; 12.2% of the tested students attend inclusive classes with one student identified as having SEN; 4.7% of the tested students attended classes with two pupils identified as having SEN; 2.4% of the tested students attended classes with three students identified as having SEN; 1.9% of the tested students attended classes with four students identified as having SEN, and 1.7% of the tested students attended classes with five students identified as having SEN. The rest (1.7%) are likely to be invalid entries or miss-estimations from missing values estimations. Therefore, classes with more than six students identified as having SEN were excluded from further analysis.

The classroom teachers were also asked about the number of students with a first language other than German in their classes. The variable has a range from 0 to 28. Frequencies are presented in Figure 1.

Finally, classroom teachers (form teacher, hence teachers mainly responsible for the certain class) were also asked whether they estimate the support available through a Special Needs teacher as sufficient or not. Totally 53.3% of the teachers stated that there exists no need for special needs teachers because no children identified as having SEN attended these classes. About 10% regarded the support as sufficient, and about 15% mentioned they received support from special needs teachers but not sufficiently.
Twenty-five per cent of the teachers did not answer this question. For calculations, this variable was recoded and used as a dummy variable.

The following variables were used at the individual level: gender, age, number of books at home, education of the parents and the highest socio-economic status-HISEI. Statistical characteristics for gender and age are presented in chapter 3.1. The number of books at home was used (as it is used in the PISA tests) to estimate the cultural background of the tested students. It is a 5 point categorical variable with a range from 1 (less than 10 books) to 5 (more than 200). The education of the parents was measured with an 8-point scale ranging from 0 (no compulsory schooling) to 7 (university degree). Finally, the HISEI was used to estimate the highest socio-economic status of the parents of the tested students. The mean of the HISEI was 46.72 (SD: 20.66).

### 3.3. Procedures

The initial calculations were carried out with the R-package BIFIESurvey at a subsample of approximately 4200 students from 250 classes. The generated R-code was then sent to the BIFIE and applied to the complete data set [thanks to the BIFIE-research support team for the technical assistance]. This procedure was chosen because of anonymity and privacy reasons. All calculations in this study refer to the complete data set.

### 3.4. Mathematical regression models

As mentioned multi-level regression modelling was performed. The data-set was a multiple imputed dataset with the nested data structure. The random slope model can be mathematically defined as:

\[
y_{ij} = X_{ij} \gamma + Z_{ij} \mu_j + \gamma \epsilon_{ij}
\]

\[
y_{ij} = X_0 \gamma + Z_0 \mu_j + \gamma \epsilon_{ij}
\]

\[
y_{ij} = X_{i(sex, age, parent\_education, books at home, Hisei)} \gamma + Z_0 \mu_j + \gamma \epsilon_{ij}
\]
\[ y_{ij} = X_{ij}(\text{CT\_SEN, CT\_first\_language}) \gamma + Z_{0j} + \epsilon_{ij} \]  

(4)

\[ y_{ij} = X_{i}(\text{sex, age, parent\_education, books at home, Hisei}) (\text{CT\_SEN, CT\_first\_language}) \gamma + Z_{0j} + \epsilon_{ij} \]  

(5)

(1) represents the general mathematical model, whereas \( y_{ij} \) is the dependent variable, in this case, the overall achievement score in mathematics in the national standards evaluation. \( X_{ij} \) contains the fixed effects and \( Z_{ij} \) contains the random effects. Moreover, decomposition of the variance of fixed and random effects is considered between and within levels. Model (2) is the blanc model without any predictors at individual and class-level (model 0 in Table 1). The third Model (3) contains only predictors at individual level (model 1 in Table 1), model 4 only the predictors at class level (represented as model 2 in Table 1).

Model (4) represents the regression model with variables on both, the individual and the class level as a fixed effect model (model 3 in Table 1). All other models represented in Table 1 were calculated analogous to the above mentioned, please see results for further specification. For the random effect models variables were considered analogous to the fixed effects models for \( Z \) instead of \( X \).

### 4. Results

In Figure 2, standard achievement scores x number of students identified as having SEN are presented. The comparison of the means and the variances for the different classes shows that the number of students identified as having SEN does not affect the educational standards achievement of their fellow students in a linear way. In fact, the standard achievement in classes with one student with SEN in class (\( M: 531.5 \)) is almost the same than in classes with four students identified as having SEN (\( M: 531.4 \)). Compared to classes with zero students with SEN (\( M: 537 \)) and classes with two or three students with SEN in class (\( M: \text{ca. 525} \)) means remain roughly the same and no linear pattern was found within the data structure. However, it must keep in mind, that this model

![Figure 2](image_url)
|                | Model 0 | Model 1 | Model 2 | Model 3 | Model 4 | Model 5-n1 | Model 6-n2 | Model 7-n3 | Model 8 | Model 9 | Model 10 | Model 11 | Model 12 | Model 13-n1 | Model 14-n2 | Model 15-n3 |
|----------------|---------|---------|---------|---------|---------|------------|------------|------------|---------|---------|----------|----------|----------|-------------|-------------|-------------|
| Sex            | 18.22   | 18.05   | 15.55   | 18.05   | 18.05   | 18.05      | 18.05      | 18.05      | 18.04   | 17.9732 | –        | –        | 3.59      | 3.6        | 3.6         |            |
| Age            | −29.35  | −28.51  | −26.11  | −28.55  | −28.52  | −28.52     | −28.52     | −28.33     | −25.44  | −31.05  | −13.27   | −13.28   | −13.30    |            |             |             |
| parent         | 5.18    | 5.25    | 5.11    | 5.25    | 5.25    | 5.25       | 5.25       | 5.24       | 5.23    | 5.58    | 4.90     | 0.63     | 0.63      | 0.63        |             |             |
| education      | books at home | 15.49 | 14.91 | 11.35 | 14.91 | 14.92 | 14.92 | 14.91 | 14.90 | 14.91 | 15.70 | 14.57 | 2.69 | 2.69 |             |             |
|                | HISEI   | 0.84    | 0.82    | 0.59    | 0.82    | 0.82 | 0.82 | 0.82 | 0.82 | 0.82 | 0.80 | 0.87 | 0.24 | 0.25 |             |             |
|                | CT, SEN | −1.29   | −0.73   | −0.75   | −0.78   | −4.95 | 1.29 | −0.07 | 0.04 | −0.86 | −1.03 | −0.40 | −0.20 | 1.18 | 3.82 |             |             |
|                | CT, first | −3.72 | −2.44   | −2.42   | −2.47   | −2.46 | −2.47 | −2.39 | −2.38 | −2.46 | −2.48 | −1.9 | −1.09 | −1.09 |             |             |
|                | language | supporting teacher | special | education | teacher |            |            |            |            |            |            |            |            |            |             |             |
|                | R²-Level 2 | 0     | 0.23    | 0.26    | 0.44    | 0.48 | 0.45 | 0.45 | 0.48 | 0.48 | 0.45 | 0.46 | 0.32 | 0.32 | 0.32 |             |
|                | R²-Level 1 | 0     | 0.17    | 0      | 0.17    | 0.16 | 0.16 | 0.16 | 0.16 | 0.17 | 0.16 | 0.16 | 0.03 | 0.03 | 0.03 |             |
| ICC's          | 0.18    | 0.14    | 0.14    | 0.12    | 0.12    | 0.12 | 0.12 | 0.12 | 0.11 | 0.11 | 0.12 | 0.14 | 0.18 | 0.07 | 0.07 | 0.07 |
allows only a very simplified look at the data. The nested structure of the data and other predictors which affect the achievement scores are not considered. Therefore, in order to consider these issues, a multi-level analysis was performed.

In the first table, fifteen different multi-level regression models are presented. The models can be categorised that models 3–10 were conducted on the full dataset, whereas models 10–15 were only conducted at a specific dataset as outlined below. Models 3–10 were performed in order to provide insights in the effect and, in particular, in the size of the effect the presence of students identified as having SEN have on the standard math achievement scores of their fellow students. Moreover, in particular models 5, 6 and 7 and again 13, 14 and 17 were performed in order to explore the existence of any kind of linear relationship.

Model 0 is the blank model without any predictors at the individual and class level. Model 1 contains the predictors on the individual level and model 2 only the predictors at the class level. Model 3 represents the first model with predictors on both levels with fixed effects. This model is virtually the model mathematically described under formula 5 in the last chapter, and contains on the individual level: sex, age, parent_education, books at home and the Hisei. At the class level, the number of students identified as having SEN in class (CT_SEN) and the number of students with another first language than German (CT_first language) were taken into account.

Variance explanation is about 45% at the class level (R² Level 2) and 17% at the individual level (R² Level 1). Variance explanation remains roughly constant for all models except the last three ones were variance explantation decreases. This is mainly because for the last three models only students representing the lower 25% bandwidth were considered and therefore variance explanation is limited. Model 4 can be regarded as similar to model 3 with random effects instead of fixed effects.

Because there is no linear relationship assumed between the number of students identified as having SEN in class and the educational standards attainment of their fellow students, in models 5, 6 and 7 the number of students identified as having SEN was dichotomised. In this regard, model 5 only refers to classes with one student identified as having SEN attending class, and 0 refers to classes without children identified as having SEN attending class. In model 6, two to three students identified as having SEN attending class was defined as 1. Finally, in model 8, four students with SEN attending class was defined as 1.

Models 8 and 9 refer to the adequate support of a special needs teacher or a para-professional. In this regard, it is important to keep in mind, as outlined in the methodology sections, that a number of misidentifications and misestimations regarding the number of students identified as having SEN attending a specific classroom exists. Therefore, the number of students identified as having SEN attending an inclusive classroom was limited to a maximum of ten for models 0–9. In a second step, in order to mirror more closely the working reality of inclusive schools in Austria, the number of students identified as having SEN was limited to five for models 10–15.

Model 10, then, can be regarded as analogous to model 3, only the number of students with SEN in class is restricted to a maximum of five. Because effect sizes remain largely the same for model 3 and model 10, this limitation of the population does not have to seem any consequences in regard of effect size.
Model 11 only refers to the educational standard attainment of girls. In contrast, model 12 only refers to the educational standard attainment of boys.

For models 13, 14 and 15, the number of students with SEN attending a specific class was dichotomised, similarly to models 5, 6 and 7. The difference between these models being that models 13, 14 and 15 only refer to the weakest 25% of students not being identified as having SEN. Hence, model 13 only refers to classes with one student identified as having SEN attending class. Everything else was set to 0. In model 14, two to three students identified as having SEN attending class were defined as 1, everything else as 0. Finally, in model 15, fourth students with SEN attending class was defined as 1 and everything else as 0.

5. Discussion

The outcomes of multi-level regression modelling reveal mainly small negative effects of the presence of students identified as having SEN on the standard achievement of their fellow students in class, even when controlled for socio-economic and cultural composition effects. In this regard, socio-economic and cultural composition effects are relatively strong to moderate and are approximately at the same level which were reported in other studies like PISA or TIMMS (Biedermann et al. 2016; Stubbe, Schwippert, and Wendt 2016). For example, the beta-values of model 3 three reveal a strong effect of sex (18.05), age (−28.51), and books at home (14.81) on the national math standard achievement of the test-takers. Hence, having 100 books instead of 50 books at home will increase the math achievement scores of a test-taker of almost 15 points. The only exception is the HISEI were only relatively small effects were revealed. This is not comparable to similar results in the existing literature (Biedermann et al. 2016). However, it is very likely that this can be explained by the fact that the explaining variance of this variable is limited because of other variables like education of the parents or books at home, where definitely variance overlaps exist.

In contrast to this result beta-values and therefore also effect size of students identified as having SEN in class on the math performance of their fellow students remains only very marginal for all calculated models.

This means, for example, that increasing the number of students identified as having SEN by one leads to a decrease in the average math achievement of 0.73 points (see model 3). Compared to a mean of 533 and a standard deviation of approximately 100, it is very likely that the presence of students identified as having SEN has no practical implications for the math performance of the other students in class. The same is true for all other models calculated and presented in this study. In fact, the range of the beta-values is from 4.95 to 3.82. Theoretically, then, there would be very small positive, as well as negative, effect found on the standard achievement of students without SEN. Because of diminishingly small effect sizes, though, no practical implications can be expected, no matter in which direction. These results are comparable with the results of a recent meta-analysis of Szumski, Smogorzewska, and Karwowski (2017) which analysed 47 studies on the effectiveness of inclusive education for students without SEN. These authors found a positive, but very weak ($d = .12$) effect on the academic achievement of students without SEN in inclusive settings.

Another important fact revealed by the data can be seen in the circumstance, that no linear relationship exists for the degree of presence of students with SEN and the standards
achievement of their classmates in mathematics. According to the results presented in Table 1 for models 5, 6 and 7, beta-values reveal an u-shaped curve (model 5: −0.74, model 6: −4.95 and model 7: 1.29).

This stands in contrast to findings regarding socio-economic composition effects where linear negative effects are assumed (Sirin 2005) and can be proved for the data set of the present study (Biedermann et al. 2016). According to the results of this study, positive, as well as negative, effects were revealed. Additionally, negative effects do not represent any kind of linear patterns. Therefore, any assumptions about any linear relationships between the number of students with SEN in class and the math achievement of their fellow students can be rejected. In this regard, it is impossible to estimate any kind of cut off point, where any effect, whatever which direction, is likely to be relevant.

Contrarily to this results, a closer look to models 13, 14 and 15, where the same dichotomised models were performed on the lower 25% population actually shows some kind of a positive linear relationship between the number of students with SEN and the scores of their fellow students (model 13: −0.20, model 14: 1.18 and model 15: 3.82). Along these lines, the presence of students with SEN seems to have a positive effect on the standards achievement of the other under-performing students in class not identified as having SEN. Nevertheless, it must be kept in mind that effect size is again very small. This positive outcome may also be explained by the fact that the presence of students with SEN in class in most cases trigger administrative and special educational support systems, allowing other under-performing students in class to benefit as well.

In this regard, multi-level regression analysis also revealed that under specific circumstances, the presence of students identified as having SEN has a positive effect on the standards achievement of all their fellow students (as shown in model 7). Hence, not only under performing students benefits, but rather all students in class benefits from the presence of students identified as having SEN. The reason for this positive outcome can be probably found in the specifics of the Austrian school system. This model refers to a class situation in which at least four students with SEN attended a class. Four students with SEN attending class also means that a special needs teacher is present in the class for all class hours. The consistent availability of two teachers in class certainly influences a number of different issues regarding a specific classroom, ranging from classroom management to the academic or socio-emotional development of all students in class. Hence, in a professional co-taught classroom, all students may take their benefits from the presence of a second teacher in the Austrian context. The positive effects of efficient and high-quality co-teaching were outlined by various authors (Friend et al. 2010; Murawski and Lee Swanson 2001; Pancsofar and Petroff 2016; Schwab et al. 2015).

Finally, a closer look at the data also reveals that girls seem to be more negatively affected through the presence of students identified as having special needs. Effect sizes, though, remain diminishingly small. However, the reasons for this circumstance my be found in the fact, that a specific gender gap exists in regard of the national mathematics standards evaluation, in particular in German speaking countries (Stubbe, Schwippert, and Wendt 2016).

6. Limitations and future research directions

This study only refers to the standards achievements in mathematics of primary students in the fourth grade in Austrian primary schools. Implications for other settings or subjects
cannot be drawn. In this regard, it would be interesting whether the results of this study could be replicated in other subjects, such as language arts. Additionally, it would be noteworthy if the differential negative effect on girls or the positive effect on under-performing students can be replicated in other subjects as well. Finally, it would be of importance to conduct controlled longitudinal-studies to analyse in detail different academic achievement developments in heterogeneous classes and possible predictors of it.

7. Conclusions

To summarise, the presence of students identified as having SEN in class has, at least from an effect-size determined perspective, very few practical implications for the mathematics standards achievement of their fellow students. From a statistical point of view, very small positive, as well as very small negative, effects of the presence of a student with SEN were revealed. In this regard, it is very likely, according to the data, that specific class compositions exist where the presence of students identified as having SEN is beneficiary for the math achievements of all students.

Disclosure statement

No potential conflict of interest was reported by the authors.

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