Dealing with Diversity in the Mathematics Classroom

Guðný Helga Gunnarsdóttir and Guðbjörg Pálsdóttir
University of Iceland

Mathematics teachers in Iceland are teaching in an inclusive school and in this study the focus is on analysing how they deal with the diversity in their classes. Data from a study on teaching and learning in Icelandic schools, where 51 mathematics lessons were observed, are used. The findings reveal that the teachers are using an individualistic approach. The students are using most of their time working with assigned problems in the teaching materials and little time is used on public interaction. Most common is that the students are working with the same topic. The teacher and an assistant are mostly assisting the students by their desks. The focus is on helping all students even though the assistant is there because of students with diagnosed difficulties.

Introduction

In this paper we report on a study of how teachers deal with the diversity of students in an inclusive school. Data from observations of 51 mathematics lessons in a big study on teaching and learning in Icelandic schools was used to identify how the teaching was organized in order to meet the diverse needs of the students.

In Iceland the development towards an inclusive education started in 1974 with the approval of a law for a nine-year comprehensive school. In the law education for all was mandated regardless of the children's learning abilities and social background. It was a requirement that classes should be heterogeneous. The discourse of this period focused on integrating students with special needs into the mainstream schools. Through the years the discourse and ideas about inclusive education has been changing and it can be seen as a process focusing more and more on the right of every child to get quality education in their neighborhood school. One turning point was the

Salamanca declaration which was confirmed in 1994, translated into Icelandic by the Ministry of Education and sent to all schools in Iceland (Menntamálaráðuneytið, 1995).

Background

In a new Icelandic school legislation for all school levels set in 2008 it is clear that inclusive education is what is aimed for. In the compulsory school act it is stated that all students have a right to go to their neighborhood school regardless of their physical or mental abilities and that their needs should be met in an inclusive school (Lög um grunnskóla nr. 91/2008). In the national curriculum guidelines it is stated clearly that inclusive education is a coherent process with the aim of providing good education for all students. Diversity, different needs, abilities and characteristics of students should be respected and emphasis should be put on eliminating all kinds of differences and segregation in schools. Inclusive education is defined in a regulation about students with special needs in compulsory school. There it says that an inclusive school is a school in the students neighborhood where their learning and social needs are met in a regular school with human values, democracy and social justice as the guiding light.

Even though the aim is clear the practice is sometimes different. In 2013 there were three special schools operating in the country and only 0.37% of students were attending these schools. But 27% of all students in compulsory schools (grades 1-10) were getting some kind of special education or support and 36% of them were getting this support in a special education classroom, 16% in the classroom and approximately 48% both in class and in a special education classroom (Statistics Iceland, 2014). So there is still some segregation within the schools. The biggest threat against the inclusive school comes possibly from within the schools (Sigurðardóttir, Guðjónsdóttir & Karlsdóttir, 2014). Teachers find it difficult to deal with the diversity within the class and a recent study shows that only 49% of teachers found it important that all students attended their neighborhood school and 83% felt they were not prepared to meet students with diverse needs (Björnsdóttir & Jónsdóttir, 2010). According to international comparisons like PISA equality is considered to be on a high level in the Icelandic school system. However in the PISA 2012 results there are

for the first time some indications that socioeconomic status could be affecting students' outcomes (Halldórsson, Ólafsson & Björnsson, 2014).

The city of Reykjavík has for the last ten to fifteen years been promoting a policy called individualized and cooperative learning with the aim of better meeting the needs of all students. Their definition of individualized learning is:

> The organisation of learning that builds on the abilities of individuals but not on a group of students or whole classes in a compulsory school. Students are not learning the same thing at the same time but can be working on different content or tasks alone or in groups. Students are responsible for their own learning and their learning is built on an individualized learning plan (Menntasvið Reykjavíkurborgar, 2007).

This definition is much narrower than the definition of inclusive school in law and regulations and it implies that if teachers are to meet the different learning needs of students an individual learning plan has to be made for each student. There are many indications that teachers find it difficult to fulfil this goal (Gunnþórsdóttir, 2010; Gunnþórsdóttir & Jóhannesson, 2013). They feel they have not been prepared properly in their teacher education for dealing with the diversity of students in regular classes and they also feel they need more support within the schools.

In the study *Teaching and Learning in Icelandic Schools* (Óskarsdóttir et al., 2014) one of the main goals was to establish the schools´ progress in the development towards individualized learning. In the study, a measurement tool on individualized and cooperative learning developed by educational practitioners in Reykjavík School District, was used as a framework. The framework consists of six strands; internal structures, learning environment, attitudes towards students learning, teaching strategies and practices, students activities and responsibilities and parental involvement (*Measurement tool on individualized and cooperative learning*, 2005). According to the study only small steps have been taken towards individualized learning, where teaching practices are based on individual learning plans for students, different assignments, learning strategies and assessment. The biggest progress is probably in assessment but in most lessons students in the same

class or learning group are working with the same tasks at the same time (Sigurgeirsson, Björnsdóttir, Óskarsdóttir & Jónsdóttir, 2014).

Guðjónsdóttir and Karlsdóttir (2009) studied the implementation of inclusive education in Icelandic schools. In a study in four of the largest school districts they found that three districts had stated a formal school policy on their web site and they all emphasized that all students should have equal access to education but only one used the term *skóli án aðgreiningar* (e. *school without segregation*) which is the Icelandic term used for inclusive schools or education. In this school district the policy is more clearly stated and it is made clear that all children have the right to attend their neighborhood school if the parents wish so. When looking more closely on the websites of 68 individual schools in these school districts only 52 display an inclusive policy, and in stating how to meet students' diverse needs emphasis is put on special education in or out of class, special classes and learning centers for students with difficulties.

Karlsdóttir and Guðjónsdóttir (2010) also studied the implementation of inclusive education in five schools in Iceland. They interviewed teachers, special education teachers and school leaders in all schools and observed teaching in grades three, six and nine, in total nineteen observations. According to their findings more students with special needs getting support within the classroom either by special educators or an unqualified assistant. Those who leave their home classroom for special support have some specific needs that cannot be met within the classroom. Within the class children with special needs most often get individual support from a special education teacher or an assistant. The focus is on students with some kind of difficulties but rarely on the more able students. There are positive attitudes towards inclusion in the schools and close cooperation between teachers teaching the same year group and also between the classroom teachers and the special education teachers. Teachers find it challenging to meet the diversity in the class and they would like to get more support for instance in the form of courses on different teaching approaches and assignments. Teachers make individual learning plans for students with special needs in cooperation with special education teachers and other specialists. There seems to be little room for cooperation between the teacher and teaching assistants even though they are supposed to work under the guidance of the teacher (Karlsdóttir and Guðjónsdóttir, 2010).

In a study conducted in 2012 on mathematics teaching in grades eight through ten in eight schools in Iceland 102 lessons were observed (Þórðardóttir and Hermannsson, 2012). The most common form of support was to get an extra teacher into the class. It was also common to assign an extra teacher to a year group with for instance two classes and then dividing the whole group into three, sometimes according to ability with the weakest group the smallest one. Some of the schools had special learning centers where students would go for support. Here there were usually less than ten students together getting individual support in the center. In the study it was noted that in 56% of the lessons the students were working individually with their textbooks and the teacher(s) were walking between the desks assisting them.

Inclusive education is still in some countries in the world mainly about providing effective education to all children (Ainscow, 2005; Ainscow & Miles, 2008). In others the main issue is how ensure that children with disabilities have their needs met within a general education system. Internationally inclusive education is seen more broadly as a reform that welcomes and supports diversity among learners. The aim is to eliminate social exclusion based on for instance diversity in social class, gender, race, ethnicity, religion or ability. Education is seen as basic human right and a foundation for a more just society (Ainscow & Miles, 2008)

According to Meijer (2010) all European countries have ratified the Salamanca declaration from 1994 and most have signed the UN Convention on Rights of People with disabilities from 2006 where it is stated that all states shall ensure an inclusive education system at all levels. However dealing with difficulties and diversity is, according to Meijer, still one of the biggest problems within European schools. But as he points out the success and failure of inclusive education depends on the practices that teachers in ordinary classrooms use in order to deal with diverse groups of learners. There are various approaches that have proven to be effective among them co-operative teaching and learning, collaborative problem solving, heterogeneous grouping and more general teaching based on high expectations and assessment for learning.

In most European countries individual education programs, focusing on how to adapt a mainstream curriculum for certain categories of students, are used for students with special needs (Meijer, 2010).

According to Ainscow and Miles (2008) this preoccupation with individualized teaching draws the attention away from developing ways of teaching that suits all learners within a class and creating conditions within schools that will encourage such developments. The introduction of teaching assistants, who work alongside teachers, often assisting students having special needs, has created some problems because teachers sometimes feel they can no longer cope if the assistant is not present or available. Ainscow and Miles (2008) say that we need to move away from the emphasis on individualized planning to more personalized and active engagement with the whole class. They also claim that there is no need for separate special needs pedagogy.

Adequate funding and availability of support within mainstream schools is one of the important factors influencing inclusive education and by many considered a barrier (Meijer, 2010). Ainscow (2005) claims that the development of inclusive schooling has to be seen in relation to factors that can help or hinder the progress. According to him the definition of inclusion and the evidence used to measure educational performance are the two most important factors. A debate of important elements like: inclusion being an ongoing process, about identification and removal of barriers, the presence and achievement of all students especially those who may be at risk of marginalization, exclusion or underachievement, is crucial for a wider understanding of the principle of inclusion within a community. When it comes to gathering evidence we need to make sure that we "measure what we value" and that it is about the presence, participation and achievement of all students. We have to create disruptions in order to see and explore new possibilities (Ainscow, 2005). According to Ainscow and Miles (2008) there are many possibilities in increased cooperation within and between schools, all kinds of networking across contexts and collection of relevant data. There is no need to invent new strategies and techniques.

In Iceland the discourse about inclusive education has been influenced by the definition of individualized and cooperative learning put forward by the local authorities in Reykjavík and adopted by many others. Both within the schools and in society there are individuals who are questioning the policy, how it has been interpreted and put into practice, and whether the schools are really able to meet the needs of all students. These voices have grown louder due to less funding to schools as a result of the recent financial crises in Iceland

(Sigurðardóttir, Guðjónsdóttir & Karlsdóttir, 2014). When we got access to observation protocols from 51 mathematics lessons from the study *Teaching and Learning in Icelandic Schools* we therefore found it interesting to look into how Icelandic teachers were dealing with the diversity in mathematics classrooms. We had these questions in mind:

- How is the teaching organized?
  - Who is present in the class and what are their roles?
  - What is the teacher focusing on during public interaction sessions?
  - Are the students working on the same topics or are they working through curriculum materials at their own speed?
- Are there any special arrangements made for students with special needs or more able students?
  - Are there examples of ability grouping?

Data and Data Analysis

In this study we use data from a study on *Teaching and Learning in Icelandic Schools* (age levels 6-15) conducted in 2009–2010 (Óskarsdóttir et al., 2014). The study was done in cooperation with many stakeholders in education. The study focused on many aspects of teaching and learning like the learning environment, student learning, teaching strategies and internal structures. A special focus was put on the development towards individualized and cooperative learning advocated by school authorities both on local and national level according to a framework developed by local school authorities in Reykjavík. Data was gathered by using multiple methods including observations, interviews, focus groups, questionnaires and action research in 20 schools in four municipalities. At this time 175 schools were operating in the country. In total 518 lessons in all school subjects were observed (Óskarsdóttir et al., 2014).

In this study observations from 51 lessons mathematics lessons in grades one through ten were analysed. None of the researchers had specialized knowledge about mathematics teaching and learning. The observers made detailed notes in an observation protocol during the lessons. The focus of the observations was on the progress of the lesson and the activity of those present during the lesson. This has its limitations but nevertheless we feel the observation protocols give us

an idea of what is happening in the classroom, how the teaching is organized and how teachers deal with the diversity of the students. We, the authors of this paper, have been actively engaged in teaching mathematics teachers and making mathematics curriculum materials for a long time and are therefore well known to most mathematics teachers in Iceland. We felt that by using this data we could gain some information about mathematics teaching in Iceland without collecting the data ourselves and thereby probably influencing the results.

In our analysis we started by reading carefully all the observation protocols. We then formed some categories on basis of the data and the ideas of categories used by Savola (2010) and Johansson (2006). We have used the same data in another study on instructional practices in mathematics classrooms in Iceland (Gunnarsdóttir & Pálsdóttir, submitted). We made a diagram of each lesson using the categories: (a) non-mathematical work, (b) teacher's public interaction with the whole class including presentation of new material and checking and assignment of homework, (c) individual seat work, (d) assessment, (e) group work, and (f) playing of games. We also described with few words what was happening in each part of the lesson for instance whether the students used textbooks or not. In our analysis we also noted who was present in the classrooms, their roles and interactions with the students. For this study we used the lesson diagrams but we also went back to the observation protocols to get better ideas about how the teachers and other assistants were working with the students trying to meet their different needs. We analysed the data with the research questions in mind.

Findings

There were 19 observations from grades 1–4, 13 from grades 5–7 and 19 from grades 8–10. Two thirds of the lessons were 40 minutes long and the rest 60–80 minutes. In about half of the lessons at all grade levels there was some public interaction between the teacher and the students. There was usually a short presentation in the beginning of the lesson cantered on guiding students through the textbook, explaining or demonstrating procedures or reviewing homework. The public sessions were usually only 5–15 minutes followed by individual work of the students. In the lowest grades there were several examples of

the teacher working through the pages with the children by using an overhead. During the students individual work the teacher was circling in the class assisting the children.

In one third of the lessons the students were working individually during the whole lesson. Here they were usually working at their own speed through some textbooks or worksheets. In most cases they were working within the same textbook. In grades 8–10 there were examples of the students working individually according to a plan set for a certain period of time or a chapter and then taking tests when they had finished the module.

In about half of the lessons in the lowest grades (1–4) an unqualified assistant or a social educator was present in the class with the teacher. In most cases they were walking between desks and assisting the children alongside the teacher. In one case the social educator was working with one child with some disabilities and in one case the teacher was working with a small group who needed special support and the assistant was assisting the others. There was only one mention of a special education teacher working in class with the teachers and no example of children being referred to a special teacher not working in class. In the lowest grades there were two examples of ability grouping. In one of the classes the teacher was working with the middle group and the children were working on different multiplication tasks at four work stations and in the other two teachers and one assistant were working with 29 children in two groups.

In the middle grades an assistant was present and assisting in general in two lessons. There were two examples of small groups of four-to-six students leaving the class for special assistance by another teacher and one of a group getting special assistance by a social educator in class. There was one mention of a single child not following the others and working on an individual plan. In two lessons it was noted that students who were quick to finish their tasks in the lesson either got to leave the class to work on a special assignment or got to work with computers. In two classes the teacher was working with children who had been grouped by ability.

At the lower secondary level there were four examples of another teacher coming into class working with a small group or individuals needing special assistance and working with different materials than the rest of the class. There were also examples of more able students working on their own with teaching materials from upper secondary

level. In two lessons the teacher had divided the class into two groups where one group was working on their own and the teacher was working publicly with the other group reviewing or introducing new material. In one school two classes were observed where the students were working on collaborative problem solving in mixed age groups from grades 8–10.

It seemed to be most common that in the main textbooks the students were working within the same chapter or even the same pages or problems in class. In the lower grades the students sometimes had extra workbooks were they could work at their own speed when they have finished the problems for the day. But here there were also three examples where the students were working at their own speed through the textbook and some were just on the first pages while others were on page 50 or 80. Both in the middle grades and in grades 8–10 there were examples of the curriculum being divided into modules, monthly plans or plans for each chapter where the students work through the problems listed at their own speed and taking tests at the end of the unit. At lower secondary level there were examples of the entire curriculum being divided into modules the students work though on their own.

Discussion

From the data it seems evident that the teachers put a lot of emphasis on assisting individual students. This is also the main role of the teaching assistants and reflects the belief that you do not have to know much about mathematics and its teaching and learning to be able to assist students in grades 1–7. In grades 8–10 in almost all cases the extra resource is a qualified teacher (presumably with some knowledge of mathematics) and not an assistant or a special education teacher. There it seems to be the belief that some knowledge is required.

The idea about individualized learning seems to indicate that the students have to work on their own through teaching materials and learn by themselves. In the organization of the teaching the curriculum materials play a central role; the teaching relies on them and it is assumed that completing the tasks in the textbooks constitutes the learning.

From the data it cannot be concluded that there is an emphasis on

assisting the less able students by a special education teacher in class as stated in the study done by Karlsdóttir and Guðjónsdóttir (2010). The assistance provided in class is rarely focused on the more able students. But the presence of teaching assistants indicates a need for extra resources in the class based on diagnosed problems of some sort.

By focusing on individual instruction teachers can be using their knowledge of students and differentiating their teaching and meeting their diverse needs. But this cannot be concluded based on this data. There are only a few examples of ability grouping and it has to be noted that ability groupings in Iceland are usually flexible and are often only used in subjects like mathematics and Icelandic. It is also not evident whether the students are all working towards the same goals or not. In most classes they seem to be working on the same topic at the same time and the main difference between individuals seem to be that you can work faster or solve more tasks.

Instructional approaches are not very varied and the teachers mainly try to make some variations by organizing work stations where students use hands on materials, play games or solve problems but often these activities are only drill and practice put in another format. There seems to be an emphasis on creating a warm and positive atmosphere where all students have their space and are a part of a community or as Ainscow (2005) puts it, can be included in a community. The teaching and learning is individual for each student and it is presumably based on the belief that everyone is special. In most of the classrooms the students´ work is organized by the teacher in way that all are working on the same topic. This gives an opportunity for opening the social community and make it into a learning community. It is also likely that in many classrooms small learning communities will be created. This situation gives opportunities shift emphasis from individualized planning to more personalized and active engagement with the whole class.

From the data we can conclude that there are often two persons assisting the students in class, either a teaching assistant or another teacher. The teacher focuses on assisting the students in completing the tasks in the textbook. In most cases the students are working on the same topic. Students with some difficulties seem to be getting support mostly within the class. From the data it is difficult to say if this also applies for more able students or students with other needs, but the main focus is on assisting individuals. This strong focus on

individualized learning raises some questions for us, the authors of this paper. We are authors of almost all curriculum materials used in Icelandic schools at the time of data gathering for this study. The materials are written with more collective an inquiry based teaching approaches in mind where discussions between students and teachers play a central role. There is tension between how the materials are used in practice and the ideas about mathematics teaching and learning they are based on. We doubt that our curriculum materials (if any) are suited for this kind of use in classrooms.

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