



# Screening 0+

## Handbook for teachers



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## Forword

This manual is designed to support you in administering the DiToM 0+ screening and in using the test results effectively with your class. On the following pages, you will find:

1. a brief introduction to the aims and guiding principles of the Erasmus+ project DiToM;
2. detailed, step-by-step instructions for conducting DiToM 0+ in the classroom;
3. concise explanations of each task in DiToM 0+, including notes on possible support strategies
4. for children whose screening results indicate learning gaps in key mathematical competencies;
5. guidance on how to evaluate and document the results.

The administration guide (Section 2) and the evaluation tables (Section 4) can also be downloaded separately as individual PDF files from <http://www.ditom.org/>

We recommend printing the administration guide double-sided and spiral-binding it. In the booklet that you will get, you can keep the teacher-facing page for reading the instructions aloud, while the page facing the children often includes an example that helps you explain what the children are expected to do.

## 1 Aims and guiding principles of DiToM

Mathematics learning progresses in stages: new knowledge builds on secure prior understanding. When fundamental ideas and concepts are missing, students find it increasingly difficult to grasp and make sense of mathematical content that builds upon that foundation. Both national and international studies show that a significant proportion of students already fail to meet the minimum standards in mathematics at the primary level—and, for the reasons described above, almost inevitably continue to struggle in secondary school. Alarming, many young people finish their compulsory education without having achieved the basic level of mathematical literacy that, according to the OECD, is essential for “full participation in social life.”

To counteract this, teachers must first be able to identify mathematical learning difficulties—ideally early and as precisely as possible. Only on this basis can targeted support measures be taken. This is precisely where the EU project Diagnostic Tools in Mathematics (DiToM) comes in. In a partnership between Germany, France, Greece, Croatia, Italy, Sweden, and Spain, five interconnected screening instruments were developed. These tools enable teachers, at the end or beginning of a school year, to gain a concise overview of which students are at risk of falling behind in mathematics if they do not receive targeted support measures.

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The screenings follow a two-year cycle:

- **Screening 0** – Beginning of primary school
- **Screening 2+** – End of Grade 2 / Beginning of Grade 3
- **Screening 4+** – End of Grade 4 / Beginning of Grade 5
- **Screening 6+** – End of Grade 6 / Beginning of Grade 7
- **Screening 8+** – End of Grade 8 / Beginning of Grade 9

### What are the DiToM screenings and what do they achieve?

The five screenings are paper-and-pencil tests focused on key mathematical competencies that should be secure at the start of a grade level for new content to be learned with understanding. Each test can be administered to the whole class within a single lesson and, using the provided

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scoring tools (see Section 4), evaluated with relatively little time investment. The results give teachers an initial structured overview of which children are likely to need additional support in particular areas.

The word “likely” is crucial: a screening does not replace an individual, qualitative assessment of a child’s learning status. At best, it provides initial clues as to what strategies or solution approaches a child may have used. More detailed understanding requires targeted observation and one-on-one discussions, using more finely differentiated tasks. The screening, however, can serve as a valuable starting point to determine which children would benefit most from such follow-up assessments.

### **What are “key mathematical competencies”?**

As noted earlier, school mathematics is characterized by an “internal learning hierarchy” (Wittmann, 2015, p. 199). This is particularly true in the domains of arithmetic (numbers and operations) and algebra—the very areas that DiToM screenings intentionally focus on. In these domains, it is possible at every learning stage to identify key competencies—those without which further learning cannot take place meaningfully and sustainably.

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For example: To work successfully with natural numbers, children must understand them in terms of the part–whole concept—a developmental process that should be completed during the first school year. The part–whole concept means, for instance, that the number seven is understood as a whole composed of parts—five and two, four and three, one and six, and so on. This understanding should then become automatic: a child should no longer need conscious effort to recognize five as the missing part of seven when two is given as the other part. In other words, children should automatically think of numbers in terms of their decompositions and relationships. This combination of understanding and automation is characteristic of many key competencies: only once certain skills are automatic can mental capacity be freed up to tackle higher-level mathematical challenges.

Whether the key competency of “thinking of numbers as compositions” (or “number decomposition”) is well established can be seen, for instance, in a child’s calculation strategies. A child who thinks of seven as five and two will solve  $7 - 5$  effortlessly, even in the first school year, without counting. Children who lack this competency, however, often continue to rely on

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laborious, error-prone counting strategies well into later primary and secondary grades. Counting-based addition and subtraction soon become unmanageable when two- or three-digit numbers are involved. Such children also struggle to use relationships between multiplication facts—for instance, recognizing that  $9 \times 6$  is six less than the easily remembered  $10 \times 6$ . Deficits in one key competency (understanding numbers as compositions) thus hinder the acquisition of others (addition, subtraction, multiplication), which in turn are prerequisites for more advanced skills (division, proportional reasoning, etc.).

This chain continues beyond primary school: students who struggle with natural numbers will face even greater difficulties with fractions and decimals. Algebra, later on, builds on insights that should have been gained from working with the basic operations in primary school. Without those insights, algebra can appear to students as an indecipherable code.

For this reason, the DiToM screenings focus on key competencies—those that should be securely established at the start of Grades 1, 3, 5, 7, and 9, so that further mathematical learning can proceed successfully.

### **After administering the DiToM screening – what’s next?**

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Using the evaluation tools described in Section 4, teachers create a table (Excel or paper) that can be read in two directions:

- Across rows: Each child’s results show which tasks were solved correctly, partially correctly, incorrectly, or left blank—resulting in an overall score for that child.
- Down columns: For each task, the table shows how many children solved it correctly, partially correctly, incorrectly, or not at all.

#### **With a view on individual students:**

DiToM is not about labeling children. The screenings are not designed to identify students with “dyscalculia.” Clinical diagnoses of that kind do not address the core question that DiToM seeks to answer: How can teachers best support children struggling with key arithmetic competencies? Targeted support requires an accurate understanding of each child’s current learning level. DiToM helps identify those for whom such detailed assessment is urgently

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needed—nothing more, but also nothing less. Section 3 provides brief notes on what kinds of follow-up support may be helpful for each specific task.

The “critical threshold scores” given in Section 4 were determined based on trials of the DiToM screenings with 8,820 children across the seven partner countries. Using latent class analysis (see Livingston, 2014), children were grouped as follows:

- Group A: Children showing widespread difficulties across several key competencies.
- Group B: Children showing indications of difficulties in specific areas.
- Group C: Children showing no major indications of difficulty.

It is important to remember that any screening captures only a snapshot. Some children may simply have had a bad day or been distracted, others might have—despite precautions—copied answers. Screening results should therefore be interpreted cautiously. They should always be compared with observations from daily classroom, and used as a prompt for further targeted observation and followup tasks in the coming days and weeks.

If it becomes clear that a child falls into **Group A**, there is reason to expect that their mathematical difficulties will worsen over the school year unless timely and effective interventions are implemented. Section 3 can only suggest general directions for such interventions, based on the key competencies assessed by each task. For more extensive guidance, teachers must refer to the relevant educational literature.

Children in **Group B** are also likely to need targeted support in at least some areas to progress successfully in their learning. It is worth remembering that all screening tasks assess key competencies. The screening is intentionally designed not to distinguish among high achievers—ideally, most children should find the tasks quite easy. Therefore, any errors made by **Group C** children on individual tasks should also be taken seriously, as they may reveal gaps in key foundational skills.

### **With a view on the class as a whole:**

The latter applies particularly when the results show that multiple children struggled with the same task. This may indicate that they have received insufficient or unfocused practice with that competency, either in their prior schooling or before entering school. In such cases, it is all the more important that these learning opportunities now be provided, even if the

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curriculum has already moved on to new content. Again, it is important to take into account the hierarchical structure of mathematics learning: each level depends on secure understanding of the foundational competencies before moving forward.

## 2 Instructions for administering Screening 0+

Screening 0+ is designed for use with the entire class at the beginning of Grade 1. It comprises the following tasks:

- 1 Translating number words into numerals
- 2 Perceptual subitizing
- 3 Conceptual subitizing
- 4 Emerging part-whole understanding
- 5 Comparing sets
- 6 Ordinal understanding (number after)
- 7 Counting
- 8 Ordinal understanding (number before)
- 9 Counting out a quantity

The following section provides detailed, task-by-task instructions on what to tell the children before and during the administration of the test.

These instructions are also available as a **separate PDF file for download**, expanded with sample and blank pages for printing. If you print this file double-sided and bind it with a spiral, you will have a booklet from which you can read the instructions aloud during the test and refer back to key points to keep in mind during administration. The additional pages included in the print version allow you, by turning the left side of each double-page, to hold up the booklet and read the instructions from the page in front of you, while the children can see the corresponding example task on the back of the booklet.

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**Before and during the distribution of test booklets**

Tell the children that at the end (Preschool) / beginning (Grade 1) of the school year, that you would like to find out, what the children already know and can do.

Inform them that each of them will receive a little booklet with tasks to solve and that you will guide them through the tasks and tell them what to do.

Explain to them that it is important that they do the tasks by themselves and that it is not helpful, if they copy from their neighbours, because in their booklets there are different tasks. Stress that it does not matter, if they do not know the answer for some tasks.

Tell the students to use a pencil. Explain that using a razor takes too much time and show them on the board what to do, when they realise that they have written something wrong: Cross out what is wrong and write the correct answer above, below or next to it.

Tell the children that you will lead them through the tasks one by one and that you will explain what to do for each task. **Ask them NOT to go ahead by themselves.**

Explain to them, that it is important that they pay attention and listen carefully to your instructions. To help them solve the tasks, you will give an example to the whole class, before they work on the tasks by themselves.

Make sure that all desks are empty, and that each child has only a pencil in front of them.

Tell the students that you are about to hand out the booklets and **stress that for the moment the booklets will stay closed** on their desks until you ask them to open them.

Now hand out the booklets and invite the students to write their first name and class on the front page.

**Please note:**

- The dot pictures related **Item 2** and **Item 3** are not the examples but belong to the task. Only show these dot pictures when it is pointed out in the instruction.
- For **Item 4** you can choose between two versions. Only do one version and skip the other. **Do not do both tasks.**

Furthermore, there is **no example**, so the picture of the hand and the candy, i.e. option A (alternatively of the pencil case and the coloured pens, i.e. option B) belongs to the task. Show it when pointed out in the instruction.



### 3 Explanations and suggestions for support regarding the single tasks of DiToM screening 0+

#### Task 1: Translating number words into numerals

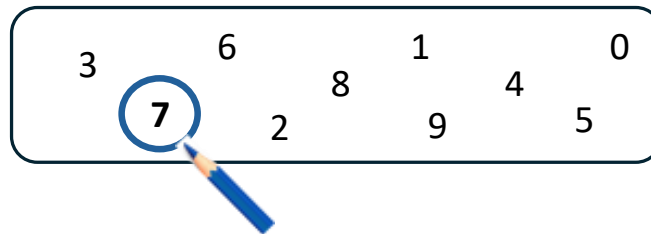
##### Example

“Look at this box.”

→ *Point to the box in the example.*

“We wanted to find the number 7. Here it is.” → *point to the number 7*

*We found the number 7 and we made a circle around it.*



#### Screening tasks 1a - 1d

“Now I want you to circle some numbers . Please turn your page.”

**1a:** “In the top corner you see a little **horse**. That is the right page. Now look at the numbers and circle the number **2**. Look for the **2**.”



**1b:** “Now turn over your page until you see a **cat** in the top corner. The next number to find is **5**. Find the **5** and circle it.”



**1c:** “Well done. Turn your page over and you will see a **bird** in the top corner. Find the page with the bird. Now look at the numbers and circle the number **6**. Find the **6** and circle it.”



**1d:** “One more number. Turn over your page and you see a **fish** in the top corner. We are looking for the page with the little fish. The last number to find is **9**. Find the **9** and circle it.”



“Well done. Please put your pencil down on your desk. We will do something different now.”



## Task 2: Perceptual subitizing

**No example for this task!**

### Screening task 2

“Now please turn the page over and you will see a **star** in the top corner. You see the star? That is the right page.”



“In a moment I will show you a picture with dots. But I will show it only once and only very quickly. So, you must pay attention. All eyes on me.”

“Once you know how many dots are in my picture, I want you to find that number in the box and circle it.”

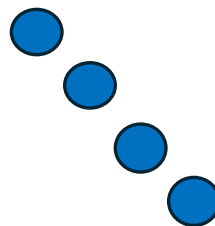
“Do not call out the number so that all the others can hear. Keep it to yourself.”

“Ready? Look at the picture and circle the right number on your page”

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“Ready, set, go!”

Show the picture with the dots  
for just **1 second!**



“Now circle the correct number.”

“Well done. You can now turn over to the next page.”



### Task 3: Conceptual subitizing

**No example for this task!**

#### Screening task 2

“Now please turn the page over and you will see a **sun** in the top corner. Look for the page with the sun.”



“In will show you another pages with dots. Look at me and pay attention.”

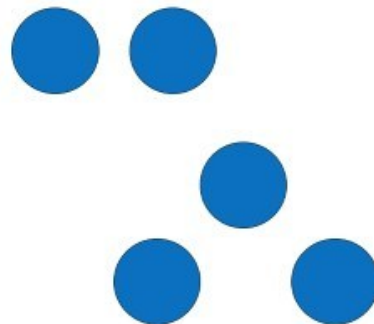
“Again, I want to know how many dots you saw”

“Remember: Do not call out the number so that all the others can hear. Keep it to yourself.”

“Ready? Now look at the picture and circle the right number on your page.”

“Ready, set, go!”

Show the picture with the dots  
for just **1 minute!**



“Now circle the correct number.”

“Well done. Please put your pencil down on your desk. I will show you another picture.”



## Task 4: Emerging part-whole-understanding – Option A

**No example for this task!**

### Screening task

“Look at this picture.”

→ *show the picture for Item 4*



“Now there are **5** candies altogether.  
You can see **3** candies here”.

→ *point out the 3 candies*

“And some are hidden in the hand. We cannot see how many are  
hidden in the hand”

→ *point at the hand*

“How many are hidden, if there are **5** candies altogether? Don't call  
out the number!”

“Instead, circle the right number in the box.”

“Once you are finished, please put your pencil on your desk.”

“We move on to the next task now.”



### Task 4: Emerging part-whole-understanding – Option B

**No example for this task!**

#### Screening task

“Look at this picture.”

→ *show the picture for Item4*



“Now there are **5** pencils altogether. You can see **3** pencils here”.

→ *point out the 3 pencils*

“And some are hidden in the pencil case. We cannot see how many are hidden in the pencil case.”

→ *point at the pencil case*

“How many are hidden in here, if there are **5** pencils altogether? Don’t call out the number!”

“Instead, circle the right number in the box.”

“Once you are finished, please put your pencil on your desk.”

“We move on to the next task now.”

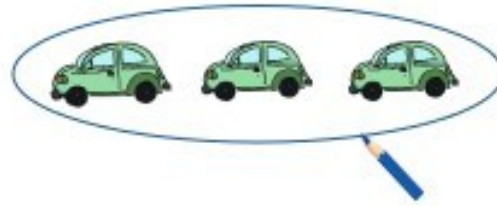


### Task 5: Comparing sets

**Example:**

“Please look at this picture.”

→ *show the example*



“You see red cars and blue cars. But there are more blue cars than red cars.”

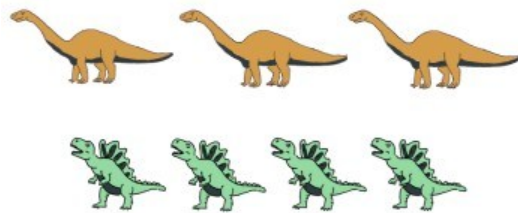
“This is way I have circled the blue cars. There are more blue than red cars.”

### Screening task 9a:

“Please turn your page over to the next task.”

“On this page you see dinosaurs.”

“One row at the top and one row below.”



“Circle the row where there are **more** dinosaurs. Where are **more** dinosaurs? In the top row or in the bottom row? Circle that row.”

### Screening task 9b:

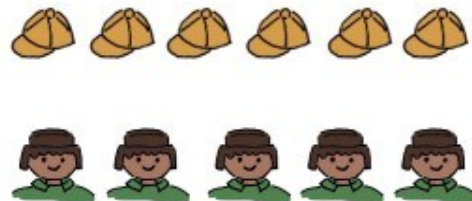
“Now please turn over to the next page.”

“Here you see caps and heads.”

“Are there more heads or caps?”

“Circle the row where there are **more. More** caps or more heads?”

“Once you are finished, please put your pencil on your desk.”



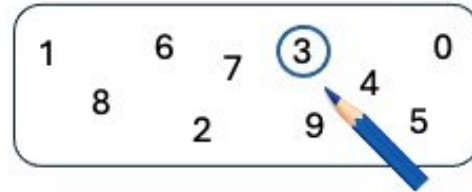


### Task 6: Ordinal understanding (number after)

#### Example

„What number comes after 2 when you count?

→ *let the students answer*



”That is right. The number **after 2 is 3**.

One, two, **three**. This is why I have circled the number 3.”

→ *hold up the example and point to the number 3*

#### Screening task

**6a:** “Now, please turn the page over and you see an **apple** in the top corner. Does everybody see the apple? Good.”



“When I count, which number comes **after 5**?

**Do not call out the number.** Circle it on your page.  
The number **after 5**.”

**6b:** “Please turn the page over and you see a **banana** in the top corner. Put your finger on the banana.”



“Now, when I count, which number comes **after 3**?

**Do not call out the number.** Circle it on your page.  
The number **after 3**.”

**6c:** “Now, please turn the page over and you see an **orange** at the top corner. Put your finger on the orange.”



“When I count, which number comes **after 3**?

**Do not call out the number.** Circle it on your page.  
The number **after 7**.”

“Once you are finished, please put your pencil on your desk.”



## Task 7: Counting

**no example needed**

### Screening task

“Please turn your page over to the next task.”

“Here you see an apple tree with nice red apples.”

“How many apples are hanging on the tree?  
Count the apples and then circle the the right number in the box.”

“How many apples are hanging on the tree?”



9	5	1	0	4
2	7	8	3	6

“Once you are finished, please put your pencil on your desk.”

“You are doing really well. Only two more tasks to go.”



### Task 8: Ordinal understanding (number before)

#### Example

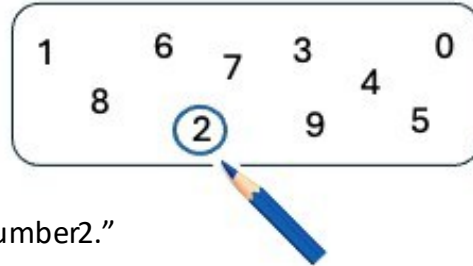
„What is the number before 3 when you count?

→ *let the students answer*

”That is right. The number **before 3 is 2.**

One, **two**, three. So I have circled the number 2.”

→ *hold up the example and point to the number 3*



#### Screening task

**8a:** “Now, please turn the page over and you see a **T-shirt** in the top corner. Does everybody see the T -Shirt? When I count, which number comes **before 6**?



**Quiet. Do not call out the number!** Circle the number **before 6** on your page.”

**8b:** “Now, please turn the page over and you see a pair of **shorts** in the top corner. Does everybody see the shorts? When I count, which number comes **before 4**?



**Do not call out the number!** Circle the number **before 4** on your page.”

**8c:** “Now, please turn the page over and you see a **cap** in the top corner. Does everybody see the cap? “When I count, which number comes **before 8**?



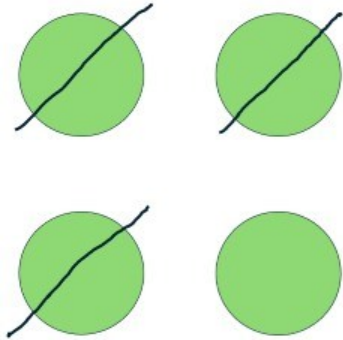
**Do not call out the number!** Circle the number **before 8** on your page.”

“Once you are finished, please put your pen on your desk. Well done. We only have one more task to do.”



### Task 9: Counting out

#### Example



“Look at these four circles.”

→ *show the example*

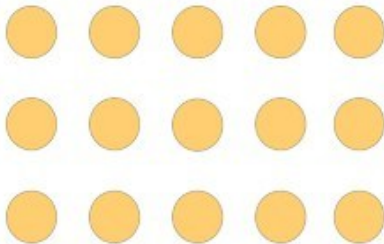
“I have crossed out 3 circles.”

→ *point to each of the three lines*

“Can you see that?”

#### Screening task

“Please turn the page over to our last task.”



“Here you see more circles.”

“Cross out **8** circles. Eight circles need to be crossed out.”

“Please cross out 8.”

“Once you are finished, please put you pencil down, close your booklet and I will come around and collect it.”

→ *After collecting all the booklets: Thank the children for their hard work and cooperation and treat them with a run around the school yard or a game!*

## 4 Notes on the evaluation and documentation of results

To help you evaluate the test results, various tools are available for download at <https://www.ditom.org/>.

If you prefer to evaluate the tests manually, we provide the following aids:

- a) An overview sheet for scoring, which lists for each task the criteria for awarding one point, half a point, or no points (see page 25);
- b) A class evaluation sheet for recording and documenting the results of the entire class (see page 26).

A much less time-consuming option is to evaluate the results in Excel on your computer. For this purpose, you can download:

- c) A pre programmed excel file with two worksheets that you can switch between via the tabs at the bottom left.

In the sheet titled “qualitative”, simply enter, in the appropriate column for each child, the numbers the child wrote in their test booklet as answers to each sub-task. If a child left an item blank, please enter 999. When you have finished entering the data, switch to the “quantitative” sheet. The program will then automatically indicate whether each sub-task was answered correctly (1) or incorrectly (0) and will calculate the appropriate score for each overall task (1 / 0.5 / 0). At the end of each row, you’ll find the percentage of correctly solved tasks and the total score for the individual child. At the end of each column, you’ll find the percentage of children in the class who solved that particular task correctly.

### The “critical score thresholds” for DiToM 0+ — and how to interpret them

As explained in Section 1, DiToM is not intended to label children. Please refer back to the discussion of DiToM’s goals and guiding principles in that section.

There you will also find a more detailed explanation of the “critical score thresholds,” which were determined based on pilot testing of DiToM (for version 0+, with 1,150 students in the final piloting across the project’s seven partner countries) using the statistical method of

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Latent Class Analysis. This method makes it possible to assign children, based on their total score in DiToM 0+, to one of the following three groups:







Score Range	Group
0 to 5.5	A - Signs of broad difficulties across several key areas
6 to 7	B - Indications of difficulties in some key areas
7.5 to 9	C- No indication of major difficulties in key areas

A final note referring back to Section 1: Keep in mind that a screening provides only a snapshot. The results should therefore be compared with your own classroom observations and experiences and, where indicated, used as a starting point for follow-up interviews with individual children — to deepen, refine, or expand your understanding, and, if necessary, to adjust your conclusions at least in part.



Screening 0+

**Evaluation and scoring DiToM Screening 0+ (max. 9 points)**

1a-d	Translating number words into numerals 	1 P 0,5 P 0 P	all 4 numbers correct ( <b>2, 5, 6, 9</b> ) at least 3 numbers correct all other solutions
2	Perceptual subitizing 	1 P 0 P	<b>4</b> was marked all other solutions
3	Conceptual subitizing 	1 P 0 P	<b>5</b> was marked all other solutions
4	Emerging part-whole understanding 	1 P 0 P	<b>2</b> was marked all other solutions
5	Comparing sets (more)	1 P 0 P	<b>both</b> parts of the task correct all other solutions
6	Ordinal number understanding (number after) 	1 P 0,5 P 0 P	all 3 numbers correct ( <b>6, 4, 8</b> ) at least 2 numbers correct all other solutions
7	Counting (apples on the tree)	1 P 0 P	<b>7</b> was marked all other solutions
8	Ordinal number understanding (number before) 	1 P 0,5 P 0 P	all 3 numbers correct ( <b>5, 3, 7</b> ) at least 2 numbers correct all other solutions
9	Counting out a quantity	1 P 0 P	<b>8</b> circles were crossed out (or clearly marked in another way) all other solutions

Please note: The scoring applies to both test versions A and B.



## References

Livingston, S. A. (2014). Equating Test Scores (without IRT). 2nd edition. Educational Testing Service.

Wittmann, E. Ch. (2015). Das systemische Konzept von Mathe 2000+ zur Förderung „rechenschwacher“ Kinder. In H. Schäfer & Ch. Rittmeyer (Hrsg.), Handbuch Inklusive Diagnostik (S. 199–213). Beltz.