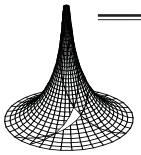

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Why some children fail? Analyzing a test and the possible signs of learning disorders in an answer sheet

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Dedicated to the memory of Julianna Szendrei

The errors occurring in a test has conclusions for both the teacher and the pupil.
Julianna Szendrei

Abstract. Teachers and educators in mathematics try to uncover the background of the mistakes their students make for their own and their students' benefit. Doing this they can improve their teaching qualities, and help the cognitive development of their pupils. However, this improvement does not always support their students with learning disorders, since their problem is not caused by wrong attitude or lack of diligence. Therefore, it is the interest of a conscientious teacher to recognize whether the weaker performance of a student is caused by learning disorders, so the helping teacher can give useful advices. Although the teacher is not entirely responsible for the diagnosis, but (s)he should be be familiar with the possible symptoms in order to make suggestions whether or not to take the necessary test of the learning disorders.

In this article, through examining a test and the answer sheet of a single student, I show some signs that might be caused by learning disorders.

Key words and phrases: cognitive processes, learning, learning theories, diagnosis, analysis and remediation of learning difficulties, misconceptions and student errors, control and rating, syllabuses.

ZDM Subject Classification: C30, D30, D70, Q70, B70, C90.

1. Introduction

Several years ago I suggested Julianna Szendrei the topic "The nature of errors" to study ([7]). She mentioned she had similar thoughts on her mind and

was interested in working with me on the topic. We even looked through some test sheets to examine the possible reasons of pupils' failure on a math test. I found that there could be three major reasons for that: (a) poor knowledge (factual or contextual) of the pupil (b) unsuitable problems (c) poor communication. I concluded that the test chosen was not suitable to measure what it was meant to measure or, at several points, it was worded poorly.

That time I believed that "poor communication" could solely come from the test itself. Only later I learnt about learning disorders (LDs) and that changed my point of view entirely.

Recently I reviewed the answer sheet I picked earlier and was surprised to see how many small signs of a learning disorder can be found in a single answer sheet. This experience is of significant importance, therefore I would like to share it with the reader.

First, I *review the problems of the test* and the answers of the pupil whose answer sheet I picked. Then I *analyze the test itself* and *make some suggestions* on the making of such a test. Last – but far not least – I make some remarks on the *signs that can point at some kind of a learning disorder*.

2. Object and Tools of the Research

1. I am going to examine the problems of a test for grade six pupils to enter grade seven ([1]). The test was a 45 minute one, there were 10 problems given. (Thus, as an average, there were 4.5 minutes given for solving a problem and writing down the complete solution.)

One of the problems was supposed to test space perception, one (consisting of five questions) converting units, two problems leading to solving an open sentence, one was about fraction algebra of a complex structure, and finally five problems were to test logical or combinatorial skills. The latter ones are also called problems of "thinking methods" (or better, "thinking skills"), a topic in the Hungarian curriculum of mathematics.

According to S. Pálfalvi's categories ([2]), the problems can be categorized from N1 (creative testing of knowledge, problem no. 10) to HH (creativity and knowledge, problem no. 4). According to Bloom's taxonomy ([3]), the solution of at least five of the problems need problem solving skills or higher level of thinking. Many of the problems needed understanding of complex texts. There was only one problem (number 7) that tested knowledge.

Analysing each problem from a mathematics didactics point of view, we have conclusions for both the teachers assembling and correcting the tests. I – with the help of József Korándi – asked the opinion of university students in mathematics teaching line, what I found very useful. I asked them to sit the test and discuss their experience according to a list of criteria. This criteria included questions concerning formal, content, cognitive, test theoretical, diagnostic, complexity signs. We will also find, that the otherwise well-intentioned but not carefully thought over setting of the test can be counter-productive and can impair the effectiveness of the outcome of the test.

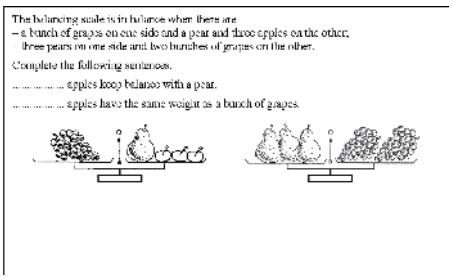
2. I picked one answer sheet at random, which, analyzing in details, one can show some warning signs of a possible LD. The student whose test I picked is going to be referred to as K. T. I have no information whatsoever about K. T.

The correcting teacher might play an important role in uncovering the signs of LDs of a child. The diagnosis itself is not the task of a teacher (unless having the licence for it). But the examples presented here can open the mind of the teachers to make them more sensitive to LDs.

3. About the Problems

In this section we are going to analyze the problems presented in the test. Also, we will see K. T.'s solutions to the problems.

The wording of the test is really ambiguous at some places and I translated all ambiguity I could. There is an importance of such ambiguous language in mathematics and such problems can play a role in testing someone's mathematical language skills, but this test was not meant to be like that.


1 The balancing scale is in balance when there are
– a bunch of grapes on one side and a pear and three apples on the other,
three pears on one side and two bunches of grapes on the other.
Complete the following sentences.
... ... apples keep balance with a pear.
... ... apples have the same weight as a bunch of grapes.

Problem 1 is, what I call a pseudo-equation, and it is a good way to prepare the thoughts of the so called "scale principle" for solving equation. It plays an important role in *developing* the thoughts of the pupils ([4]). One might measure

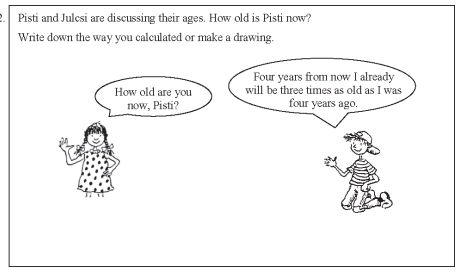
creative thinking by this problem. However, the closed form of the question (Complete...) and being the first of ten problems suggests that this is a simple problem and can be solved just by looking at it. Well, this is not the case. Here, deep understanding of the problem an analyzis are necessary. The required skills and knowledge: understanding, recognizing ratio, application, comparison, conclusion from more to one and from one to more.

The form of the problem can be questioned: the questions of the problem were not named (should have been *a), b)*). Usually (not in this case), this makes it difficult to recognize that they are actual questions one has to answer. Later we will see examples of this formal problem.

K. T. answered 3 for both the first and the second question. Maybe, he made a mistake. If you once understand the question, you make some sketches and, in worst case, you miscalculate something. There was nothing written or drawn there, only the answers given. According to diagnostics, we must think over, if there is another reason deriving from the structure of the problem. The expression "keeps the balance" is easy to misunderstand. This is out of mathematics, and the everyday expression might be outside of the understanding of a 12 year of child (especially with LDs). It is common knowledge in psychology, that if you do not understand an expression, you try to make up one from your own vocabulary, even if it means the opposite. He might have thought that keeping balance with something means that the balance is kept together with something. In this sense: 1 pear together with 3 apples keep the balance with the bunch of grapes.

In the second question a similar misunderstanding might have occurred: the weight of a bunch of grapes is the same as that of 3 apples – and a pear.

After having the suspicion of misunderstanding, one should have the possibility to clarify the mistake verbally. What does it mean...? What were you thinking of...? By having the answers, we can conclude if the problem is about understanding the given expression.



Problem 2 has a complex formal structure. It is set in a dialogue context, however, there is no actual conversation going on. The girls' question is the question of the problem given above. The sentence about the children having a conversation does not play an important role. The drawings distract the attention of the pupils. The problem can be reduced to one question: How old is Pisti now, if 4 years from now his age is going to be three times as much as his age was 4 years ago?

The problem can be solved by arithmetic consideration or by using the proper drawing.

K. T. did not give an answer to this problem. Could understanding the redundant text cause him a problem?

3. There are cubes and marbles in a box. Each piece is either red or white. We pick eight pieces at random. Two of them are cubes, three of them are red.
Put an * into the appropriate fields.

		Certainly true	Could be true but not sure	Impossible
a)	There is a red marble amongst the picked pieces.			
b)	Exactly three picked marbles are white.			
c)	We can find a red cube amongst the picked pieces.			
d)	All picked marbles are white.			
e)	At least three picked marbles are white.			

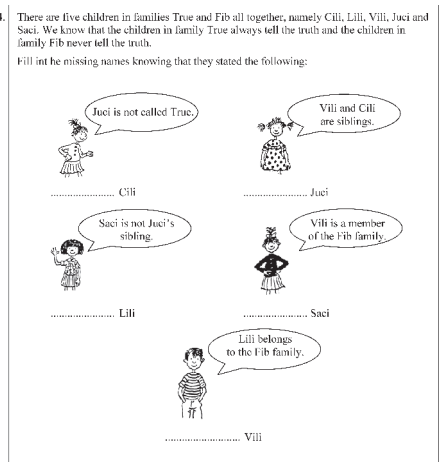
In problem 3, besides understanding it, thinking and logic methods play an important role: pigeon hole principle and modelling (examples and counter examples). In the text of this problem we learn 5 properties of the 8 objects picked. This definitely is a contradiction for a child with LDs. Compensating, he corrects the text: there were actually only 5 pieces picked. The text was also criticised by the university students. They had objections, like: just because there are 3 red pieces, it does not mean that exactly 3 of the picked pieces are red.

I presume that the errors K. T. made arose from his correcting: the 8 picked pieces were actually 5. Two of which were cubes (of white color), and 3 of them were red (marbles).

And in this sense his solution was perfect. But the teacher correcting the solutions does not have the chance (ability?) to consider any options, K. T.'s solution was marked incorrect. I also believe that many children made the same mistake, not only ones with LDs. If something controversy pops up, children correct according to their experiences.

Problem 4 has a far too decomplex structure. Usually, such logical problems are solved using case separation. We presume something, and keep our presumption up until we encounter a contradiction, then we drop the presumption.

However, if we do not encounter a contradiction, we might make other presumptions during the solution of such a problem. At the end, we have to check all the possibilities to find all correct solutions. (There are, of course, other ways for solving this problem.)



This problem is made more difficult than the problems children of this age usually are used to. Not only the logical value of the statements are to be checked, but also if it suits the persons' name. And when changing the value of a statement, the name of the person saying it has to be changed as well.
University students found this problem far too complex, and impossible to think over thoroughly in such a short time.

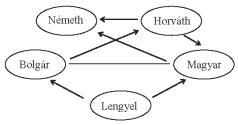
We will never learn K. T.'s way of solving this problem, since he did not write anything. He just gave the last names (all but one wrong). He would have reached a better result if he had given all five children the same name. Most probably, he did not just guess the answers. What could have been his thoughts then?

Obviously, he didn't take into consideration that his presumptions had affects to his earlier presumptions. Most probably he presumed that Cili was telling the truth, ignored the 'not', and according to it he filled in the names, just as they occurred.

He didn't even bother to check the case when Cili was fibbing, which – according to those who put this problem into this test – seems to be quite acceptable.

In problem 5, understanding the text plays an important role. For some reason, I (and most of the students) thought it would have been more natural if

5. On a chess tournament there are five players called Bolgár, Horváth, Lengyel, Magyar and Németh. The competition is not over yet. The figure shows the results of the games played so far in such a way that the arrow points at the winner. In case of a tie, there is now arrow on the line joining the players. A player gets two points for winning, one point for a tie and zero points for losing.



a) Who is in the lead at the moment? .....

b) Who is the las tat the moment? .....

c) How many matches are yet to be played? .....

Completing the figure, give a possibility when, at the end, there is a tie on the first and on the second place as well (that is, two players have the same point on the first place and two have the same points on the second place).

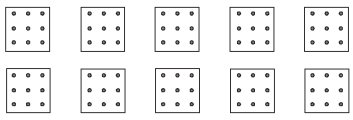
the arrows pointed at the person defeated. The line for tie was easy to mix with the starting of an arrow. This made it more difficult to count automatically the point values the players got.

The first three questions (*a), b), c)*) concern understanding (Bloom). The fourth question – surprisingly – did not get a name (*d)*). Also, it is quite a difficult question for this age group. For a systematic answer, first we have to see that each match is worth 2 points. Altogether there are 10 matches, so 20 points can be achieved. The distribution of the points at the end can only be 5-5-4-4-2. For this, you need evaluation (Bloom).

From K. T.'s solution one can see that he misinterpreted the meaning of the arrows. In this sense he answered the first three questions correctly. Sadly, this way he never got a point. Also, he skipped the last question. Was this perhaps because it wasn't named?

6. Draw triangles with two equal sides **of different sizes** into the squares below whose vertices is one of the nine points given.

Find more solutions. (There are more figures than possibilities.)



Problem 6 asks about shapes of different sizes. Those who put this question into this test thought 'size' meant the same thing for everybody, but it does not. On the contrary, it is obvious that size can mean a lot of things. This problem was to test combinatorial skills with geometry perception (used wrongly).

K. T. found two types of triangles 'of different sizes', and drew them in different positions, systematically. He did not think that the triangles of the same length of sides were the same when drawn in different positions.

7. Put the appropriate sign (< ; = ; >) between the given amounts.

a) 6950 g ..... 69,5 kg

b) 2,74 km ..... 2470 m

c) 93 m^2 ..... 930 dm^2

d) $\frac{4}{5}$ hour ..... 48 min

e) 71 000 cm^3 ..... 71 m^3

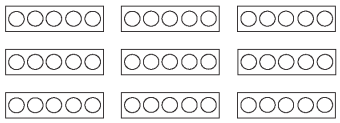
Problem 7 was about comparing measurements. This is the only problem which is purely "checking knowledge" (Pálfalvi, [2]), with some calculations. The required level of problem solving according to Bloom is "knowledge". In part *b)* of this problem some minor conversion was needed. In parts *a)*, *c)* and *e)* all digits of the measurements one had to compare were the same. However, in question *b)* two neighbouring digits were exchanged. This causes a problem for children with dyslexia (a type of LD). Many of the university students made a mistake because of this. Was checking dyslexia the aim of those putting together the test? I doubt it.

K. T. has given the right answer in question *b)* and made a mistake in all of the other questions. We do not know the reason.

8. Everybody in the class got three blue (k) and two red (p) disks. They were told to put them in a row avoiding the two red ones being beside each other.

Find as many possible orders as possible. Put the appropriate letters into the disks. (There are more figures than possibilities.)

E.g.:



Problem 8 is a combinatorial one, and the only difficulty is keeping in mind that no two red discs can be put beside each other. According to Bloom, the level of solving this problem is "analyzing".

The solution of K. T. is systematic and perfect.

9. Uncle Béla spoke about his family on the fifty-year high school reunion:

"$\frac{2}{5}$ of my grandchildren are boys. Six of my grandchildren are girls."

How many grandchildren of uncle Béla are boys? How many grandchildren has he?

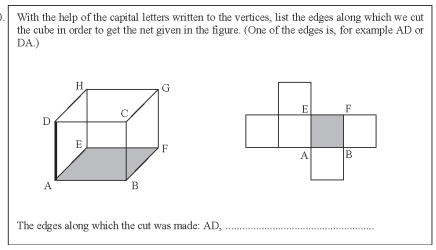
Write down the way of calculation.

Problem 9 requires a kind of a complementer point of view and the understanding the equivalence of two different types of amounts (a part and the value

attached to it) at the same time. Calculating skills play some minor role, as well. The level of solving this problem is "analyzing".

Formally, the two questions of the problems are not separated. One can only guess that both questions have to be answered.

The solution K. T. gave to this problem is incorrect. He changes the form of the fraction to decimals, and then gives the wrong answer: there are 8 grand children. No reasoning can be found on his paper.



Problem 10 is suitable to test spacial vision. The operation needed for solving it, according to Bloom, is "understanding".

K. T. misses an edge from the list, and one edge is added incorrectly. Apparently, one point is taken away for the wrong answer. This is very unfortunate, the wrong answer is probably caused by a mistake, not because of cheating. K. T. had not completed the drawing, he had not written the names of the points on the drawing. It appears, he made up his answers in his mind. It is clear that K. T. has a tolerably good spacial view. This might come from compensating the lack of verbal skills.

Many of the university students found this problem difficult.

4. Some possible shortcomings of the test and suggestions for improvements

The structure of the test

As mentioned before, there are some problems about the form of some of the problems. A test, of course, has to spread the results on a wide scale, therefore it is reasonable to include difficult problems as well. However, we have to take special care of not increasing the level of difficulty by improper wording of the problems.

We have to keep an eye on the typical abilities of the given age group (12 year). The questions within a problem have to be named (by letters). Questions of closed form suggest a simple solution, apply it only when that is the case.

The content of the test

According to the content, this test is quite difficult. There are too many problems, there is too little time, and some of the problems are far too complex. The test was assembled in 2003. Many years have gone by, tests have changed. But this was not an entering test exam for special math classes. It was designed for ordinary classes. Half of the problems concern "thinking methods" (or "thinking skills"), which is for introducing pupils into mathematics and developing their thinking, and not something one should test to this extent.

The time frame of the test

It is quite impossible for a twelve year old to solve all problems in 45 minutes. This results in a frustration. Children will have a bad feeling about themselves and their skills. Also, such a short time makes them less careful, less thorough in solving the problems and writing the solutions.

From the point of view of a child with LDs

A child with LDs most certainly will perform below average. Besides the frustrating time frame, they have to deal with problems such as reading and understanding the text, difficulty in written communication, etc.

True, they are entitled to work for a longer time (once their LDs have been diagnosed), but working for 75-90 minutes is no real solution: it is a challenge for every child at this age.

Understanding the wording of the problems, verbalizing the connections between the given data, and keeping the required information in mind is a real challenge in problem 4. Here, you even have difficulties making notes of the information you find out, because these information keep changing.

It is less challenging to make notes for problem 3, however, understanding the text and uncover the connections could cause a problem. In problems 1 and 6 understanding some expressions (keeps balance, different size) might be a hard task.

Marking the answers

In a multiple choice test it is appropriate to take away points for guessing (cheating), that is, if somebody marks the wrong answer, it is (for some) reasonable to take away points for wrong answer.

In an entering test like this one, however, it is definitely unfair: there is no use taking away points for wrong answers. One should not punish mistakes. They can also be caused by misinterpreting the question or by the flaw of the test.

The teacher correcting the test should be able to see whether a pupil is guessing or not.

On the other hand, if somebody makes a mistake at the first step solving a problem, (s)he still should have the chance to get the points for the second step (as long as it is correct in itself).

The objects and tools of measuring

There are only a few problems in these test which measure actual knowledge. Solving most of them require some tricky thoughts. Tricky thoughts might be very important but should not take such a large chunk of a nation wide entering test.

"Thinking methods" (thinking skills, to be precise) have other, more important aims rather than an object to measure ([4]). When discovering something, the child goes through an emotional experience which helps him to remember the result. But there is no time to discover mathematics again and again, and emotional ties can be created in other ways, as well (like the more interesting wording problems).

Analyzing the test from the *cognitive point of view,* the text can and should be simplified and clarified at several points, reduction of ambiguity would be necessary. Understanding the test as it is now might be a problem for *all* pupils, not only for those with LDs.

Problem 4 is very interesting and entertaining, but is not suitable in a test like this. It does not measure anything that should be measured (see later). There are several problems for testing thinking skills. One such a problem would have been quite enough.

The last question of problem 5 seems to test combinatorial thinking. This, however, is measured by problem 8 as well. Also, this question is not easy to answer (trial and error is the best, however time consuming method).

Problem 1 can easily be solved by the scale principle children learn later anyway. The problem in grade 6 can be solved by comparing amounts, concluding from one to more and from more to one. For this, however you have to make notes, for which you should have more room on the paper. Also, the questions of closed form suggest that there is no need to write or draw. If, however somebody chooses to draw, he can find that reproducing the drawings is a tough task.

In problem 2 there is a lot of unnecessary information. The problem actually is not a conversation, the girl is an unnecessary persona there. The drawings are unnecessary as well. I really would like to understand why the form of this problem.

Particular thoughts about problems 1 and 4

No matter, how interesting and exciting problems 1 and 4 sound, they are not suitable for such a test.

Both problems 1 and 4 are covered by – what we call – thinking methods (or skills, rather), according to the Hungarian mathematics curriculum. "Thinking methods" is not at all a topic in mathematical sciences, rather an objective to help children get used to more complex mathematical thoughts, thus acquiring enough knowledge for understanding more abstract conclusions.

Problem 1 (in higher classes) can be solved by using the scale principle (a general method for solving equations). Such "pseudo equations" are a good tool to make children playfully understand the principle itself. If a child is aware of the principle, problem 1 is easy to solve. Otherwise, it is barely possible, especially in 4.5 minutes.

One problem of this kind in an entering test would not express high expectations, but five of them do. It is not a sheer coincidence that on Pisa tests, e.g. you do not find problems testing such thinking skills.

Problem 4 can be solved using formal logical tools or graph colouring, in higher mathematics. Revealing the contradictions between some statements and finding true/false statements plays a role in understanding indirect proofs in mathematics. The double way of thinking (referring to both statements and names) makes the model of this problem far too complex for this age group. Unifying the solution (if found any) causes further problems. All this takes too much time and too much effort. Thus, there is no place for such a problem in this test. (In spite of that, I have to admit that the problem in itself is very catchy.)

We give a more or less formal logical solution to the problem. Let X denote that X is telling the truth. (X is C, J, L, S, V – the initials of the children.)

The statements of the problem are:

(1) $C \equiv \neg J$, (2) $J \equiv (V \equiv C)$, (3) $L \equiv (S \equiv \neg J)$, (4) $S \equiv \neg V$, (5) $V \equiv \neg L$

We can consider two disjoint and contradicting cases and discuss them. Or, we can notice that from statements (4) and (5) it follows that L and S are siblings. Thus, from statement (3), J is called Fib. If so, then from statement (1) C is

called True. From statement (2) V is called Fib. We can conclude from statement (4) that S is called True, and so is L.

Cili, Saci, Lili are telling the truth and are called True, Juci and Vili are fibbing and are called Fib.

This, obviously, can not be expected from a twelve year old child.

(We did not use another obvious conclusion: V is Fib from (1) and (2): C is contradicting J, who states that $V \equiv C$. From this we can conclude that S is True, L is True, J is Fib, C is True.)

My suggestion for a possible test

Knowing the flaws of the test: there are too many problems (for the given time frame, which is just correct), it does not test knowledge thoroughly; there are topics multiply covered; there is too much of thinking methods tested; some formulations are ambiguous, we can try to improve it.

1. The number of problems has to be reduced (see Table 1).

The topics measured by each problems: 1.: knowing basic arithmetics; 2.: knowing fraction operations, logic; 3.: comparing measurements; 4.: basic logical conclusions; 5.: reading, understanding graphics; 6.: combinatorial thoughts, recognizing a given geometric concept; 7.: combinatorial, arithmetical thinking; 8.: spacial vision

2. The wording of the problems should be thought over. It does not mean that we should give up measuring useful knowledge. (See Table 1.)

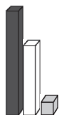
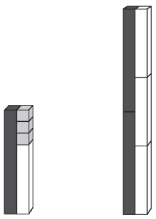
5. Signs of LDs in K. T.'s test

In some countries more and more attention is paid to the importance of recognizing learning disorders of students.

In [6] we can read the common definition of LD:

"The hallmark sign of a learning disability is a distinct and unexplained gap between a person's level of expected achievement and their performance. Learning disabilities affect every person differently and they present differently at various stages of development. LDs can range from mild to severe and it is not uncommon for people to have more than one learning disability. In addition, about one-third of individuals with LD also have Attention-Deficit/Hyperactivity Disorder (ADHD). While LD and ADHD can share common features, such as difficulties with concentration, memory, and organizational skills, they are not the same types of disorder. Unfortunately, LD is often confused with ADHD and is frequently

Table 1. Formal changes to questions

New num.	Orig. num.	Suggestion in changing the text
1.	2.	Simpler wording according to the age group, omitting the conversation, the redundant question and the graphics *Four years from now Pisti is going to be three times as old as he was four years ago. How old is Pisti?*
2.	9.	The two questions should be marked by letters (a) and (b).
3.	7.	Question (b) should have the same digits on the two sides, or the numbers should be completely different.
4.	3.	Text should give somewhat more details. *There are cubes and marbles in a box. Each and every one of them is red or white. We picked eight pieces at random. Two of the picked pieces are cubes, the rest are marbles. Three of the picked pieces have colour red, the rest is white.*
5.	5.	Changing the direction of the arrows, changing the style of the lines for tie matches to dashed. Question four should be omitted.
6.	6.	Clarify the expression "of different size". *Draw triangles on the grid that have two sides of equal length and whose vertices are picked from the grid dots.* ***The triangles drawn should have different shapes and size, independently of their position on the grid.*** *Find as many solutions as you can. (There are more grids than possibilities.)*
7.	1.	Simpler wording and graphics according to the age group. *We build towers of black white and green rods. Each rod has a length and a width of 1 cm.* *Rods of different colours have different height, rods of the same colour have the same height.* *– The black rod in itself is as high as a white and three green ones together.* *– The tower of two black rods is as high as the tower consisting of three white rods.*   *(a) How many green rods are needed to build a tower as high as a white rod? (Do not measure it on the figure.)* *(b) How many green rods are needed to build a tower as high as a black rod? (Do not measure it on the figure.)*
8.	10.	

mistaken as laziness or associated with disorders of emotion and behavior. A careful and thorough review of concerns, with input from multiple sources (including parents, educators, physicians, psychologists, speech-language providers and, of course, the person themselves) is the only way to rule in or rule out a learning disability."

The behaviour and the performance of a child with LD does not constantly and necessarily differ dramatically from those of the others.

Psychological research shows that a significant proportion of children with LD compensate, therefore the (not necessarily existing) physical signs of LD often remain unobserved. It can also happen that while LD causes problems in some respect, in other areas results in outstanding performance. In my work I had the opportunity to monitor the education, the behaviour and school performance of some children (diagnosed) with LD.

The integration of children with LD into the education system takes place within the framework laid down by law. Uncovering LDs, however is incidental (also, it is not clear whose duty it is). I presume that it turns out only rarely (or far too late) of a child if he or she has LD. Treatment of the LD – perhaps due to the lack of adequate practical experience – is only superficial, or even unresolved, thus teachers are generally clueless.

In Hungary, pupils diagnosed with LD have the opportunity to take special courses with special educators. These educators only occupy children who have their problem diagnosed. However, it can happen that pupils having LD feel they do not need to take the special courses, they do not need special handling as they do not percept their own disability. Thus they skip special classes. Schools for children with LD are not frequent in Hungary.

According to the school system here, it is mostly the teacher who has the possibility to recognize the signs of LDs. In rare cases, parents initiate the examination of their child, in which case it is not always accepted well amongst the specialists. Recognizing LDs is not easy, since the symptoms vary and it is difficult to make a difference from other problems. When the teacher notices that the performance of a student is worse than expected or is just controversy, it is up to him/her to decide whether to check what is behind it. There is a further problem in mathematics. Namely, that getting to a new topic, it often occurs that some students become more/less interested. That is not a sign of LDs. It is only a sign that our students are not alike. We have to take that X is better in geometry while Y prefers algebra, etc. It is less frequent that we notice that one of our students communicates better verbally than in writing, or is able to think well but cannot communicate his or her thoughts. However, it would make a teacher happier if (s)he found out that her/his students are actually good at mathematics, they only cannot communicate properly. The teacher's frustration reduces and the student might experience more success.

It is somewhat baffling that K. T.'s test contains so many *almost good* answers. It is a sad thing though, that he got 0 points to almost all of his solutions. His solution to problem 8, however, is completely correct. This was the point where I started to search for the reasons of the failure of this pupil. My conclusion was that there is a possibility that K. T. has LDs. My aim is to share my conclusions. Of course, I can not diagnose LDs and also, it is not my task. But I could recognize that there is a chance that K. T. needs to be checked.

In problem 1 he gave an answer difficult to understand, he made no drawings. He obviously did not think that the problem was hard to solve. The problem being the first, the questions given in closed form must have suggested him that this is an easy question. He must have presumed that all he had to do was reading from the drawings. Also, he must have misunderstood the expression "keeps the balance". Of course, seeing what the other pupils answered would help us telling whether "keeps the balance" was understandable. (Here we see a possible sign of a communication problem.)

He did not give a solution to problem 2.

His answers to problem 3 can only be considered correct (but then entirely correct) if the number of pieces picked was 5, 2 of which being (white) cubes and three being red (marbles). The wording of the problem is a general every day text but understanding the mathematical content requires experience and routine. University students agreed on this. (A possible sign of a communication problem, but it could be a problem for other pupils as well.)

His answers to problem 4 point at the fact that he kept on concluding the standard way (according to his possible previous experience) forgetting about the "double way of thinking".

One could see from his answers to problem 5 that he could not keep the information read in mind for a long time, since he misinterpreted the meaning of the arrows (according to which misinterpretation he gave the correct answers). Anyway, the meaning of the arrows (according to many university students) seems to be somewhat more logical the other way. K. T. did not answer the last question. It could be caused by the fact that (unlike the first three questions) it was not marked by a letter. (A possible sign of an LD.)

In problem 6 he drew many triangles of the same shape (or should I say size), but at different positions on the grid. The wording was questionable by the university students as well. (A possible sign of a communication problem.) This could cause a problem to many children not having LDs.

Problem 7 was a complete mixup of dimensions for K. T. I believe, he has problems with measurements and units.

His solution to problem 8 is correct, and even systematic.

In solving problem 9 he converted the fraction into a decimal fraction and gave an answer that had nothing to do with either of the questions. He did not answer the first question. It is possible that after having read the last question, he forgot about the first one. (A typical possible sign of a communication problem.)

His solution to problem 10 was partial. He did not make any drawings, however and did not name the points on the graph on the right hand side. He tried to solve the problem in mind. (Strangely enough, this could be caused by a communication problem, as well.)

In several problems (1, 2, 9) there would have been a possibility to use a drawing to interpret amounts but K. T. did not make drawings at all. Had he made a drawing but no conclusion about the amounts, it could have been a sign of dyscalculia ([5]).

6. Conclusions and further researches

So what is the reason of failure?

If most pupils had poor results, it is the test, that failed. It could be the problems, it could be the guide for correcting the test. Entering tests should focus less on thinking skills, it is rather in the scope of mathematical contests.

If children in general had satisfactory results, we still have to find the reason why others failed.

It could be the lack of knowledge or the lack of thinking skills. But it could also be the lack of proper communication which is a possible sign of LD.

It would be salutary to make a test that does not put too much stress on children with LDs.

A child with LDs takes his state naturally (as it is the case for disabled persons). He is not aware of the things he is unable to percept or do. Therefore, he is not going to ask for help. On the contrary, he refuses help if it is not coming discretely with patience, and the professional way. It is the task of the educators to approach tactfully, otherwise the child will not accept it. Preparing teachers for this task is not entirely solved in Hungary.

I do not mean to say that K. T. is excellent in mathematics. On the contrary. *With this test, K. T. had no chance to show what he knew.* I only state that some of his errors might have come from some kind of an LD.

Why is it important to keep an eye on children with LDs? There are many reasons. One possible approach focuses on their future and their role in society. If, due to their LDs they are fallen back in their studies, their possibilities in future studies reduce and have less chances when getting a job. There is even a danger for them to be marginalized. Another possible approach considers their mental balance. The self-esteem and the mental health of our children, ultimately, our society is very important.

Further researches could include checking how these types of tests have changed during the last decade. Also, it would be interesting to check how pupils would perform in the suggested corrected test as opposed the original test.

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References

[1] `http://www.oktatas.hu/pub_bin/dload/kozoktatas/beiskolazas/feladatsorok/2003ev_gimn6_8oszt/M16.doc`, Downloaded: April 1, 2009.

[2] J. Pálfalvi, *private communication*, 2014.

[3] B. S. Bloom, M. D. Engelhart, E. J. Furst, W. H. Hill and D. R. Krathwohl, *Taxonomy of educational objectives: The classification of educational goals*, Handbook I: Cognitive domain, New York: David McKay Company, 1956.

[4] J. S. Bruner, *Új utak az oktatás elméletéhez*, Gondolat, Budapest, 1974.

[5] S. Dehaene, Downloaded March 14, 2014 (in Hungarian), `http://dyscalculiaport.blogspot.hu/2012/10/meret-es-mennyiseghatas.html`.

[6] `http://www.ncld.org/types-learning-disabilities/what-is-ld/what-are-learning-disabilities`, Downloaded March 25, 2014.

[7] Private communication, 2009.

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