What is Dyscalculia and What Do We Need to Know about It?

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A difficulty in acquiring basic arithmetic skills unrelated to low intelligence and/or poor schooling is called dyscalculia (Kaufmann and von Aster 2012). Dyscalculia is used as a general term for any aspect of arithmetical difficulty (Shalev, Weirtman, and Amir 1988). Population studies among primary-school pupils in the United States, Europe and Israel have demonstrated approximately the same prevalence of developmental dyscalculia, which ranges from 3-6,5% of minors (Gross-Tsur, Manor, and Shalev 1996; Badian 1983; Lewis, Hitch and Walker 1994; Hein 2000). Unfortunately, there is no exact data about the percentages of primary school pupils with dyscalculia in Azerbaijan.

Clearly, dyscalculia is a common learning disability among pupils; many teachers and parents are not informed enough about and do not know the difference between dyscalculia and common difficulties in understanding math. Some of us may remember from school years that teachers often employ methods such as having consultations or assigning less advanced problems for pupils who have constant challenges in math class, which does not result in much progress for some. In these scenarios being informed about dyscalculia can be helpful for teachers and parents to understand the vital differences between pupils with and without dyscalculia, how to diagnose them, and thus help them in an effective way.

More recent research (Shalev 2007) demonstrates that this mathematical disorder has a slightly higher prevalence than previous data has indicated—about 5% to 7%—which is almost the same prevalence as dyslexia (Gabrieli 2009). To be clear, dyslexia is defined as a language-based learning disability which has a direct impact on spelling skills and fluent

reading (Roitsch and Watson 2019). Students with learning disabilities are much more likely to drop out of school, to inconsistently attend class and to experience emotional instability (Sudha and Shalini 2014). On the other hand, dyscalculia is an economic issue, as adults with poor arithmetic skills suffer a major disadvantage on the job market (Kaufmann and Von Aster 2012). About 22% of young adults have poor arithmetic skills (Von Aster et al. 2007; Krinzinger, Kaufmann 2006).

According to international literature, teachers and teacher candidates believe that the education they receive is insufficient to inform them of specific learning disabilities and that they are not sufficiently trained to properly intervene (Birol and Zor 2018; Çoğaltay and Çetin 2020; DeSimone and Parmar 2006; Kuruyer and Çakıroğlu 2017; Fırat and Koçak 2018; Subban and Sharma 2006).

I believe this article can help both parents and teachers in Azerbaijani society with dyscalculia. Here I focus on explaining what dyscalculia is and how to diagnose it correctly, and which actions a teacher should take if a pupil has dyscalculia.

Firstly, either as a teacher or a parent, we need to know that dyscalculia is a specific learning disability and mainly impacts students' arithmetic learning process (Williams 2013). The main reason we need to diagnose pupils is because a diagnosis helps define which interventions will best alleviate students' difficulties. (Bird 2007). However, sometimes it is not easy to determine whether a pupil has dyscalculia or just common difficulties with math (gaps from previous stages, missing school excessively, etc.) in order to clarify the main aspects of dyscalculia and how we can observe it during class, I explain several insights in the next paragraphs.

Common symptoms of dyscalculia

According to diagnostic criteria, dyscalculia is caused by a

dysfunction of mathematical processes and areas in the brain (Sudha and Shalini 2014). Scientific data shows that the brains of children with dyscalculia demonstrate disruption between the activity of the IPS (intraparietal sulcus) and numerical distance (Ansari 2008). It is not possible for us to understand these neuroscientific characteristics when we observe these pupils, so below we list the main symptoms (Sudha and Shalini 2014) we might observe:

1. Difficulty grasping and remembering mathematical symbols and concepts;
2. Difficulty with basic operations (adding, subtracting, multiplying, dividing, estimation and approximation);
3. Difficulty with directions (as in playing a game);
4. Poor memory of the layout of things (for example, pupils cannot remember that negative numbers are on the left, positive numbers are on right of a number line);
5. Limited strategic planning skills (like those used in chess);
6. Often will reverse or transpose numbers (36:63).

When we read these symptoms, we might think that these have been common problems for all of us at least once during primary school years; however, the main indication that might lead us to suspect dyscalculia is if a pupil demonstrates these symptoms for at least two years continuously (Geary 2004). In general, all people have the ability of understanding counting concepts when they see things around them after learning how to talk, while people with dyscalculia do not have these characteristics (Butterworth 2005).

Another necessary aspect to understand about these pupils is that they usually show a lack of self-esteem and self-doubt, even when they find the correct answer (Emerson and Babtie 2010). If, for instance, we were to ask them to find “5+3” and right after that “3+5” they would likely not understand that the answer will be the same for both calculations. Observations of dyscalculic pupils show they can solve

problems on the day the teacher explains a new concept, and the next day seemingly forget the operational rules and produce an incorrect answer or mix operations again (Geary 2017).

On diagnosing

The above noted symptoms can be observed by teachers and parents but in order to assess dyscalculia, the best tools (Michaelson 2007) are standardized tests, direct observation and the Dyscalculia Screener (Butterworth 2003).

A standardized test measures a child's age-appropriate arithmetical/mathematical skills and attainment (Shalev and Gross-Tsur 2001). However, these tests cannot always correctly diagnose students since there could be other reasons behind a student's failure on such a test (Michaelson 2007). Because standardized tests are usually intended for students of a certain age and level to see if the pupil can solve the problems related to the topics they have learned. A pupil with dyscalculia or a pupil who has difficulty with some topics or arithmetical skills can easily be confused in standardized test since both circumstances are too general to be distinguished by a test alone.

Another method, direct observation, focuses on observing whether the pupil uses less-developed methods to find solutions (Geary 1990); whether they commit computational errors caused by poor memory working span (Siegel and Ryan 1989); whether they have a slow rate of processing basic arithmetical skills (Geary and Brown 1991) and other characteristics. Unfortunately, these listed performance indicators can be observed in any student who has difficulty with math so this method is not fully reliable by itself either (Michaelson 2007).

The final tool, the Dyscalculia Screener (Butterworth 2003), is a software program that measures a pupil's natural numerical skills such as counting dots, comparing numbers and

arithmetic achievement regarding their age and level (Michaelson 2007). According to this tool, the student who has dyscalculia will show low results on counting dots and comparing numbers and a medium level on the arithmetic test. Students with mathematical difficulties rather than dyscalculia will have high results on the first and second and low results on the arithmetic test.

How we can help them

Some strategies for pupils with mathematical disabilities are listed below for teachers, tutors, parents and even for pupils themselves. Overcoming math anxiety is important because when a pupil already knows they have dyscalculia it can increase their anxiety about themselves and their learning process. Teachers' conversations with these pupils in which they encourage students to share their challenges with math or their worries can help to treat these pupils' math anxiety; celebrating small and big achievements can motivate their learning process (Wadlington and Wadlington 2008).

Some necessary instructional modifications to accommodate dyscalculic learners are listed below. Teachers and others may consider which might be useful for pupils in accordance with their needs (Trott 2003). These modifications are mainly categorized as improving reading skills, mathematical problem-solving skills, and general instructional design (Michaelson 2007):

1. Separating large sections from each other with page breaks, and bullet points; using colored overlays to minimize glare from black font; and using Sans Serif fonts such as Ariel or Tahoma assists dyscalculic pupils in reading and understanding material.
2. Separating multi-step problems into smaller, one-step problems; various parts of problems or questions can help pupils understand what the problem is and what they need to do to solve it.

3. Making sure the pupil has all the necessary notes and formulae to solve a problem. This can be accomplished by placing posters with basic concepts in the classroom, by using flow and tree diagrams to explain necessary operational steps, teaching lessons at students' own pace and having review sessions from time to time.

I became acquainted with a case of dyscalculia when I first started teaching at secondary school as well. Having a pupil in the classroom with dyscalculia requires having a more detailed plan about each new topic you need to teach. Frequent review of previous related topics lessens anxiety in the classroom because most of the time these pupils cannot remember much when you ask them a question. From my own experience, teachers can consider, in accordance with the student's age and level, the use of additional resources, such as calculators and applications. Such resources usually help students in grades 7-10, while with primary (grades 1-4) and lower middle school (grades 5-6) most of the time students are not diagnosed, so if a teacher has already observed the abovementioned main symptoms, they can consider testing students themselves and discussing the results with parents (Sudha and Shailini 2014).

Another point worthy of parents' attention is that their motivated approach and help can positively impact a pupil's self-esteem with regard to math. Considering dyscalculia shows its symptoms from a very early age, parents can easily observe their children and start to assist them.

Conclusion

Because mathematics is not usually students' favorite subject, and because they are easily impacted by negative comments and influences, understanding students and their problems is crucial. A dyscalculia diagnosis takes years. So, when pupils have other reasons for showing lower performance in assessments, it does not always mean they have dyscalculia. By

contrast, investigation of the reasons behind pupils' lack of motivation and understanding should be investigated by teachers and parents together as a team. In the case of dyscalculia, school administrators and parents can decide on assessments together or follow school policy regarding such assessments. Teachers and parents who lack pedagogical knowledge about learning disabilities can cause serious challenges for dyscalculic pupils. Asking for more advanced skills and performance from dyscalculic pupils can be enough reason to make them disappointed in themselves and in their whole academic improvement. `Instead, we should increase awareness around this issue in public campaigns, organize specific training in educational institutions (both public and private schools, universities, etc.), and call for dedicated collaboration between teachers and parents.

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