Classroom Studies in Mathematics: Comenius Project

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Three classroom-based studies were undertaken in three European countries - the Netherlands, Ireland and England - to determine the similarities and differences in mathematics learning for pupils with dyslexia. These pupils were aged 11-13 years and all attended special schools for children with specific learning disabilities/dyslexia.

BACKGROUND

Comenius is the name given to the European sponsored programmes which focus on the first phase of education, from preschool and primary to secondary school. Comenius provides a framework for multilateral partnerships between schools and fosters cooperation among partner countries. It offers students and educators within the EU countries a variety of programmes designed to enhance first hand their knowledge and awareness of other systems of education. One of these programmes, Comenius Action 1, aims to develop school partnerships and strengthen the European dimension of education.

This article is a brief summary of one such EU-sponsored project, Comenius Action 1 Schools Project, 1997–2000.

DESCRIPTION OF PROJECT

Between 1997 and 2000, three one-year classroom studies were carried out at three specialist schools for pupils with dyslexia in the Netherlands, England and Ireland. The schools involved in the classroom studies were: The Kohnstammschool, Hilversum, Netherlands; Mark College, Somerset, U.K; and, St. Oliver Plunkett School, Monkstown, Co. Dublin. The teachers involved in this project all teach in these special schools, and are particularly interested in the difficulties faced by pupils with dyslexia when studying mathematics.

Description of the three schools

The Kohnstammschool (now called Annie M.G. Schmidt School), Hilversum, Netherlands, is a special school (LOM/MLK) for about 250 pupils aged 4 - 13 years who have either specific learning disabilities or moderate general learning disabilities (in Ireland, these would be children with mild general learning disabilities).

Mark College, Somerset, England, is an independent school (Section 347, Education Act) approved by the Department of Education and Employment for teaching pupils with dyslexia. There are 80 boys aged from 11 to 17 enrolled at this boarding school.

St. Oliver Plunkett School, Monkstown, Dublin is a special day school for children aged eight to twelve years with specific learning difficulties. The school is funded by the Department of Education and Science. Sixty pupils are enrolled for the year 2001-2002; forty-five are boys, fifteen are girls. Children are enrolled in the school

following referral based on psychological assessment. Attendance is normally for a period of one or two years after which the children return to mainstream education.

A total of 132 pupils participated in the study, 44 from each of the three countries.

SUMMARY OF FINDINGS

Many of the pupils in the special schools had difficulties with mathematics. Teachers were interested in finding out if the same difficulties were present in each of the three countries, and, if so, to what extent.

YEAR 1

In the first year of the study, the areas of difficulty faced by the pupils with dyslexia were investigated. This research compared the frequency of occurrence across the three schools of ten difficulties which can be considered as contributors to problems with learning mathematics.

The areas of difficulty specified in the study were:

- reading accuracy
- reading comprehension
- lag in mathematics age
- sequencing
- transposals
- reversals
- organization of work
- speed of working
- knowledge of multiplication and division facts
- knowledge of addition and subtraction facts

These ten areas of difficulty were directly measured by standardised tests in each country and supported by structured teacher observation over a period of time.

Results

The results (Figure 1) show a remarkably similar profile for the three schools as well as the relative frequency of occurrence of each of the ten areas of difficulty.

**************Insert Figure 1***************

The occurrence of a difficulty appears to be independent of teaching environment. It seems that the teachers in the three schools are facing similar profiles of difficulty in mathematics in their pupil populations.

The most frequently observed areas of difficulty were reading and learning multiplication and division facts. This bears out teachers' classroom experience and research facts (Chinn, 1994). Transposals (writing 42 for 24) and reversals (writing P for 9), which are commonly cited by teachers as areas of difficulty for pupils with dyslexia, are shown to be one of the least prevalent areas of difficulty in this study.

YEAR 2

The second Year of the Comenius Project focussed on pupils' preferences and relative strengths in mathematics.

The pupils in each of the special schools were asked to choose their favourite topic in mathematics and create an activity/game/worksheet for a pupil of similar age in each of the other two countries. They did this under the guidance of their teachers

All children who participated in the project were aged between eleven and thirteen. The children created each activity in the classroom over a period of time. Some children worked alone, some in a small group. Each activity was refined several times as other children in the class attempted it and discovered difficulties in structure and some computational errors. Eventually, two copies of each activity/game were made for the children in the other two schools participating in the project.

Results

As the graph shows (Figure 2), the topics chosen by the pupils were classified into the four categories of Space, Measure, Number, and Shape.

******************Insert Figure 2 here***************************

The larger proportion of pupils in the Irish school choosing Number as their most favoured topic may be explained by their return to mainstream education at the age of 12 to 13 years. In preparation for this move, every effort is made to raise their level of numerical competence so they are not disadvantaged by this transition. It will be interesting to see if Irish pupils' preferences and mathematical competencies will change as a result of the new Math curriculum now being introduced to Irish schools (Ireland, 1999).

In contrast, pupils from the English school remain in their school until age 16 and teachers can take a broader perspective of the mathematics curriculum. These pupils made 80% of their choices for activities on Shape and Space.

A similar profile is seen from the Dutch result. Some years ago, Dutch teachers changed their mechanistic arithmetic instruction into a new realistic (set in the real context) mathematics scheme to improve their mathematical education and results (Heuvel-Panhuizen, 1996; Streefland, 1991). The Dutch pupils appear to be most comfortable working with shape and space.

YEAR 3

The third year of the Comenius Project looked at cognitive style used in solving mathematical problems among these pupils compared with their non-dyslexic counterparts in each of the three countries.

Cognitive style refers to the way a person thinks through a problem. The literature supports the belief that children approach mathematical problems with an individual learning style. The work of Bath, Chinn, and Knox (1986) on cognitive style arose from observations of and work with dyslexic children in the classroom. The authors labelled the two extremes of the continuum as 'Grasshoppers' and 'Inchworms'.

Chinn (in Chinn & Ashcroft, 1998) provides a list of characteristics associated with these two learning styles.

********************Insert Table 1*******************

Results
Pupils from the Irish and English schools show a broad similarity in tendency for dyslexic pupils to using the 'inchworm' cognitive style for solving mathematical problems. Pupils from the Dutch schools showed the highest number of pupils using a 'grasshopper' cognitive style. When compared to non-dyslexic pupils in mainstream environments within each country, the profiles clearly show that pupils with dyslexia display more 'inchworm' characteristics than their non-dyslexic counterparts (Figures 3 and 4).

********************Insert Figure 3********************

********************Insert Figure 4****************

Pupils in the Netherlands were closer to the midline in their profiles than pupils from Ireland and England. After six months intervention, profiles of pupils from the Netherlands and Ireland remained very similar whereas profiles of pupils in the English school had moved towards the midline.

The tests have shown that pupils with dyslexia are more restricted than their non-dyslexic counterparts, tending towards the safe and consistent 'method' in their approach to problem solving in mathematics in all three countries.

Implications for teaching
Irish pupils with dyslexia appear to depend on one cognitive style, i.e. 'inchworm', when solving math problems. This results in less flexibility when faced with even simple number relationship problems.

Examples of questions:

Q. 2 121 - 99
How did you do that?

Q.3 2 x 4 x 3 x 5
How did you do that?

Q.11 There are 25 squares in the figure below.
How many of them have a cross?
How did you do that?

These questions could have been attempted by looking at number bonds/number relationships. The predominant approach (Ireland) was to use the numbers exactly as given (focus on the parts, attention to detail), use a single method, usually tending to add or multiply. Such an overload on short-term memory resulted in many errors for the pupil with specific learning difficulties.

'Mental Arithmetic' and 'Oral Problem Solving' in Mathematics, as recommended in

the revised curriculum (Ireland, 1999), is a positive approach to fostering flexibility in solving math problems. Pupils with dyslexia have an added difficulty if they are overly dependent on one style. It will be interesting to see if the Approaches and Methodologies recommended in the revised curriculum will have an impact on the cognitive style profiles of pupils with and without dyslexia.

CONCLUSION

It is hoped that dissemination of the results of the projects may be of interest to Special Education Teachers, Resource Teachers and others involved with pupils with dyslexia. The following points emerged clearly from the studies:

- Flexibility in learning style is an advantage for all pupils but particularly so for pupils with dyslexia. This study showed that the pupils with more flexibility in problem solving are at an advantage in math problem solving.
- Teachers need to be aware of pupils' individual preferences in cognitive style; the teaching methods should encourage flexibility. Asking pupils questions such as, "How did you do it?" "Do you know any other way to solve the problem?" "Can you think of another way to solve this problem?" encourages flexibility in problem solving.
- Discussion of strategies used by pupils fosters more flexible and adaptable approaches.
- A broader mathematics programme, including enjoyable activities on shape and space, fosters confidence among pupils.
- More risk taking in solving math problems can be encouraged by using the strengths of pupils with dyslexia.
- Greater confidence among non-dyslexic pupils in math problem solving was evident in all three countries.
- Poor performance in computation should not prevent pupils from progressing to other more enjoyable parts of the math curriculum where they may have strengths.

If readers are interested in more detailed discussion of the classroom studies, a fuller description may be consulted in the following publications:

- A survey of perceived difficulties in mathematics for dyslexic pupils in special education in the Netherlands, Ireland and the U.K., *Dyslexia Review, Spring, 1998.*
- Classroom studies into cognitive style in mathematics for pupils with dyslexia in special education in the Netherlands, Ireland and the U.K., *British Journal of Special Education, 28 (2), June, 2001.*
- Comparative study of perceived difficulties in mathematics experienced by children with specific learning difficulties in Ireland, England and the Netherlands, *Irish Educational Studies, Volume 18.*
- *Mad maths: Maths games and activities* by St. Oliver Plunkett School, Mark College and Kohnstammschool. A copy is on display in each of the special schools involved in the project.

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Teachers involved in the Project

Steve Chinn, Julie Kay, Les Skidmore, Hans Harmsen, Rob van Elswijk, Don Mahon, Therese McPhillips, Angela Power, Donna McDonagh.

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