

The Numbers Count Intervention: Do the Benefits Persist through Key Stage 2?

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Abstract:

Starting in 2008, Edge Hill University developed a new intensive mathematics intervention, termed Numbers Count, for Year 2 pupils considered to be in the lowest 5% for mathematics attainment. Children receive half an hour of individualised, or very small-group intervention per day. Children, who received this intervention, performed much better than controls on Key Stage 1 assessments and on standardised tests. In the present study, 6359 children who underwent Numbers Count intervention in 2010-2011 or in 2011-2012 were followed up at the end of Key Stage 2, using information from the National Pupil Database. The children were compared with a group, whose Key Stage 1 results had placed them in the bottom 5% in mathematics. Their performance on Key Stage 2 tests was significantly better than that of the other initially low attainers. This suggests persistent effects of the programme.

Keywords: mathematical difficulties; intervention; primary school; Numbers Count

Introduction and Background

The British government, in the first decade of the 21st century, became increasingly active in developing interventions for children with numeracy difficulties so as to prevent children from getting more and more mired in their difficulties, experiencing increasing amounts of confusion, failure and discouragement, and also developing negative attitudes and anxiety about mathematics.

The Government - commissioned independent Williams Review (2008) provided a strong impetus for larger-scale development of early intervention programmes, and robust research into their effectiveness. The report recommended that children with serious difficulties in mathematics should receive intensive intervention from a qualified teacher, if possible, on a one-to-one basis.

In 2008, Edge Hill University was appointed to develop and deliver a new bespoke mathematics intervention, which was termed Numbers Count.

The original Numbers Count programme, which is the focus of the present report, was developed for Year 2 pupils, with the greatest mathematical difficulties. There has since been expansion upwards in age, with a Numbers Count 2 programme aimed at Key Stage 2 pupils, and sometimes even used in secondary schools.

The Numbers Count programme involves fine-grained assessment of individual children's strengths and weaknesses, followed by intervention targeted at addressing specific weaknesses. It addresses many aspects of numeracy, with particular emphasis on counting and number representation. Multisensory teaching is a key aspect of the programme. Children receive a half an hour of individualised, or

sometimes very small-group (two or three children to a teacher) intervention for at least three days per week.

The programme, which is overseen by Edge Hill University, is delivered by teachers who have received a comprehensive programme of Continuing Professional Development focused on the pedagogy and structure of the Numbers Count intervention. Numbers Count teachers receive a total of 7 days specific training over two terms in use of the programme. They can begin delivering interventions after three days of the training.

Most Numbers Count lessons include counting as a key activity. The children practice both verbal counting and the counting of objects. When they have largely mastered these, they proceed to more sophisticated counting skills such as backward counting, counting in steps, and counting toward or from a given number. They are encouraged to use resources such as concrete objects and number lines to assist them in these tasks. They are given tasks where they count by touch and hearing as well as counting visible objects.

Teachers use number-related games, such as Snakes and Ladders and Dominoes, to give children practice in counting and matching quantities and carrying out simple arithmetic. They also use games devised by themselves and/or the Numbers Count trainers.

Torgerson et al (2012) carried out an independent evaluation, which included a randomized controlled trial, comparing Numbers Count with business-as-usual teaching. Participants in the first trial were 528 six-year-old Year 2 pupils, who were an average of 11 months behind in mathematics. The children made impressive progress and were scoring at or near chronological age level by the time they left the programme. They performed significantly better than a group of waiting-list controls..

It was now crucial to find out whether the gains are maintained over a long period, and what factors influence the maintenance of these gains. This paper deals with their results at the end of Key Stage 2.

Method

Edge Hill University provided a list of schools known to have taken part in Numbers Count during one or both of the two years in question. 1217 of the schools were approached by letter or email and asked if they would consent to take part in the study. 373 schools returned consent forms. The National Pupil Database provided data regarding the children in these schools, after the appropriate request procedures were carried out. These included in total 6359 children: 4203 from the 2010-2011 group, and 2156 from the 2011-2012 group.

The key comparisons at Key Stage 2 are with two low-attaining comparison groups. Because waiting list controls were used in the original evaluation (Torgesen et al, 2011), all the original matched control group did ultimately receive the intervention, and thus we do not have a matched business-as-usual control group for the Numbers Count group. However, we do have extensive data concerning other children who were low attainers in their early school years. This data is not on an individual pupil level but comes from government statistical records on pupil attainment and characteristics at Key Stage 2, combined with additional statistical information provided for me by the National Pupil database.

One comparison group consisted of the 13% of the whole year cohort in the National Pupil Database, who performed below Level 2 at Key Stage 1, usually regarded as the 'low attaining band' in government documents. They are identified here as the Low Attaining (LA) comparison group. The second comparison group, a subset of the first, consisted of the 5% of the whole cohort, who performed below

Level 1b at Key Stage 1. The percentage of such pupils was the same for both the 2010-2011 and 2011-2012 groups. They are identified here as the Very Low Attaining (VLA) comparison group.

2010-2011 group

There were 567,387 children in the year cohort as a whole. 18,485 children had received Numbers Count intervention in 2010-2011. 4203 of the children are reported on in this study.

2011-2012 group

There were 561,621 children were in the year cohort as a whole 8,534 of these children received Numbers Count intervention. Data from 2156 of the Numbers Count children are reported in this study.

Results: The Numbers Count Children at Key Stage 2 and Comparisons with the Low-Attaining Comparison Groups

During this report, one key measure will be the proportion of children in each group, who met age expectations. This measure is not as simple as it seems at first sight, as the government has used different criteria at different times and for different purposes. At Key Stage 2, until and including 2015, Level 4 was the expected level; but this too was divided into sublevels, and 4B corresponded to exactly average achievement and 4C somewhat below. In 2016, the assessment system was changed, and expectation was that children should attain a standard score of at least 100 on the set test. In our analyses, following the usual government guidelines, the key benchmarks for meeting age-related expectations were Level 4 in 2015, and standard score over 100 at Key Stage 2 in 2016; bearing in mind that the age-related expectations were effectively increased between 2015 and 2016.

2010-2011 group

There were 4203 children in the 2010-2011 Numbers Count group, who reached Key Stage 2 in 2015. The LA comparison group was the 13% of the whole cohort, who performed below Level 2 at Key Stage 1, excluding those who were also in the Numbers Count group analyzed in the present study. These were 69,958 children in this group. The VLA comparison group was the 5% of the whole cohort, who performed below Level 1b at Key Stage 1, excluding those who were also known to be Numbers Count. There were 28,080 children in this group.

Very low attainment at Key Stage 2 (Level 2 or below):

4.9% of known Numbers Count children.

2% of year cohort.

26% of Low Attainer group

41% of Very Low Attainer group.

Average or higher attainment at Key Stage 2 (Level 4B or above):

46% of known Numbers Count children.

69% of year cohort.

25% of Low Attainer group

13% of Very Low Attainer group.

Chi-square tests revealed a significant difference between the Numbers Count group and the Low Attainer group, $X^2(2, N = 76733) = 897.35, p < 0.001$; a significant difference between the Numbers Count group and the Very Low Attainer

group, $X^2(2, N = 29772) = 2745.21, p < 0.001$; and between the Numbers Count group and the cohort as a whole, $X^2(2, N = 567,397) = 1036.99, p < 0.001$. Thus, the Numbers Count group performed much better than the Low Attainer group and especially the Very Low Attainer group. However, the Numbers Count group did perform significantly worse than the year cohort as a whole.

2011-2012 group

There were 2156 Numbers Count pupils in the 2011-2012 group, who were tested at Key Stage 2. The LA comparison group consisted of the 13% of pupils who had performed below Level 2 at Key Stage 1. There were 72,530 children in this group. The VLA comparison group consisted of the 5% of pupils, who had performed at Level 1b at Key Stage 2. There were 27,369 children in this group.

The assessment system had changed, so that children were now given standard scores on a test.

Mean standard scores:

Known Numbers Count children: 95.6.

Whole year cohort: 103.

Low attaining group: 91.01.

Very low attaining group: 85.1.

T-tests showed that the differences between the Numbers Count group and the comparison groups were highly significant. The Numbers Count pupils scored significantly higher than the Low Attaining group $t(74,684) = 13.85, p < 0.001$. They scored significantly higher than the Very Low Attaining group $t(29,523) = 31.59, p < 0.001$. However, they scored significantly lower than the year cohort as a whole $t(561,619) = -22.86, p < 0.001$.

Thus, once again, the Numbers Count group performed much better than the Low Attainer group and especially the Very Low Attainer group. However, the Numbers Count group did perform significantly worse than the year cohort as a whole.

Both year groups: relationship to performance at Key Stage 1 After receiving the intervention, most Numbers Count pupils had achieved at least Level 2 at Key Stage 1, though just under a quarter had not. However, very few had performed *above* average at Key Stage 1.

Performance at Key Stage 1 proved to be a very strong predictor of performance at Key Stage 2. If the intervention brought the children up to Level 2 at Key Stage 1, the improvement was usually maintained.

Demographic factors

Both Numbers Count pupils and other low attaining pupils were more likely to be eligible for free school meals than the cohort as a whole. The Numbers Count pupils were more likely than the LA groups to be eligible for free school meals (53% compared with about one-third), but less likely to be assessed as having special educational needs, than the LA groups (43% versus over 70%). However, the differences between the Numbers Count and LA groups in terms of Key Stage 2 outcome were so dramatic that they are very unlikely to be due just to demographic differences.

Teachers' comments

While it was not usually possible to interview individual teachers, and the study relied mostly on information from the National Pupil Database, I had the opportunity to have an informal discussion with two teachers from a primary school that used Numbers Count. They made the following points:

(1) Children improve considerably with Numbers Count in the short and medium term.

(2) Their chances of maintaining the improvement long-term are enhanced if the Numbers Count teacher liaises with the classroom teachers at the end of intervention, and the teachers provide occasional 'boosts' during subsequent years for topics that had caused difficulty.

(3) Children develop greater confidence in mathematics through the intervention, and often maintain it long-term.

(4) Children tend to make, and maintain, better improvement in arithmetical procedures than in arithmetical reasoning. Arithmetical reasoning difficulties tend to be more 'stubborn' and harder to shift by any method of intervention.

Discussion

Results are quite similar for the two year-groups studied, bearing in mind that Key Stage 2 assessment and reporting methods changed between 2015 and 2016. This suggests that the findings are generalisable.

The Numbers Count pupils did very much better than comparison groups (whether the latter were confined to the bottom 5% or included all who had performed below Level 2 at Key Stage 1) in Key Stage 2 mathematics. This suggests a very positive effect of the Numbers Count. They did not perform quite as well as their entire year cohorts (of all prior attainment levels), but still mostly performed at a fairly adequate level. Considering that they had been selected for very low attainment in Year 2, this is a striking result.

More speculatively, the Numbers Count may have reduced the risk of special educational needs during Key Stage 2. Unfortunately, we do not have data as to how many Numbers Count children had been assessed as having special educational needs in Key Stage 1. The fact that they were much less likely to have assessments of special educational needs at the end of Key Stage 2 than the LA comparison groups is very interesting. It could indicate that having Numbers Count intervention actually reduced the incidence of children, who were assessed as having special needs in Key Stage 2. This would be an important outcome, indicating that Numbers Count intervention had an important protective effect. However, we cannot rule out the possibility that schools might have been more inclined to select children for Numbers Count, if they were not already receiving other interventions in connection with special educational needs

Thus, the results are encouraging, and suggest that the Numbers Count intervention has a long-term effect in improving performance by initially low-attaining pupils and reducing the risk of long-term failure.

The pupils' performance in secondary school is now being investigated, and their grades at GCSE and at A level and/or other examinations at 18+ will be compared with those of their year cohorts and other initially low-attaining pupils.

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