Complex Instruction in England – the journey, the new schools, and initial results.

Jo Boaler, Lori Altendorff & Geoff Kent, The University of Sussex.

When Gordon Brown became the prime-minister of the UK in June of 2007 I (Jo) had recently returned to the UK from California, where I had been working as a professor at Stanford. In one of Gordon Brown's first statements as prime-minister, he said that he would be continuing to support the practice of ability grouping in schools. I decided to write to the PM to tell him about the success of Railside school, partly because of his statement but also because of the wide gap between what we know works in the learning of maths, from research, and what happens in most classrooms. Research evidence in mathematics education has consistently shown the advantages of *all* students being encouraged to high levels and all students engaging in discussion and problem solving in classrooms, but the 'performative' culture of testing and target setting in recent years, has pushed problem solving and high expectations further from maths classrooms (Mansell, 2007; Boaler, 2009). In 2000 in an international test of problem solving the UK scored in 8th place, in 2007 the UK had dropped to 24th place. The target setting culture has also encouraged teachers to divide students by "ability" at an early stage, communicating to *most* students that they will never achieve well in mathematics. There is also a huge gap between the types of teaching that OFSTED hope to see in schools and that which they observe. In their annual report of 2008 OFSTED report that in the best lessons 'Pupils were expected to work productively in pairs or groups, discussing their learning, trying out new skills and exploring concepts' but in most lessons teachers 'present mathematics as a collection of arbitrary rules and procedures, allied to a narrow range of learning activities in lessons which do not engage students in real mathematical thinking' (OFSTED, 2008).

In my letter to Gordon Brown I said that I had studied a school in California that used a mixed ability approach, called 'complex instruction' (CI) that brought about very high achievement and respectful relations between students, and that I wanted to tell him about it. To my surprise he invited me to Downing Street to show some details of the approach to his chief policy advisors. That was a fascinating trip, for many reasons, not least of which the reaction of his advisors, who were completely supportive of the approach and wanted to help me introduce the approach to schools in the UK. I have since had subsequent meetings with other high-level politicians, such as Lord Lucas in the House of Lords, and I have always received the same positive response – it seems that when people learn about students working together in mixed achievement groups, on a broader form of mathematics, they can easily understand the advantages of delaying ability

grouping and encouraging all students to high levels.

My meeting in Downing Street led to work with representatives from the Specialist School and Academies Trust, who provided funding to offer a workshop to interested schools in England. We hosted the workshop at The University of Sussex in June of 2008, and it was attended by teachers and head-teachers from 25 schools in England. Schools were offered the opportunity to move to the complex instruction approach and *all* of the teachers who attended the workshop shifted their practice in some ways, with many of them using the pedagogical techniques of complex instruction with their setted groups of students. The teachers all reported positive changes from the introduction of group-work and roles and teaching all students that they are 'smart' as Teresa reported:

"I have already introduced two groups to the roles and have had group work that is far more successful than it has been in the past so cannot thank you enough. The business of picking out an individual and raising his status has worked miracles already for one quite disaffected student in the foundation year 8 group".

Five schools went further and made the brave decision to teach students in mixed ability groups in years 7 and 8 and use the complex instruction approach, in as many lessons as possible.

This provided us with an important opportunity to conduct research on the approach that had been so successful in the US in schools in England. It was not possible to conclude that all teachers in the five schools used complex instruction with fidelity, or at all, as only one or two teachers from each department had attended the workshop. In some cases schools had meetings to share the new approach and all teachers in the maths department took it on board (such schools were among the most successful) in other cases only certain department members used the approach. Despite this variation, we had five schools who were teaching students in mixed ability groups, working in mainly complex instruction ways, and we matched these schools with a control group of schools who were similar in terms of geography, demographics and achievement. In the control schools the teachers used ability groups and traditional teaching methods. During the next year we conducted a research study to examine the experiences and outcomes of students who were learning in different ways.

Research Results.

The Schools.

The schools with which we have been working provide a range of geographical locations, student demographics and success rates as set out below. The five schools were matched with control schools that provided the same details below, but were using traditional teaching and grouping methods.

	Location	Level of Deprivation	Achievement
School 1	North urban	High	Low (National challenge)
School 2	South suburban	Middle	High
School 3	East rural	Low	High
School 4	East urban	Low	High
School 5	East urban	High	Low (national challenge)

The control schools were matched demographically to the experimental schools using the DCSF Tax Credit deprivation indicator, Neighbourhood Statistics deprivation indicators and Ofsted statistics on the distribution of free school meals, ethnic minority and SEN students. To match schools by attainment, the most recently published GCSE attainment statistics and Ofsted reports were used.

Using a mixed methods research approach we have collected various forms of data on the changes occurring in the schools adopting complex instruction approaches with their year 7 and 8 students and we conducted an achievement analysis for the year 7 students. Over the course of a year we conducted the following research methods

100 hours of classroom observations
60 hours of video recorded observations of student group work
10 hours of video recorded observations of whole class lessons
18 hours of audio recordings of interviews with students
Questionnaire Data from over 2000 students
Achievement data collected from 1800 Y7 students

In the following we set out the main results.

Changes in Classroom Environment.

Among the 5 schools that took on the complex instruction approach, some had already been teaching students in mixed achievement groups, with an emphasis on problem solving and investigating, whilst others changed from a traditional approach with students working in sets. In our classroom observations we observed students working in groups, discussing complex problems, with the teacher circulating the room to help and scaffold students' thinking. Many of the teachers, particularly those who had previously taught students in sets, reported that a much wider range of students were participating in whole class discussions, with many examples of students who would have been in low groups, being the ones to solve problems and offer important insights. Many of the teachers indicated that they had been surprised by the quality of the work produced by "low ability" students and they were pleased with the change in approach and grouping. In our observations we saw students working extremely well together and were particularly impressed with instances of, for example, high achieving students working with very low achieving students with special needs, enjoying the opportunity to help and support them. In our interviews with teachers they also reported moving from 'talking to the students from the front' to an approach whereby they engaged students in collaboration and discussion around complex tasks. The teachers have reported that this shift allows them new access into the *thinking* of their students. Also, instead of determining the path of student thinking in advance, teachers have been able to listen to student thinking as they work then intervene strategically as appropriate.

Indications of the different type of environment provided by the complex instruction approach were shown in the questionnaire results. The following questions given to year 7 and 8 students produced significant differences with the complex instruction students agreeing in significantly higher numbers in every case:

In maths lessons, how often:

Do you work in groups? ($p < 0.00$)

Do you get to use your own thoughts and ideas? ($p < 0.00$)

Do you learn from another student? ($p < 0.00$)

Do you get really interesting problems to solve? ($p < 0.1$)

And how often in maths class:

Do you talk about maths in the world? ($p < .00$)

Significantly more students in the complex instruction classes reported that they engaged in all of these important practices. Also, significantly more of the CI students reported that 'success in maths is mainly about thinking for yourself' rather than 'success in maths is mainly about learning and remembering facts and rules' ($p < 0.00$), and significantly more students agreed with the important statement: 'I like maths' ($p < 0.1$).

In interviews the students report many benefits of the CI approach. Most of the students interviewed talked about the benefits of working on complex problems and discussing methods with each other:

> *L: And lots of interesting problems to solve out and it's quite interesting when you can actually solve it and get to argue.*

As with previous research (Boaler, 2009) the students are very positive about working in groups not because they can talk or socialize, but because of the increased access discussions give them to understanding:

> *B: Last week and the week before I had no idea what we were doing but my group gradually built up and explained it to each other and last week with the bearings I know how to do it because everyone explained it.*

Many students appreciated the increased access they gained to understanding, in general, but also, as the following student highlights, being able to understand ideas 'in different ways':

> *J: Because with the group work if you think you've understood it, you explain it and then other people will say 'well I think it's this' and then what I do is work out what it really is and talk to Miss, she comes and talks to us and then we all know because we go around one by one telling everyone.*
> *Q: How is that different from your other lessons? Or is it the same?*

J: It's easier than just doing it the same way all the time because you can try and understand it in different ways.

Students highlighted particular aspects of the complex instruction approach, such as the use of roles, which are employed to make the group work more equal:

Int: So Tom how is it different to the group work you did in primary school?
C: We never had any roles, you would have to try but you wouldn't have to do much
Int: So you didn't have any responsibility and you could sit back if you wanted to, is that what you're saying?
C: You never sat back but you never had a responsibility to do anything
Int: And do you like having that responsibility?
C: Yes because it makes you think more.

The student above talks about groups in which you "don't have to do much" and contrasts such experiences with the CI roles which gave him something particular to do. Other students also talked about the increased responsibility they felt when working in roles:

Q: How do you feel about taking on these roles? What does it feel like?
A: Good
B: It's like we're in charge so Miss doesn't have to tell us what….well she tells us what to do then we have our own groups so we can say what we have to say instead of talking to Miss about it
C: It gives us responsibility
D: the recorder/reporter...because you have to write…
C: It gives us a better responsibility and we take it into our own hands so it's a good thing

Students also talked about the increase in authority, with the students above talking about the enjoyment of 'being in charge' and being able to 'say what we have to say' rather than only communicating the teachers' ideas.

Students also talked positively about the mixed nature of groups:

Well talking about maths is sort of like you, it can help you because if you're kind of like a level 4 and the person next to you is a level 7 then he or she can really, really help you getting to his or her level. So that's really good.

Students linked the mixed nature of the groups to increased opportunities to progress mathematically:

A: I think its better that we're altogether because we can help the people that didn't do it at school and they can improve
B: I like how we do it in groups because say all the better people at maths were together and the not so good were together, they probably wouldn't get any better and the good ones probably wouldn't either.

Despite the challenges teachers faced in implementing a new teaching approach and pedagogy, teachers and students reported more engagement with mathematics and excitement at the new ways of working. Teachers also reported that students came to class excited to get into their groups and work on tasks.

Challenges.

The biggest challenge faced by the teachers moving to the complex instruction approach was finding enough tasks that were "group-worthy". The teachers used tasks from the NRICH site, as well as other materials, such as CAME but felt that they needed more time to find good materials for students working in groups.

Student Achievement.

The support for our research was minimal and so we could not conduct careful assessments of the students' learning over the year. Ideally we would have administered achievement tests that assessed a broad form of mathematics and students would have taken them under the same conditions. Instead we asked the teachers for their assessment results for the end of year 7, which we compared with the students Key Stage 2 SAT sub-levels. Teachers gave us their results but different schools had used different forms of assessment and so the results should be considered

lightly. The results showed that the improvements in levels for students, were equal in every case of matched schools except one where the CI school was significantly ahead ($p < 0.05$). In that school students improved by an average level of 0.9 during one year. This tells us that schools implementing a new form of teaching and grouping, and teaching students broader mathematics, did not appear to compromise the students' performance on fairly narrow tests, even during the first year of their new approaches.

School	Geographical location	Deprivation	Achievement	Level increase	Higher/Lower than comparison school.
School 1	North urban	High	Low (National challenge)	0.2	lower
School 2	South suburban	Middle	High	0.9	higher
School 3	East rural	Low	High	0.8	equal
School 4	East urban	Low	High	0.4	lower
School 5	East urban	High	Low (national challenge?)	0.7	higher

Such results need to be taken lightly as the assessments were not the same in all the schools, and none of the differences were significant. In addition, school 4, which showed a moderate increase, is one of the best schools we have ever visited, but the teachers do not aim to increase achievement greatly in year 7, as they focus more on teaching students careful norms and new ways of working that will serve them well across key stage 3 and beyond, rather than jumping ahead in terms of knowledge. This should remind us that measures of learning over short periods of time, even one year, are not as useful as those that consider learning over some years, which we hope to collect in future years.

In Conclusion.

The schools in the UK that have moved to a 'complex instruction' approach are in the early stages of moving to a new way of working. Our observations of the classroom environments, and interviews with students and teachers, tell us that the changes the teachers are making have been extremely positive for the students, even though it has been challenging for the teachers to find sufficient "group-worthy" tasks. Our aim in dedicating this month of the NRICH site to group-worthy tasks is to help these teachers, and others who give students the opportunities to work in

groups, discussing mathematics and, as Jasmine said “understand it in different ways”.

References.

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