Good math education in kindergarten cannot prevent dyscalculia

Una buena educación matemática en la escuela infantil no puede prevenir la discalculia

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Resumen

Most children only need some explicit instruction to learn mathematics. Nevertheless, a minority experiences difficulties from the start of their school career: first with math prerequisites in kindergarten and later with formal math from first grade in primary school. In this article, the content of early math education in kindergarten will be described, as well as what schools can do to assist low-performing kindergartners in learning math prerequisites during kindergarten. Furthermore, the connection between weak math performance in kindergarten and dyscalculia will be described. The disability—of course—cannot be prevented, but specific support in kindergarten can help children from failing immediately when they start learning math in the beginning of first grade.

Palabras clave: kindergarten education, dyscalculia, early numeracy, math prerequisites.

Abstract

La mayoría de los niños necesitan muy poca instrucción explícita para aprender matemáticas. Sin embargo, una minoría experimenta dificultades desde el inicio en la escuela: en primer lugar con los requisitos previos de matemáticas en la educación infantil, y más tarde con las matemáticas formales de primer curso en la escuela primaria. En este artículo, se describe el contenido de la educación matemática temprana en educación infantil, además de lo que las escuelas pueden hacer para ayudar a los niños de bajo rendimiento en el aprendizaje de los requisitos previos de matemáticas durante esta etapa educativa. Se describe también la relación existente entre el rendimiento bajo de matemáticas durante la educación infantil y la discalculia. Esta discapacidad no se puede evitar, pero el apoyo específico en el inicio de la escolaridad puede ayudar a los niños a evitar el fracaso académico cuando comienzan el aprendizaje matemático en el comienzo del primer año de educación primaria.

Keywords: educación infantil, discalculia, conocimiento numérico temprano, prerrequisitos matemáticos.

Most kindergartners develop early numeracy almost automatically, while for a minority of children (around 20%) this development is less natural. Research shows the importance of mastering such skills before children move towards formal math in first grade in primary school (Jordan, Glutting, & Ramineni, 2010). Especially for children who find these skills difficult, it is of great importance to adequately support them. In this article the importance of preschool mathematics as a foundation for later numeracy will be discussed, and also that good early numeracy education does not mean all children can easily master mathematics from first grade and upwards. Based on recent scientific insights the development of counting and early numeracy in kindergartners and children (in first grade) will be explained. Also, specific skills within learning mathematics and different child dependent factors that play a role in early numeracy will be discussed. Next, the challenges facing teachers in kindergarten in the field of kindergarten mathematics, as well as the possibilities for dealing with them will be discussed. The importance of differentiation will be illuminated and attention will be paid to how early math problems can be identified and how children who fall behind in math can be characterized. Finally, the possible connection of weak math skills in kindergarten and dyscalculia will be discussed.

Number Sensitivity

'Number sensitivity' begins for most of us at a very young age. Babies are unconsciously capable of distinguishing different small quantities. Four-month-old children look longer at a screen with a small number of objects when this number suddenly deviates from previous experiences; for example, when there are no longer two dolls, but three displayed on the screen. This type of research shows that even very young children are already able to perceive differences in small quantities of objects or differences between larger quantities with high contrast, such as nine or 18 dots (Lipton & Spelke, 2003). This number sensitivity quickly develops during infancy and toddlerhood. At the end of kindergarten most children are already aware of six arithmetic properties. For example, when they are counting fingers from one hand and arrive at 'five':

- Firstly, the kindergartner knows that a number refers to a collection as a whole. A number refers not only to the last counted object, but to all objects of the collection counted together. 'Five' refers to all the fingers and not just the last one counted.
- The kindergartner also knows that the sequence of counting has no

effect on the quantity. In order to determine an amount, it is for example not necessary to count from left to right; it can and also may be from right to left.
- Thirdly, the child is aware that the objects to be counted do not have to be identical. Five fingers can be counted together, but so do a pear, an apple, a banana, a cherry, and a tangerine (five pieces of fruit).
- Moreover, it does not matter if the objects are in a row or placed randomly. The physical location is irrelevant to the number of objects to be determined.
- Fifth, the kindergartner knows that numbers refer to the absolute quantity. Five fingers are equal to five elephants. Despite major physical differences between objects, the amount remains equal.
- Finally, the kindergartner knows that a number has its own place in the number line. One object less also means that the sequence is a position less long.

Young children acquire various math related skills up to the age of about seven years. When these skills develop well, most children will reach a sufficient level of early numeracy, which allows them to also master the normal math curriculum: first when dealing with numbers in all possible situations at the kindergarten level and then in actual formal mathematics, such as addition, subtraction, and with solving 'linguistic' problems in a mathematical context. The first conscious awareness of quantities starts at about two years of age. This awareness has little to do with determining an amount by counting, but is rather to be understood as the detection of a 'quantity image'. Children understand that different numerals indicate different amounts, but cannot yet create the right link between a quantity and a matching numeral (Toll & Van Luit, 2014a).

From different theoretical perspectives, diverse empirical research on counting has been done, especially about how it develops (Lipton & Spelke, 2003). Moreover, the literature describes practical experiences with counting in young children and results of developmental research. For most experts, number sense is for the most part determined by the ability to count. On this there is consensus on the six consecutive phases in learning to count: recognizing an amount image and 'subitizing' (direct recognizing of three or four objects in a random position), acoustic counting, asynchronous counting, synchronous counting, resultative counting, and resultative shortened counting (for a more elaborate description see Van Luit & Van de Rijt, 2009).

On average early numeracy begins to develop from the age of four years and kindergartners prepare themselves for initial math as presented in first grade and upwards. Good early numeracy facilitates the transition from kindergarten into the more formal mathematics education in first grade. Various sub-skills are distinguishable in early numeracy: the more traditional 'Piagetian' calculation conditions, such as one-to-one correspondence and counting skills. The more traditional calculation conditions are based thematically on the four conditions developed in the 1960s by Piaget (1965). These are the characteristics of learning to think logically, as usually developed in kindergartners naturally with aging, but then linked to the skills that facilitate early numeracy or even are a part of it.

Based on professional publications and scientific research nine components, or aspects, of early numeracy are distinguishable. These nine components are loaded together on one factor, which we have named 'number sense at the kindergarten level'. It involves comparing, linking quantities, one-to-one correspondence, bringing order, using numerals, synchronous and reduced counting, resultative counting, applying knowledge of numbers, and estimating (Van Luit, 2011; Van Luit & Van de Rijt, 2009). These nine components appear, on the basis of international literature, to be an adequate operationalization of the concept of 'early numeracy'. Some 'Piagetian' conditions in this comprehensive collection are not necessary for counting skills, but are more or less related and together they form early numeracy. This can be considered as a single cognitive structure that covers the entire domain of 'early' or preliminary numeracy surrounding the development of different and interacting sub-skills and knowledge. Training in counting for four-year-old children not only leads to better results than training in, for example, seriating and classification, but also has beneficial effects on seriating and classification tasks (Gersten, Jordan, & Flojo, 2005). The ability to solve more traditional terms is not seen by definition as necessary for success in mathematics, but a moderate correlation has been found between the ability to solve tasks well that are related to these conditions and later numeracy. Several studies further show a strong correlation between weak early numeracy and weak math performance from first grade and upwards (Morgan, Farkas, & Wu, 2009).

Number Representations and Mapping Skills

Children use three ways to represent numbers and quantities in their brains. The most frequently used classification is the 'triple code model' (Dehaene, 2001). In this, three ways, also called codes, are distinguished in which a number is represented. First there is an analogue 'magnitude' code (number sense). This is the sense of numbers on a mental number line, accompanied by the knowledge of neighbouring numbers (six is nearby and before seven) and the ability to compare numbers (five is less than six). Secondly, there is the auditory verbal code: knowing the word that corresponds to a number of objects (□□□□ is the same as 'four'), and related to this also knowing the number line. Thirdly, there is the visual code: for us the Arabic numerical system in which we write down numbers (six is written as '6').

Much scientific research focuses on how these three codes are mutually correlated (Lipton & Spelke, 2005; Rouselle & Noël, 2007). As already indicated, children are found to have a congenital understanding of quantities and amounts (attention is drawn when suddenly three instead of two bears appear on a screen), which is represented in the analogue code. When children at home and at school increasingly come in contact with verbal numbers, such as counting rhymes and counting songs, and with visual numbers, which they see everywhere around them in writing, verbal and visual codes are also being developed. This new verbal or visual (also symbolic) knowledge should become integrated with the already existing non-verbal number knowledge, overseeing quantities. This results in more complex representations whereby numerals or number symbols are related to numbers. In this way, children become aware of the relative position of numbers. What is precisely the value of the number four, and how does this number relate to larger numbers like five and eight? Children learn that each number is repeatedly one more than the number before this number in the row (seven comes after six), and one less than the number that is behind it (four comes before five).

To what extent children have insights into the position of numbers can be measured using a number line task. Children are asked to place a particular number symbol on a line from 0–10 or 0–100. The estimation task measures the skills of children to 'map' a symbol with the corresponding value on the number line. Research based on this task with a number line from 0–100 has uncovered an interesting process (Siegler & Booth, 2004). Children in kindergarten tend to overestimate the value of small numbers (the number four is estimated on the number line from 0–100 on the location of 20) and underestimate the value of large numbers (the number 95 is estimated on the location of 75). Also they estimated the value of lower numbers (numbers below 20) at a further distance from each other, and the value of higher numbers closer to each other (Figure 1).

This observation shows that kindergartners have a logarithmic representation, while older children (first and second grades) are better able to estimate numbers in value. They have in the meantime gathered the knowledge that all numbers have a permanent pla-

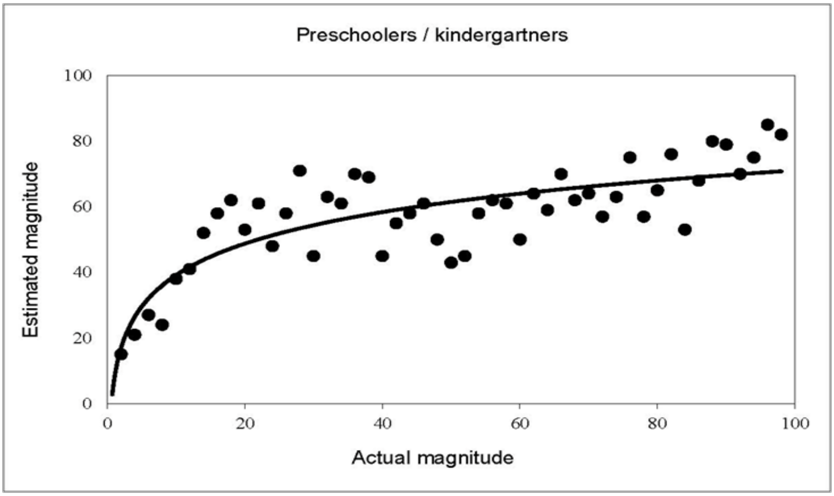

Figure 1. Logarithmic number representation of numbers up to 100 by children in kindergarten..

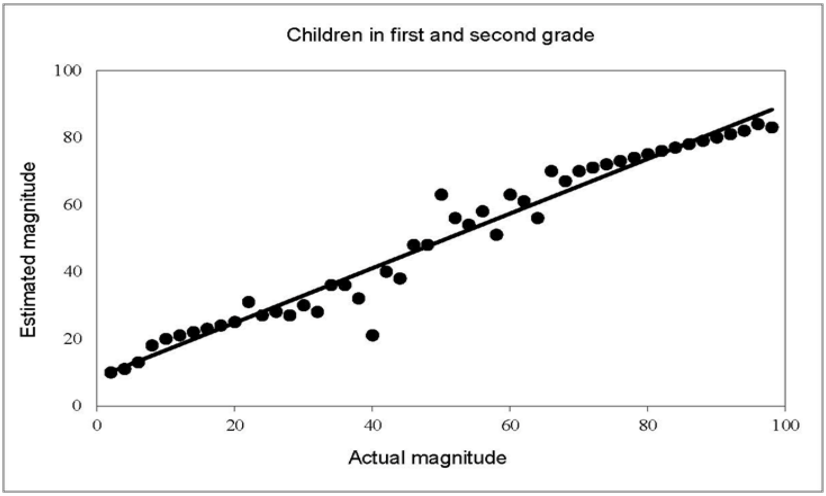

Figure 1. Linear number representation of numbers up to 100 by children in first and second grade..

ce on the line and that the differences between the numbers are evenly divided. The difference between five and six, after all, is just as great, as the difference between 55 and 56. Children this age have developed a linear representation of numbers (Figure 2).

Research shows that the degree to which children are able to estimate numbers in the right place, and thus have a better linear representation of numbers, appears to be a good predictor of their mathematical skills (Booth & Siegler, 2006).

Predictive Factors in Children and the Environment

Number sense and the development of counting are processes related to other factors in the development of learning in children. Recently, much attention has been paid to cognitive factors such as the operation of (working) memory. Children who have difficulty remembering information also more often have difficulty learning the number line. The complex working memory skill 'updating' (for the storage of temporary data and reviewing of this information as new data or information require this) turns out to play an important role in the development of number sense and thereby counting. Within working memory, a distinction has been made between two types: in the first type there is verbal input (the processing of auditory information, such as memorizing a short poem) and in the second type there is visual input (the processing of visual information, such as playing a game of memory). Both memory types play an important role in learning arithmetic. Verbal working memory is assumed to be especially important for numeracy in primary school, while visual working memory would be of specific importance to early numeracy (Kyttälä, Aunio, Lehto, Van Luit, & Hautamäki, 2003). This phenomenon is explained by the fact that children at a young age are visually set and not until later in life are able to develop mental models of the visual world around them. From that moment on, verbal working memory will play a more important role.

In addition to cognitive factors, environmental factors are also considered to be of interest, for instance, the amount of formal information transfer that children get at home. The interaction with parents, but also with brothers, sisters, and friends plays a role. At home young children on average are involved at least once a day in activities in which numbers or quantities play a role, such as counting silverware and saying or singing rhymes or verses with numbers. Research shows that on average in a middle-class family there is more interaction regarding numbers and quantity related concepts than in families from lower social classes. Moreover, it appears that the extent to which children come into contact with activities related to counting and numbers in their home environment is an important predictor for the mathematical performance of children during the first school years (LeFevre et al., 2009). The nurturing environment therefore appears to play an important role in optimal development of genetic potential.

Mathematics in Kindergarten

In kindergarten playing is the method used to learn. A four- or five-year-old learns especially through discovering things by him- or herself. The influence of adults is important. Both the parents and the teacher are the ones who 'accompany' the child in gaining new experiences. Three aspects characterize the manner in which kindergartners learn. Firstly, game activity dominates the classroom. Kindergartners actually play for most of the day and learn from it. For example, they build things with materials and they do fantasy- and role-playing, with or without all types of materials or through a motion game. The game is still largely based on their own interest and children enjoy doing it. Secondly, kindergartners' actions are increasingly purposeful. When the child does something, it is increasingly about the final result; the way he or she does it is in fact of less importance. Kindergartners can generally not yet anticipate in advance, neither can they oversee during acting if everything goes efficiently. When the result is accomplished, the kindergartner does not monitor that result; done is done and finished is finished. It is clear that he or she does not have enough knowledge to smoothly run the information processing from A to Z. Thirdly, kindergartners perceive the world around them. They form representations of it. What they see, hear, smell or feel is the most alive to them and this is what they frequently engage in. This means that events that they can imagine, such as playing a game, are the most appealing to them. They learn more from this than from abstract concepts. Kindergartners learn more when they take action themselves, when they discover how something works or how things are done. They learn less when others verbally 'teach' them all sorts of skills. Therefore, education in kindergarten should contain many play activities. A kindergartner learns, in comparison to older children, a lot by undertaking all sorts of activities independently: by looking at the environment and absorbing changes in it and by playing and talking with others (children and adults).

Before children enter the first year of kindergarten, they have already had many experiences with numbers and quantities. For instance, games (such as Castle Logix, toddler towers, Sortino, and Photo Safari), conversations and questions during dinner (e.g. how many forks and knives should be on the table?), and all kinds of scenes in television programs like Sesame Street. Gaining experiences in daily practice is also called 'incidental learning'. Incidental learning leads to informal knowledge: knowledge that is established without purposeful education. When children come in contact with more or less targeted math education there is 'intentional learning', and therefore formal knowledge. This is the case when children in kindergarten, especially in the second year of kindergarten, are taught.

Six-year-olds need to possess necessary conditional arithmetic knowledge, before they start first grade where the situation is much more focused on intentional learning compared to kindergarten. They must, for example, be aware of quantity concepts, like 'much–less', 'more–less–equal', 'equal', 'large–small', as well as being able to apply this knowledge to the ordering of concrete materials or even to objects represented on paper. The older kindergartners are for instance expected to possess the following abilities: understanding that separating five blocks implies that there are still five blocks present (conservation); being able to compare two small quantities and indicating the difference in quantity (correspondence); classifying objects and pictures by essential characteristics (classification); ordering from big to small and from many to few (seriation); and also being able to count up to around 15. During the second year of kindergarten children are expected to be able to count forwards, backwards, and continue counting from a given point. On top of that they are expected to be able to count synchronous, shortened, and resultative. The latter consists of counting structured and unstructured quantities, as well as counting covered quantities that were presented shortly before.

Research shows a strong link between linguistic proficiency and mathematical proficiency (Schleppegrell, 2007). This is true for higher ages, but also for the start of school and kindergarten. Within the vocabulary of young children, a type of language can be distinguished which is of crucial importance to learning mathematics. Consider concepts like 'many–few', 'more–less–equal', 'equal', 'big–small', but also positional words like in front, behind, between, next to. Understanding these concepts is a prerequisite to learning formal mathematics because positional words are important for gaining insight into the relationship between numbers. Which number comes after four? And which number is between eight and 10?

Parents and teachers have an important role to play in children's mastering of this mathematical language because children learn language through input from their environment. The use of this type of language in preschool differs greatly between teachers. Research shows that the growth of mathematical skills in children improves during the school year due to a higher degree of using mathematically related language (Klibanoff, Levine, Huttenlocher, Vasilyeva, & Hedges, 2006).

Targeted Early Mathematical Education for Weak Kindergartners

Dutch kindergarten programs are largely lacking in the possibility for children to differentiate between simpler and more complex tasks. The programs also assume that kindergartners are able to find the solution method for different tasks. However, mathematically weak kindergartners struggle greatly in discovering the connection between different counting abilities and the way they can be applied in all kinds of situations. Especially for these children, the programs are lacking in attention, additional exercises, and specific instructions and suggestions for teachers. The same applies to the supportive material. In some cases a kindergarten preparatory program exists for the mathematical textbooks used in higher classes. Only a limited amount of teachers systematically use these programs. The main reasons given for disuse are a lack of time or unclear instructions. Mathematically weak children benefit from systematic and targeted support in the last half-year of kindergarten but preferably even more early on.

From the literature, four challenges for mathematical education in kindergarten can be formulated: the time factor, the systematic use of mathematical activities, the application of a program consisting of a continuous series of complementary and related tasks, and meeting different individual needs (differentiation) that children have concerning early mathematics (Aunola, Leskinen, Lerkkanen, & Nurmi, 2004). This last challenge is especially difficult to achieve within the present educational framework in kindergarten. In further primary education much attention is paid to differences between children in terms of competencies and behaviour, but also to the different ways they learn. In addition, there is also growing attention to the way in which learning differences can be handled within the classroom. This also applies to mathematical education. Many schools therefore provide differentiated mathematical education from first grade and upwards. However, research shows that even at a young age large differences in early numeracy exist between children and that mastering these skills appears to be a good predictor of how children develop in mathematics throughout their entire school career (Siegler, 2009). Differentiation should therefore already begin with early numeracy. Some kindergartners naturally have a spontaneous interest for counting and the meaning of numbers, and as a result have a need to be challenged in this area. Meanwhile, a minority of kindergartners are unable to establish relationships between quantities, structures, and numbers independently and therefore need specific, structured instruction. These differences are daily practice for teachers in kindergarten and for them it is a great challenge to shape math-related activities in such a way that all children sufficiently benefit from the content so that they start first grade with sufficient understanding of early numeracy.

Characteristics of Kindergartners with a Mathematical Disadvantage

What do we know about kindergartners who are behind in learning early numeracy? In recent years there has been growing interest in this subject and this research has brought up a number of features. In summary, it can be stated that these children often meet one or more of the seven features described in Table 1.

From Problems at a Young Age to Dyscalculia

Incorrect number sense at the preparatory level and problems with elementary arithmetic in first grade increasingly leads to more limitations in the abilities of children to adequately solve mathematical tasks. Therefore, these problems manifest in children with dyscalculia at a young age in gaining early numeracy during the first half of primary school. This basic problem becomes observable when kindergartners, for example, have difficulty with fluently naming small quantities (using structure), counting, and automatizing number symbols (Van Luit, 2011).

One of the most striking characteristics Dowker (2005) identifies for dyscalculia is a weakness in recollecting numeric knowledge from memory (e.g. in a young age—six to eight years—they do not know that five is between four and six or that adding four to three equals seven). This problem can persist through older age. Furthermore, they keep using (sometimes into adulthood) number lines to solve simple math problems (12 + 6 = 12, 13, 14, 15, 16, 17, 18; while they keep track of additional units using their fingers under the table). The-

Tabla 1. Characteristics of weak math performing kindergartners.

Characteristic	Explanation
Little to no spontaneous interest in numbers	Children like to show how far they are able to count, or they repeatedly vocalize how old they are and how many numbers they already know. Children have the tendency to spontaneously count quantities (fruit in a basket), even when there is no request. Kindergartners with weak math performance show this behaviour to a limited extent. They do not often initiate math related games or tasks.
Low proficiency in math language concepts	Specific language, such as more, less, in front, behind, and between is very important in learning mathematics. Children with a mathematical disadvantage often do not master these concepts as well.
Limited (working) memory	Children with a mathematical disadvantage find it harder to remember knowledge and to refresh their memories in order to apply already acquired information to newer and more relevant knowledge. For instance, non-numerical information like colours, body parts, or the days of the week.
Trouble understanding the structure of dice	For some children with a mathematical disadvantage, a die has an irregular structure that is not logically constructed. The value becomes higher when more dots appear. The placing of these dots is not however always as expected. A clear example is the transition from three diagonal dots to four dots forming a square. The added third dot shifts to a corner and in another corner a new dot appears. This is highly confusing to children with weak numeracy comprehension. They benefit more from structures with a straightforward set up.
Limited benefit from instruction	It is known that children struggling with math from first grade and upwards benefit mostly from direct instructions in which the teacher takes a central role, structures the exercises for the child and adequately hands solution strategies to the child. For kindergartners with a mathematical disadvantage this type of instruction also appears to be the most beneficial.
’Mapping’ problems	Linking different number representations appears to be hard for these children. When children can count six blocks and are able to name the number symbol six, it is not self-evident to them that the number symbol six represents the value of six.
Unable to see the relation between numbers	Because these children are experiencing problems with ‘mapping’ quantities to symbols, they also struggle to see the relation between different numbers. The position of numbers on a number line is not always a logical order to them because they do not link the order to the number values.

se two characteristics, although on a more basic level, are also observable in kindergartners. It is not yet possible to diagnose dyscalculia in kindergartners. However, children who turn out to have dyscalculia from third grade and upwards were also among the weakest kindergartners concerning early numeracy.

The literature provides multiple explanations for the cause of dyscalculia. One stands out: limited information processing. The consequences for children with dyscalculia are poor planning skills, a strongly limited capability for using and learning to use correct strategies, having no control over their math actions, lacking good short-term memory, an inadequate knowledge of automatized numeracy, limited knowledge in math, little or no self-confidence, having no confidence in self-improvement, lacking faith in personal growth, and not being open to help from others. On top of that, it appears that automatization problems (not being able to remember that 7x8 equals 56), discrimination problems (not being able to understand that the number three in 13 is worth less than the number one), and thinking problems (not using association to quickly solve 19 minus seven via nine minus seven) play an important role in having no or strongly challenged math learning abilities.

Therefore, dyscalculia is especially concerned with the failure of declarative knowledge: numeric facts and naming numbers, such as a deficiency in fluently naming numeric information like numbers and quantities (Fuchs et al., 2005; Landerl, Bevan, & Butterworth, 2004; Willburger, Fussenegger, Moll, Wood, & Landerl, 2008). This implies that automatization problems are always present with dyscalculia. However, some students practice so intensively that they in the end are able to remember, for example, multiplication tables or all summations up to 10. This knowledge, however, is not adaptable and remains fragmented. The school-aged child will immediately know the solution to ‘10+80’, because ‘10+80=90’; but can also solve ‘41+8’ by counting from 41 upwards. With multiplying they will for instance know that ‘4x8=32’, but they would not know how to solve ‘14x8’ (not seeing that ‘14x8’ consist of ‘10x8’ and ‘4x8’). For children with dyscalculia this will be true already at a young age. They would not for instance see that when four toy cars and one toy car are added up, they then can continue counting from five toy cars when they add another one. These children will invariably start counting from the first toy car. A deficiency in declarative knowledge almost never stands alone. It will in turn, for example, complicate the establishment of procedural knowledge: understanding solution procedures. For example, using the solution procedure for solving ‘9x6’ by subtracting ‘1x6’ from ‘10x6’ assumes that the facts ‘10x6=60’ and ‘60-6=54’ are known. It also assumes that the student has insight into the act of multiplication, is able to visualize it, has insight into the connection between different multiplication problems, between multiplying and adding, and as in the example above, even between multiplying and subtracting. When this insight is present, a child will understand how mathematical facts are related and would not need as much automatized knowledge.

Factual and procedural knowledge are therefore strongly related.

Dowker (2005) points out the fact that more and more indications are being found that, apart from the possibility of early signalling (Araujo, 2014), treating early mathematical learning problems improves further mathematical education (Gersten, et al., 2005; Van Luit & Schopman, 2000). She states that the prevention of these problems during kindergarten creates a major challenge in research for the following decades. Siegler (2009) demonstrates that early numeracy in kindergartners is determinative for later mathematical skills as this extends from primary education even into secondary education. Morgan et al. (2009) note that therefore it is very important to trace problems in early numeracy as early as possible to be able to provide the best possible support at that stage, and also when children later turn out to have dyscalculia.

My own research shows that kindergartners greatly benefit from early detection. It is not just about determining a score, but more importantly about identifying specific deficits. Therefore, it is possible to help students specifically in areas where they experience problems (Van Luit, 2009). For this purpose effective programs have been developed (Aunio, Hautamäki, & Van Luit, 2005; Toll & Van Luit, 2014b; Van Luit & Schopman, 2000).

For parents and/or schools it is important that they count on behavioural specialists with additional knowledge and skills of 'diagnostics of dyscalculia' for diagnostic math research. When a child has dyscalculia, the school should make arrangements to give the student a greater opportunity to take courses that he or she is capable of. This is becoming more difficult given the barriers that the government (initiated by the former Minister of Education in The Netherlands) recently raised by the proposal (1) to make mathematics a required examination component in all forms of secondary education, (2) the required grades (at least two sixes and one five) to be achieved in the secondary education exam for the course combination Dutch-English mathematics in order to succeed, and (3) in the near future to make mathematics compulsory in middle-level secondary education. Already it appears that based on my own data, children who are leaving primary school at the end of grade six for children with dyscalculia is 90% in low-level secondary education, 10% in middle-level secondary education, and 0% in high-level secondary education, compared to 55% in low-level secondary education, 25% in middle-level secondary education, and 20% in high-level secondary education for children without dyscalculia. Dyscalculia is therefore a disorder that heavily influences the school career and therefore the working career of a student. It is therefore definitely important to encourage all those involved in education to stimulate early numeracy in kindergarten and especially strongly support the weak students. Dyscalculia cannot be prevented by intervention, but potentially weak math students can learn a lot from it and the necessary help for students with dyscalculia should be started at a young age for the highest chance of some positive results.

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