

Mediated learning experience and its role in teaching fractions to pupils with learning difficulties

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Abstract

This research focuses on studying the effect of mediated learning experience in children with learning difficulties in terms of deeper understanding of mathematical concepts. The main objective of the mediation method is to improve the cognitive skills of the participants through its close mediator–children interaction. This paper analysed the term ‘knowledge’ and how it is often interpreted mistakenly by many teachers. In the survey participated 10 pupils with learning disabilities, aged 10, who attended the fifth class of primary school in Athens, Greece. Here, the action research methodology was used because the researcher took the role of mediator and worked with the students to explore the fractions. Research findings show that mathematical concepts are easier and deeper understood through practical activities and active participation of all members of the class. The mathematical abilities of children with learning difficulties and their self-confidence towards lesson have been boosted during the survey to a remarkable extent.

Keywords: Mediation, mathematics education, fractions, learning difficulties.

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1. Introduction

The purpose of this study is to investigate the ways in which the mediating teaching method can influence the cognitive development of children with learning difficulties in the mathematics lesson. Ten children with learning disabilities took part in this research. The study focuses not only on improving the mathematical skills of children but also examined the close relationships developed between the researcher (as mediator) and children. This research focuses mainly on understanding how children with learning disabilities create and develop mathematical thinking through the mediation method. The main reason chosen for this research topic is to investigate whether all children can be taught mathematically successfully if the teaching method is changed (Zaranis, Baralis & Skordialos, 2015b).

The mediation method can be considered by students as an important tool for better development of methods, which are useful for organising the large set of information that they constantly accept from their environment. This method, as formulated by Reuven Feuerstein, is an interaction between someone working at a high level, usually an adult (mediator), and someone whose level is lower, usually a child. It explains the changes experienced by students in the process of mathematical thinking, cognitive functions and social relationships through the mediation method. It also indicates the changes that occurred to the researcher as mediator. Through the learning of fractions, the researcher had the opportunity to study how the mathematical way of thinking develops in children, what their reaction is to the mathematics lesson and how exactly the knowledge is built (Zaranis, Baralis & Skordialos, 2015a).

Consequently, this paper begins with the introduction of a relevant theory on learning difficulties, mathematics and the mediation method of teaching. It also analyses how this method can support the development of mathematical skills of children with learning disabilities.

2. Learning difficulties and cognitive functions

When we decided to engage children with learning difficulties, we realised something very important. Although in the past we have used the term 'learning difficulties' several times, we never understood the exact meaning of these two words. So, our first step was to understand as much as possible what lies behind these words. The learning difficulties of children may be general, meaning that the child faces difficulties in many areas and generally appears slower in learning than his or her peers, or may be specific, meaning that the child is experiencing difficulties in specific domains (Dockrell & McShane, 1993).

We have tried to find a specific definition of what constitutes a learning disability, but obviously there is not yet a comprehensive and generally accepted definition. According to Hooper and Willis (1989), this is because the term 'learning difficulties' refers to a heterogeneous group of difficulties. But the question remains. How can we define and understand 'learning difficulties'? The only way to find the coveted answer is to deepen the understanding of the components that are a learning difficulty. Bronfenbrenner (1979) treats learning as an interdependence between what the learner offers in learning, the teaching process and the nature of the activity he is called upon to accomplish. As a result, we can begin to build our knowledge of learning difficulties by analysing these three components.

In order to better understand the interconnection and interaction of the three key factors affecting learning, we must first make clear how knowledge is structured. According to the cognitive approach, information is transformed into knowledge through an information processing model (Dockrell & McShane, 1993). External stimuli, taken from the environment, are processed several times by the mnemonic system, stored in memory and transformed into 'knowledge'. This model implies that 'knowledge' is information/stimuli stored in the memory. Wertsch (1991) argues that the main reason why this model has been strongly criticised is because the receiver appears to have a passive role. Strong criticism has also been made by Bruner, who has reacted negatively to all neurophysiological or anatomical perceptions of how knowledge is built. In particular, he argued that knowledge is not just pieces of information (Bruner, 1974). It is the ability to transfer these pieces into appropriate decoding

systems that will provide a detailed and coincidental meaning. Knowledge could be depicted as a rhizome and not as a hierarchical system. This rhizome is based on 'dynamic relations' and 'semiotic structures' in order to exist (Avramidis, Bayliss & Burden, 2001)

3. Mathematics and learning difficulties

Mathematics and their understanding are by nature complex. Its language, the abstract nature of the concepts and their complexity are some of the basic features of mathematics (Macnab & Cummine, 1986). All these features are interrelated and do not only appear in mathematics. Each one individually exists in most courses, but their combination may create barriers to learning mathematics. Perhaps, this is the reason why children are afraid to take up this lesson (Koleza, 1997).

However, we must consider what impact a learning difficulty may have on this particular nature of mathematics (Koleza, 2000). In order to answer this question, we decided to isolate some of the most common learning difficulties and try to analyse their effects on mathematics. Most features of mathematics are linear and follow step-by-step procedures. When performing the steps of each process, some information must be stored in the working memory (Davis, Maher & Noddings, 1990). Consequently, children with learning disabilities may forget their original goal or the instructions given to them, and often they do not understand what they are doing (Copeland, 1979). Often, these children experience difficulties in procedures that require a sequence of steps and in combination with memory weaknesses, contribute to long-term memory difficulties and vice versa (Yeo, 2003).

The relationship between working and long-term memory is multifaceted, but usually poor working memory also causes difficulties in transferring numerical data to long-term memory (Chinn & Ashcroft, 1998). Problems of language and lack of concentration are also common in children with learning disabilities and this makes mathematics look much more difficult, since both abilities are critical to the lesson (McCallum & Whitlow, 1994). The children are asked to read the instructions, understand the mathematical language, decide which procedure to follow to solve the problem, and at the same time remember the order in which the above steps should be followed (Kay & Yeo, 2003). As a result, linguistic difficulties combined with concentration difficulties make multi-step problems even more difficult. All of the above have a negative impact on children's self-confidence as fear of failure is constantly growing. Continued failures in mathematics increase child anxiety and fear of later failures (Haylock, 1991).

Children with learning difficulties usually consider themselves stupid and incapable of dealing with maths, thus, avoiding attendance at the lesson (Kay & Yeo, 2003). As teachers, we must strive to make the math lesson a pleasant and creative experience in order to eliminate fear and negative emotions. This can be achieved with positive thinking and enthusiasm during lesson (Evans, 1977). Children with learning disabilities should not be stigmatised. Instead, the stigma should relate to teachers and the educational system that fail to meet the needs of all children (Skordialos & Baralis, 2017). Mathematics at school does not have to be a horrible experience. It can—and must—be entertaining. The question is how can we achieve this? Is it a simple process? If so, then why is it not implemented?

4. Mediated learning experience

Mediation teaching method can be described as the interaction of an individual with his/her environment through a mediator, aiming at improving the cognitive and emotional functions of the individual (Feuerstein & Feuerstein, 1991). Through this method, the mediation receiver acquires a variety of tactics to organise and links the vast amounts of information he receives from his environment and later converts to knowledge. Mediators are essential and their role is very important. They are responsible for leading children to acquire 'knowledge' and to help them in selecting and organising the information they receive (Klaudatos, 1999).

A prerequisite for mediation is the active participation and good relationship between the mediator and the children, as the child must agree that someone else will determine his behaviour. According to Feuerstein, the quality of the mediating interaction is determined by the 12 criteria of the mediating method of teaching (Feuerstein & Feuerstein, 1991). The first three criteria—feasibility, transcendence and meaning—are the most important to meet the requirements of the method (Sharron & Coulter, 1994). The other parameters are not considered to be of vital importance, since they are determined by each student's personality and culture (Skordialos, 2015). But why is the mediation method beneficial for children with learning difficulties? How can it help them improve their math skills? Why do supporters consider it more effective than other methods?

Special education is usually characterised by approaches that treat children as passive receivers. Based on these approaches, the pupils' abilities are specific and predetermined (Bothna, 1998). Therefore, intelligence is presented as a static factor that remains unaltered and measurable at any time. This view implies that children with learning difficulties must be accepted as they are and not try to change them, as they will never be what they should (Kaniel & Feuerstein, 1989). Through the mediating method of teaching, the teacher can teach children how to think and help them understand the importance of active learning. Teachers should devote themselves to finding ways to change, rather than being used to finding reasons for obvious deficiencies. Chinn and Ashcroft (1998) and Henderson and Miles (2001) emphasise that children with learning difficulties attach more to mathematics when they are constantly guided, supported and encouraged.

Of course, teaching must be enthusiastic because children respond to each teacher's approach, especially in mathematics (Ernest, 1985). Mediation teaching can be transformed into a powerful training tool where teachers act as mediators to lead children to independent learning (Brownell & Carrington, 2005).

5. Methodology

In order to implement this research, a necessary condition was to establish a close relationship with the participants. This strategy fits perfectly with that of a flexible, quality model (Robson, 2002). So, by definition, the research is placed in the range of qualitative research approaches. The purpose of the research was to study the effect of the mediation method on the mathematical abilities of children with learning disabilities.

In the survey, 10 pupils, aged 10, attending the fifth grade of elementary school in Athens, Greece, participated and according to ratings, these children had learning difficulties. We collaborated for five 1-hour lessons and together we dealt with the lesson of fractions using the mediating teaching method. The children and the researcher worked together as a single team and we all have been actively involved in this research. The researcher used the approach of action research, since during this research the researcher took the role of mediator and had the opportunity and the joy to work with students and to explore together the learning of fractions through the mediation method.

Our main goal, as mediators, was to focus on the deeper building of 'knowledge' of children and the development of useful functions for mathematical thinking and reasoning. For data collection, all the meetings and short interviews conducted at the end of the research were videotaped. Two diagnostic specimens were also conducted before and after the teaching period. The analysis of the data was qualitative and was based on the six axes that emerged during the research (the use of the math dialogue, the fear and the pressure that the children feel about the subject, the relationship between the mediator/teacher and of the children, learning space and materials used during the course, collaborative learning and how to construct essential knowledge).

6. Results

6.1. Diagnostic essays

The average value (mean) of the results of the diagnostic essays was 13/28 for the first and 25.5/28 for the second. In both essays, the children did well in the exercises that included diagrams, while they had many difficulties in summing up fractions. The results of the second essay showed that all children's performances increased significantly.

Table 1. Results in essays 1 & 2

Student	Result (1st essay)	Result (2nd essay)
Student 1	11/28	25/28
Student 2	9/28	26/28
Student 3	17/28	26/28
Student 4	4/28	26/28
Student 5	18/28	26/28
Student 6	16/28	25/28
Student 7	18/28	26/28
Student 8	11/28	24/28
Student 9	11/28	24/28
Student 10	18/28	26/28

6.2. Interviews

During the short interviews after the teaching period, many interesting conclusions emerged. All the children agreed that they enjoyed the time we spent together. When asked why they had positive impressions from the lessons, they said, '... because I learned all the necessary words to talk about the fractions', '... because I was thinking a lot and I managed to understand the fractions', '... because I could help my friends and helped them', '... because I did not feel stupid and felt comfortable to express my opinion during the course'. They also told us that the materials we used helped them greatly improve their strategies for better memorisation and that made maths more enjoyable. One of them said: 'When we talked about fractions, I understood very little. Then, when I used my diagrams and symbols, it was easier to combine them with theory. And so, in the end when I saw the symbols, I could see the charts in my mind' and I could solve the exercises. 'What made them great was that for the first time they felt they really belonged to a team and that made them feel important'.

6.3. Video recordings

On the first day of the teaching period, the children reacted negatively when they were informed that we would be dealing with the subject of mathematics. Specifically, they said, 'I hate mathematics. I have never been good at this lesson and I cannot understand why they teach us mathematics'. Another student said: 'I agree. We will never know what the fractions are. After all, we all know this'. This gave me the start to discuss these feelings and told me that they were worried about the contests and the low marks they had in the past. All courses started and ended with dialogue. We were talking about what we did every day, what we liked and not. At first, it was noticed that the researcher tended to monologue and not give the children the opportunity to express themselves. As time went by, however, as the researcher learned to deny the position of 'power' he had, and as the children were equipped with the appropriate vocabulary to express their mathematical concerns, the monologue was taken entirely away by the discussion and the exchange of ideas. In the early days, these discussions were somewhat superficial, but as time went on, the researcher was trying to deepen the discussions and encourage children to think multifaceted and more complex.

Errors were always welcome and the researcher was trying to leave all the uncertainties and spontaneous reactions to determine the course. We analysed various mathematical concepts by going from definition to definition. We talked about the fractions by jumping from 'two-fifths' to 'the number of pieces of pizza I will eat' and to the 'number telling us how much we will get from some others', ending up with the 'number describing the quantity we get from a larger quantity'. Similar steps were used to analyse the '+' and '=' symbols, which were not yet understood by children.

The researcher always asked the children to document their answers with examples from their everyday lives, which we then tried to make them both iconic and symbolic. Students were very concentrated, especially during practical activities. Over time, children became more and more involved, and their self-confidence, in terms of math skills, was gradually increasing. Characteristics said: '... these exercises are not at all difficult. We are specialists now in fractions and it can be seen easily'. The others smiled and nodded, adding: 'Can we have some more difficult exercises? We are very good at maths now'. Practical activities were usually at the beginning of the lesson, and then, we were dealing with relevant diagrams. Through conversations, we moved from objects and charts to more abstract-symbolic concepts that we were either writing or processing mentally. The children were encouraged to find the answers themselves without giving them any specific answers. Through collaboration and discussion, they were urged to think, link information and achieve the desired results.

The researcher simply mediated, whenever he thought it was necessary to guide them and indirectly point them to the connecting links they needed. With verbal encouragement (e.g., 'I am very happy to be in the lesson', 'It is necessary to watch what your classmates say') or with physical suggestions (hugs, touching the shoulder) he was trying to keep their attention to what we did. A basic feature of all courses was the verbal description of all activities and exercises. Converting our mathematical experiences into words has increased the use of abstract thinking.

7. Conclusion and discussion

The initial aim of this research was to study the possible ways in which the mediating teaching method could support the mathematical thinking of children with learning disabilities. Of course, many other topics for discussion have emerged. Our intention was not to find specific answers but to gain more knowledge through our interaction with these 10 children. What is particularly interesting is that during the survey, children were not the only ones that learned. Through teaching, we realised that we were all together learning a quite few things. Working with children we had the opportunity to enrich our knowledge and improve our teaching style. Listening to what they had to say and treating them as people who have a lot to offer, and not as a child with difficulties to be trained, we managed to win a lot as teachers and as people.

This research confirms the theory that children build knowledge through practical, virtual and symbolic representation. Knowledge must go through these three stages, especially in mathematics, where children experience additional difficulties due to the complexity of the concepts of that language and the need for abstract thinking. Through this research, we realised that children with learning disabilities should be involved in a number of practical activities and actively participate in the lesson before proceeding to more abstract approaches, since these children are usually passive recipients during the course. Of course, practical activities are not enough. And here comes the importance of the mediation method. Our role, as mediators, was to lead children to their cognitive development. The main goal was through this method make the children to become independent knowledge recipients and later become self-mediators in order to extend their knowledge acquisition system.

Through the mediation method of teaching, the mediator provides their children with the necessary connectors to join the three modes of representation. The use of language (oral expression) played a major role in this. The dialogue was a remarkable tool for developing each person's personal way of thinking, prompting each child to think more complex and at the same time logically. Unfortunately,

dialogue is often not used as a teaching method in mathematics, because it is quite time-consuming and educators are under considerable pressure for their time.

Also, this research showed that the environment where the lesson took place and the materials used significantly influenced the concentration and motivation of the children. When the environment was creative and the materials favoured the cognitive development of children, the children worked more productively, showing enthusiasm and willingness. As our relationship with children improved, the level of participation and performance grew more and more. The children began to see the math lesson positively and their self-confidence for the particular lesson increased considerably. This also helped to create a single group whose members collaborated, trusted and helped each other. We all participated actively in the learning process, which made the lesson even more interesting to all participants. At the end of the period, we spent with children, the results were very positive. The performance of all children has improved greatly. Of course, due to the short duration of the programme, we cannot assure with certainty that the yields have improved due to the mediation method.

In conclusion, it is important to emphasise that most teachers tend to explain the failure of children with learning difficulties in mathematics based on their inadequacies and diminished skills. They argue that students are the only ones responsible for their low performance. As a result, teachers are stuck in an education system that adopts this concept and does not give them stimuli to want to change the teaching methods they use. As a result, they have neither the mood nor the ability to change their pupils. At this point, we should ask ourselves who is responsible for this attitude. Are the teachers themselves? Are the schools? Is the policy line given to schools by the government?

If we teachers themselves believe that children with learning disabilities cannot learn mathematics or any other lesson, then, what is the purpose to teach them? Or does it just take more time than other children? Or will they never be able to learn? All children can learn almost everything. The way the children are taught is important. We firmly believe that if the right methods are used, then, all children can learn. Based on the above, we find that the problem is not that some children cannot learn, but that there is a lack of individuals and right approaches to teach these children how to think and how to build knowledge. The teaching of learning and the right way of thinking is very important, but it is also a complicated, demanding, time-consuming process that needs skills and resources.

Finally, it must be emphasised that, if a child cannot learn, it is not his/her impotence, but the inability of someone else to show him the way. The responsibility for the failure of some students must be attributed to the educational system and not to the children. What is needed is understanding at all levels, from the child, parents, educators, politicians and even the government. Mediation can help more people become aware of their role and influence in others' lives and begin to have a more positive impact on their surroundings. Perhaps a good start would be if we started to see schools as a disabled child who does not yet have the appropriate stimuli but needs understanding and support.

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