

DYSCALCULIA CURRICULUM

CHANGE YOUR PERSPECTIVE:
IT'S JUST DYSCALCULIA



ENGLISH

PREPARED BY THE DYSCALCULIA CONSORTIUM

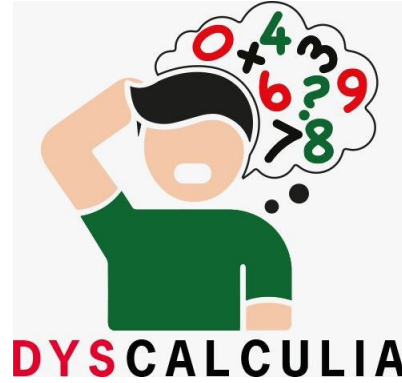
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"Change Your Perspective: It's Just Dyscalculia
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Change Your Perspective: It's Just Dyscalculia

WP2: Dyscalculia Curriculum

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Project Partners: Cukurova Ilce Milli Egitim Mudurlugu, Turkiye
Zemynos Panevezios, Lithuania
University Paderborn, Chair Business Education II, Germany
AGIFODENT, Spain
University Cukurova, Turkiye
Dalya Agency, Turkiye
Cukurova District Directorate of National Education, Turkiye



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Project Introduction

The promotion of dyscalculia at European level is becoming increasingly important, as education is seen as a fundamental building block of a prosperous society. Dyscalculia, a developmental disorder in the field of maths, significantly affects students' mathematical understanding and skills. By recognising and providing targeted support for students with dyscalculia at European level, we can take a significant step towards inclusive education and equal opportunities. These efforts not only contribute to the individual development of affected students, but also strengthen the education systems in the member states of the European Union by ensuring that all children receive the best possible conditions for their educational path. In this context, it is crucial to draw attention to the shared responsibility to create a supportive environment for students with dyscalculia and thus lay the foundations for inclusive and diverse education.

The Erasmus+ project "Change Your Perspective: It's Just Dyscalculia" has several key objectives to improve education with a focus on dyscalculia. The main objectives of the project are:

- **Improve Institutional Capacity:** With a focus on school-based education, the project aims to strengthen the institutional capacity of partner organisations. This includes refining their ability to effectively address dyscalculia and implement strategies in the school environment.
- **Inclusive education:** A key objective is to ensure that students with learning difficulties are integrated into mainstream classes. This emphasises the commitment to creating an inclusive learning environment that meets the diverse needs of all students, including those with dyscalculia.
- **Strengthening professional competences:** The project aims to strengthen the professional competences of trainers within the partner organisations at European level. This includes the provision of knowledge and skills to provide effective support to students with dyscalculia.
- **Development of dyscalculia plans:** A key aspect of the project is to design and prepare development plans specifically for dyscalculia. These plans are intended to provide a structured and comprehensive approach to address the challenges of dyscalculia in the educational context.

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To achieve these ambitious goals, the consortium will generate three main outcomes:



1. Dyscalculia curriculum and course materials: Development of a comprehensive curriculum and corresponding course materials focused on dyscalculia. This resource will serve as a valuable guide for educators to meet the needs of students with dyscalculia.
2. Dyscalculia e-learning module: Creation of an innovative e-learning module specifically dedicated to the topic of dyscalculia. This digital resource provides accessible and flexible training for educators and improves their skills in supporting students with dyscalculia.
3. Dyscalculia Quick Practice Solutions: Developing quick and practical solutions for dealing with dyscalculia in education.

This curriculum is part of the first outcome and serves as an example for the training of teachers, academicians at universities and education faculty students as well as dyscalculic students and their families.

Dyscalculia Curriculum

Welcome to the Dyscalculia Curriculum. This curriculum is aimed at teachers, academicians at universities and education faculty students, dyscalculic students and their families. Our aim is to promote a comprehensive understanding of dyscalculia and provide innovative approaches for teachers and effective learning resources for all involved.

The Curriculum is a combination of two parts: a teaching and a learning part.

Part 1: Teaching

The teaching part covers four modules:

Module 1: Development of key competences

Module 2: Diagnosis processes of dyscalculic individuals in normal education environments

Module 3: Teaching methods and techniques on the education of students with different learning levels

Module 4: Inclusiveness in all areas of education and training

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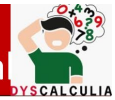
Part 2: Learning

The learning part consists of a variety of resources:

- PowerPoint presentation: A visually engaging presentation to deepen understanding of dyscalculia.
- Additional text: An in-depth text that provides supplementary information and insight.
- Additional video in English: An English-language video with additional explanations and practical examples.
- Additional video in the local language: A video in the local language to appeal to a broader participant base.
- Final short quiz: A short quiz to test the knowledge acquired.

The combination of these two parts offers innovative approaches, different teaching and learning practices and concrete examples of activities.

WP2: Contents for Dyscalculia Curriculum and Course Material



Dyscalculia Curriculum

Teaching

Learning

Target groups:
- teachers
- academicians at universities and education faculty students
- dyscalculic students and their families

Modules:
1. Development of key competences
2. Diagnosis processes of dyscalculic individuals in normal education environments
3. Teaching methods and techniques on the education of students with different learning levels
4. Inclusiveness in all areas of education and training

Course Material:
- ppt
- text
- video
- quiz

- innovative approaches
- different approaches and practices
- activity examples



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Module 1: Development of key competences

“Module 1: Development of key competences” is about the key competences which are needed as a teacher of dyscalculic students. There will be an overview of teaching and professional skills needed and how to increase them. Methodological competences are presented in order to use different approaches and practices, activity examples, teaching methods and techniques for the education of students with different learning levels. Finally, there will be an outline of how educators can develop their capacity in the long term. The curriculum is an example of how the course material can be used.

Title:	Module 1: Development of key competences
Aim of Module 1:	Teachers must prioritize the development of key competences, enhancing teaching skills, and cultivating methodological abilities. This involves adapting approaches for students with varying learning levels. Concurrently, fostering professional skills and a culture of continuous development within the teaching community is essential. By doing so, educators contribute to creating an inclusive and enriching learning environment.
Learning Outcomes	
Knowledge:	<ul style="list-style-type: none"> • Knowledge of key competences for teachers of dyscalculic students. • Knowledge of different teaching approaches and practices for students with different levels of learning. • Awareness of the importance of ongoing professional development for educators. • Familiarity with the needs and challenges of students with varying levels of learning. • Understanding of the role of methodological competencies in effective teaching.
Skills:	<ul style="list-style-type: none"> • Teaching Skills: Proficiency in planning and delivering effective lessons. • Professional Development Skills: The ability to engage in ongoing learning and improvement. • Methodological Competency: Proficiency in choosing and applying appropriate teaching methods and techniques for different learning levels. • Adaptability: The skill to tailor teaching methods to suit the needs of students with varying learning levels.
Competences:	<ul style="list-style-type: none"> • Pedagogical Competence: The ability to develop and implement teaching strategies that align with educational goals and meet the needs of diverse learners.

	<ul style="list-style-type: none"> • Collaboration Competence: The ability to work effectively with colleagues, parents, and stakeholders to enhance the educational experience for students. • Communication Competence: The ability to effectively convey information and engage with students, other teachers and families.
Activity 1	
Title:	Exploring Inclusive Pedagogy: A Course for Developing Key Competences
Learning Time:	4-5 hours
Content:	<p>Introduction (20-30 minutes)</p> <ul style="list-style-type: none"> - Overview of Module 1 objectives and learning outcomes - Discussion about the importance of key competences in teaching dyscalculic students - Establishing a collaborative and inclusive learning environment <p>Knowledge enhancement (45 minutes)</p> <ul style="list-style-type: none"> - Exploration of key competences for teachers working with dyscalculic students - Discussion on various teaching approaches and practices adaptable to different learning levels - Sharing insights into the needs and challenges faced by students with varying levels of learning - Presentation on the significance of ongoing professional development for educators <p>Skills development (2 hour)</p> <ul style="list-style-type: none"> - Prepare four working stations - Let the participants choose one of the working stations - The number of participants per station should be equal - Each station is about one key competence and contains several tasks for the participants - 1) Teaching skills station: <ul style="list-style-type: none"> o Discussion on lesson planning activities tailored for dyscalculic students o Role-play scenarios to practice delivering effective lessons for diverse learning levels o Save the results in a collaborative tool or cloud - 2) Professional development skills station: <ul style="list-style-type: none"> o Discussion on methods for engaging in continuous learning and self-improvement o Set goals for personal and professional growth o Save the results in a collaborative tool or cloud. - 3) Methodological skills station: <ul style="list-style-type: none"> o Discussion on how to enhance skills in selecting and applying teaching methods for different learning levels

	<ul style="list-style-type: none"> ○ Choose a new method you would like to try and tell the others why ○ Save the results in a collaborative tool or cloud. <p>- 4) Adaptability skills station:</p> <ul style="list-style-type: none"> ○ Discussion on tailoring teaching methods to meet the specific needs of students with varying learning levels ○ Discussion of experiences and best practices ○ Save the results in a collaborative tool or cloud. <p>- Discussion with all participants about their work</p> <ul style="list-style-type: none"> ○ Save the results in a collaborative tool or cloud. <p>Competence integration (1 hour)</p> <ul style="list-style-type: none"> - Pedagogical competence: Collaborative development of inclusive teaching strategies aligned with educational goals. Save the results in a collaborative tool or cloud. - Collaboration Competence: Group activity focusing on effective teamwork, communication, and collaboration among teachers, parents, and stakeholders. Save the results in a collaborative tool or cloud. - Communication Competence: Discussion on effective communication techniques with students, colleagues, and families. Save the results in a collaborative tool or cloud. <p>Quiz (10 minutes)</p> <ul style="list-style-type: none"> - Provide the opportunity for the participants to assess themselves through a short quiz <p>Reflection and Action Plan (15 minutes)</p> <ul style="list-style-type: none"> - Individual reflection on key takeaways from <i>each</i> part - Development of a personal action plan for implementing newly acquired competences in daily teaching practices
<p>Additional learning sources:</p>	<ul style="list-style-type: none"> - Additional text: “Meeting the Needs of Students with Dyslexia and Dyscalculia”, Witzel & Mize (2018), Link: https://files.eric.ed.gov/fulltext/EJ1166703.pdf - Additional video in English: “Dyscalculia: Teaching Strategies & Modifications”, Link: https://www.youtube.com/watch?v=BWaam8s9wSs - Additional video in German: “Rechenschwäche - Was tun bei Dyskalkulie? Schule im Gespräch #190”, Link: https://www.youtube.com/watch?v=N_ur5UD2iv4

Module 2: Diagnosis processes of dyscalculic individuals in normal education environments

Diagnosing dyscalculia in schools involves a structured approach comprising observation, assessment, and collaboration among educators, parents, and specialists. This process starts with identifying concerns through observation of a student's struggles with mathematical concepts. Initial screenings, incorporating standardized tests and teacher observations, help pinpoint students at risk. Valuable insights from teachers and parents contribute to a comprehensive understanding of the student's challenges.

A comprehensive assessment, typically conducted by a school psychologist or specialized professional, evaluates mathematical abilities and cognitive processing. This includes psychoeducational assessments to gauge overall cognitive functioning and math-specific assessments targeting strengths and weaknesses. Comparisons to developmental norms help identify significant gaps indicating dyscalculia.

Following assessment, collaborative intervention planning occurs, involving teachers, parents, and specialists. An individualized plan tailored to the student's needs is developed, with ongoing monitoring to evaluate progress and adjust support as necessary. Cultural considerations and ethical standards ensure a fair evaluation process. Professionals involved may include teachers, school psychologists, special education professionals, and other specialists, ensuring a holistic approach to supporting students with dyscalculia.

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Title:	Module 2: Diagnosis processes of dyscalculic individuals in normal education environments
Aim of Module 2:	Effective teaching requires a nuanced understanding and application of diagnostic procedures. Educators must be well-versed in various tests, understand their contents and purposes. Furthermore, the key lies in adapting the selection of diagnostic procedures to the specific characteristics and needs of the learning group. This tailored approach ensures a more accurate assessment and paves the way for personalized and effective teaching strategies.
Learning Outcomes	
Knowledge:	<ul style="list-style-type: none"> • Knowledge of diagnostic procedures for identifying dyscalculia. • Knowledge of diagnostic tests, their contents and purposes. • Understanding of the adaptability of diagnostic procedures to the learning group. • Understanding of the factors and criteria involved in diagnosing dyscalculia.

	<ul style="list-style-type: none"> • Knowledge of the characteristics and common indicators of dyscalculia in students.
Skills:	<ul style="list-style-type: none"> • Diagnostic Skills: The ability to effectively apply diagnostic procedures to identify dyscalculic individuals. • Test Familiarity: Proficiency in using and interpreting various assessment tools for mathematical abilities. • Adaptation Skills: The capacity to tailor the selection of diagnostic procedures to match the specific needs and characteristics of the learning group. • Data Interpretation Skills: The skill to analyze assessment results and draw meaningful conclusions about a student's mathematical abilities.
Competences:	<ul style="list-style-type: none"> • Assessment Competence: The ability to choose and administer tests while understanding their contents and purposes in the context of dyscalculia diagnosis. • Interpretation Competence: The capacity to interpret assessment results accurately and make informed decisions regarding intervention or support. • Collaboration Competence: The ability to collaborate with colleagues, parents, and specialists to develop appropriate strategies and interventions for dyscalculic students within the regular educational environment. • Communication Competence: The ability to communicate diagnostic findings to relevant stakeholders, such as educators, parents, and support services.
Activity 2	
Title:	Dyscalculia Diagnostic Test
Learning Time:	30-35 minutes
Content:	<p>Computer-based assessment to help diagnose individuals aged 6-14 years with dyscalculic tendencies.</p> <p>Test description: A diagnostic tool designed to diagnose dyscalculic tendencies and is not a general test of mathematical achievement and consists of 4 continuously given subtests.</p> <p>Subtest Information:</p> <ul style="list-style-type: none"> - Four subgroups: Three computer-controlled item timed tests and one reaction time test - Simple reaction time: The learner achieves one keystroke in response to the stimulus. - Dot Counting: The learner compares dots on one half of the screen with numbers on the other half. - Number comparison: The learner chooses the larger of two numbers. - Arithmetic achievement test (addition and multiplication)

	<p>Sample profiles and sample reports are provided as a result of this test. It can be used to screen whole class groups.</p> <p>Observation of test behaviour should play an important role in the implementation of the tests and should be taken into account in the interpretation of the results.</p>
Additional learning sources:	<ul style="list-style-type: none"> - Additional text: Philips S. & Kelly, K. (2018). Assessment of Learners with Dyslexic-Type Difficulties (2nd Ed.). SAGE Publications Ltd.
Activity 3	
Title:	Dynamo Math Assessment
Learning Time:	30-40 minutes
Content:	<p>The Dynamo Math Assessment is an online assessment that can be used to screen students aged 6-15 for dyscalculia. It assesses three aspects of math: Number meaning (symbols numbers, snap counting and counting), number magnitude (number comparison, estimation, prediction, estimation, ordering and sequential ordering) and number relationship (place value, number groups and facts, mental strategies, problem solving, time measurement and multiplication). The largest sample sizes for this type of assessment are at primary school age. The assessment includes multiple ranking and comparison as well as timed responses, and it is claimed that the risks of dyscalculia can thus be distinguished from the causes of low math ability. An individual support plan is provided based on the assessment results and this is linked to modules in the Dynamo Math Intervention Program, which requires a separate license. There is also an online tool for noting observations during the assessment and a template that allows children to demonstrate their exercises, allowing the assessor to use informal diagnostic assessment data when planning or recommending an intervention program.</p>
Additional learning sources:	<ul style="list-style-type: none"> - Additional text: Dowker, A., Esmail, K., & Maths, D. (2017). Development of components of mathematics in 7-to-11-year-old children: a study using Dynamo Assessment.
Activity 4	
Title:	Feifer Math Assessment (FMD)
Learning Time:	35-50 minutes
Content:	<p>The Feifer Math Assessment (Feifer & Clarke, 2016) is a pencil-and-paper-based test for participants aged 4-21 years. It is a comprehensive assessment that purports to not only assist practitioners in identifying dyscalculia, but also to identify specific subtypes of dyscalculia to better inform intervention decisions. The full assessment consists of 19 subtests. Three of the subtests can be used as rapid screenings: sequence, verbal math concepts and number comparison. These provide a single index score that indicates the risk of dyscalculia. If the index on a single subtest is low enough, the full test can be administered. This results in three additional index scores (procedural, verbal and semantic).</p>

	<p>The FMD contains 19 subtests consisting of three index scores.</p> <p>The Operational Index is derived from five subtest scores:</p> <p>Counting Forward - identify the number that follows a given number and count forward in various increments.</p> <p>Count Backwards - identify the number that precedes a given number and count backwards in various decrements.</p> <p>Numerical Capacity-repeat a sequence of numbers increasing in digit length.</p> <p>Sequence*- Point out a missing picture or number in a pattern or sequence.</p> <p>Object Counting- Count objects using picture clues and match the counted objects with the corresponding quantities.</p> <p>The verbal index is derived from six subtest scores:</p> <p>Quick Number naming- Name as many numbers as possible presented in a sequence within 30 seconds.</p> <p>Addition Fluency - solve as many addition problems as possible in 30 seconds.</p> <p>Subtraction Fluency - Solve as many subtraction problems as possible in 30 seconds.</p> <p>Multiplication Fluency - Solve as many multiplication problems as possible within 30 seconds.</p> <p>Division Fluency - solve as many division problems as possible in 30 seconds.</p> <p>Verbal Math Concepts * - select the correct definition for mathematical terms embedded in sentences.</p> <p>The Semantic Index is derived from eight subtest scores.</p> <p>Spatial Memory - identify abstract shape after 5 seconds. (Target image can be rotated or rotated.)</p> <p>Equation Formation - choose the correct equation to solve the mathematical verbal problem.</p> <p>Perceptual Estimation - identify which container has more objects or estimate the number of objects.</p> <p>Number Comparison* - identify the larger of as many pairs of numbers as possible within 30 seconds.</p> <p>Addition Knowledge - Identify the missing sum in as many questions as possible within 60 seconds.</p> <p>Subtraction Knowledge - Identify the missing add/subtract number in as many questions as possible in 60 seconds.</p> <p>Multiplication Knowledge - Identify the missing multiplier in as many questions as possible within 60 seconds.</p> <p>Division Knowledge - Identify the missing divisor/divisible number in as many questions as possible within 60 seconds.</p>
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	<p>Three subtests were used as rapid screening tools for dyscalculia.</p> <p>The FMD gives a single index score indicating the risk of dyscalculia. If the single index is low enough, the full set of tests can be administered.</p> <p>A low score on the procedural index indicates a difficulty in the ability to count, sort counts and/or sequence mathematical procedures when solving problems.</p> <p>The verbal subtype is defined by Feifer and Clarke (2016) as a difficulty with rapid number identification skills and inability to recall and recall information. Students who score low on this index may also have difficulty reading and writing, but the instruction states that size or number magnitude can be maintained.</p> <p>The semantic subtype consists of both visuospatial and conceptual components. Students scoring low on this index may have different difficulties than others in applying visualization techniques to verbally presented problems (due to deficits in the semantic visuospatial domain) and in developing number sense (due to a weak conceptual understanding).</p>
<p>Additional learning sources:</p>	<ul style="list-style-type: none"> - Additional text: Feifer, S. G., & Clark, H. K. (2016). FAM: Feifer Assessment of Mathematics. PAR.
<p>Activity 5</p>	
<p>Title:</p>	<p>Sandwell Preliminary Number Test KS2-KS3</p>
<p>Learning Time:</p>	<p>30-35 minutes</p>
<p>Content:</p>	<p>The Sandwell Early Number Test for 8-14 year olds (Arnold et al., 2013) has been included in screening methods due to its growing popularity in UK schools. However, it should be noted that it is not specifically a screener for dyscalculia, this tool aims to identify children who are severely underachieving in mathematics. As the name suggests, the screening tool assesses early number skills such as counting, number recognition and number value. However, it does not include instant counting (quickly recognizing the number of objects in a small group) or comparing number magnitude (e.g., choosing the larger of two numbers), and the duration of responses to items cannot be measured. This test may not distinguish dyscalculic students from other mathematical difficulties. It may also miss some children who perform reasonably well on the test but do so slowly and use inappropriate strategies.</p> <p>By providing profiles of individual strengths and weaknesses, the Sandwell Early Number Test can be used as a basis for planning an intervention program for students with mathematical difficulties. It can also be used to measure the effectiveness of an intervention. The class teacher may find it useful in indicating which children to refer for further assessment. For the specialist teacher, the lack of standardized scores is a disadvantage, as age equivalents and National Curriculum levels cannot be so easily compared with scores on other tests to create an overall student profile. While the results of the test may form part of the background information in a formal assessment report, the expert</p>

	assessor will need a test that provides standardized scores for the main assessment.
Additional learning sources:	<ul style="list-style-type: none"> - Additional text: Feifer Arnold, J., Haynes, M., & Sutton, M. (2013). Development and Validation of the Sandwell Early Number Assessment: A Tool to Assess Early Numeracy Skills. <i>Research in Education</i>, 89(1), 33–50.
Activity 6	
Title:	Informal Assessment
Learning Time:	Depends on Records of Anecdotes
Content:	<p>Informal assessment procedures can be used prior to formal screening where the teacher or parent is concerned about the rate of progress, or as part of the identification process to supplement information gathered through standardized testing. The most common approaches are observation and checklists. Early number skills can also be assessed informally through practical activities.</p> <p>Informal Assessment 1:</p> <p>The purpose of observation is to gather as much information as possible about how the child learns and the strategies they use. In the classroom, observation may include the length of time spent on a particular activity or responding to teacher questions; interactions with the teacher and peers; the type and amount of support provided during the lesson; available mathematical resources and those preferred by the student; strategies used in calculations (e.g., counting on fingers); and indications of confidence or anxiety. During a testing situation, observation can involve noting repetitions of instructions, reluctance to begin assessment, levels of attention and focus, length of time taken to complete a task, skipped problems, solutions, and patterns of errors in strategy usage. Observations recorded during test sessions are typically unstructured field notes taken as behaviours occur. These can be followed up with questioning after the test session to explore more about the student's approach to specific problems.</p> <p>Before formal screening, observation can use either time sampling (where behaviours are observed and recorded at regular intervals, for example, every five minutes) or event sampling (where specific behaviours are expected and frequencies are recorded, for example, using a tally sheet). Time sampling is often used to determine which behaviours are observed in classrooms where more research is needed through event sampling, for example, the time spent on tasks, frequency of contribution to group activities, and/or number of times voluntary students answer questions. More commonly, observation is used in dyscalculia screening to enable a teacher or teaching assistant to complete a checklist.</p> <p>Informal Assessment 2:</p> <p>Dyscalculia Checklist</p> <p>The purpose of the checklist is to determine whether the difficulties experienced by the student are characteristic of dyscalculia. A list of common indicators is provided, and the teacher notes down those that</p>

are specific to the individual. For example, does the student use inappropriate counting strategies, lack confidence in determining which of two numbers is larger, and frequently forget the question? It is important to correlate these characteristics with the student's chronological age. For instance, number reversals are common in young children and may inherently be only temporary. Similarly, some checklists, if designed for older students, may include features the child has not yet encountered (e.g., algebra, mathematical formulas).

On the website of the British Dyslexia Association (BDA), you can find a list of typical characteristics of dyscalculia and mathematical difficulties, which could form the basis of a checklist likely to be made by a teacher. Additionally, there are a few published checklists available. For instance, the Ann Arbor Dyscalculia Checklist (Phillips and Phillips, 2012), which lists 13 characteristics supported by research and another 5 characteristics deemed "likely to be observed," is currently available online for free.

www.annarbor.co.uk/images/PDF/DyscalculiaChecklist.pdf.

In "More Trouble with Maths" (2017, p. 30), the checklist provided by Chinn lists 31 characteristics that could contribute to failure in mathematics, covering a range of mathematical content from numeracy to algebra. It is written in a way that allows the teacher to use it as a questionnaire or in a diagnostic interview, providing an opportunity to explore mathematical difficulties with the student. However, due to the complexity of the language used, it is more suitable for use with middle school-aged students (when used in this manner).

The Dyscalculia Assessment (Emerson and Babbie, 2013) provides guidance on practical activities that can be used for informal screening of dyscalculia. It includes items for assessment related to number sense and counting, calculation, place value, multiplication, division, word problems, and formal written mathematical skills, and provides guidance for interpreting the assessment with some follow-up games. However, it does not feature a "quick screening" option for dyscalculia as completing the activities may take some time.

Dyscalculia Check List	Y/N
Sequential counting difficulty - may skip numbers, order them incorrectly, or count randomly.	
Difficulty in recalling number names.	
Inadequacy in one-to-one correspondence.	

	Difficulty understanding cardinality, which means recognizing that the last number counted represents the quantity of the set of objects being counted.	
	Over-reliance on counting strategies - inability to "subitize" small quantities (e.g., 3).	
	Difficulty in non-symbolic magnitude comparison (e.g., determining which set has more objects).	
	Difficulty in symbolic magnitude comparison (e.g., determining which is larger, 7 or 6?).	
	Inability to see the relationship between numbers (e.g., seven being made up of five and two).	
	Failure to understand the concept of one more/one less.	
	Counting on fingers in simple calculations	
	Forgetting where one left off in a calculation	
	Difficulty in counting forward from a specific number.	
	Difficulty in counting backward from a specific number (especially in groups of ten).	
	Slow/incorrect recall of basic number facts (e.g., number bonds).	
	Dyscalculia Check List	Y/N
	Difficulty in generalizing from one situation to another (e.g., from $3 + 5 = 8$ to $3p + 5p = 8p$).	
	When peers are able to use mental calculation, they resort to tally marks.	

	“Struggling with "counting on" (e.g., for $3 + 4$, counting "1 2 3... 4 5 6 7").	
	Difficulty understanding problems involving the total (e.g., $2 + 0 = 9$).	
	Weak estimation skills - makes rough estimates.	
	Cannot adjust estimates based on the previous answer.	
	Struggles to visualize an empty number line and where a number (e.g., 5) belongs on it.	
	Weak time estimation and discrimination.	
	Finds it difficult to tell time on an analog clock.	
	Counting errors persist into Key Stage 2 or beyond (ages 11+).	
	Mixes up similarly sounding numbers (e.g., thirteen and thirty).	
	Difficulty with place value (failure to understand the concept of zero).	
	Reverses or changes the order of numbers counted (e.g., 17 for 71 or 324 for 423).	
	Difficulty in recognizing patterns (e.g., 17 27 37)	
	Difficulty in learning timelines	
	Learns addition and multiplication facts and then forgets them.	
	Fails to grasp the commutative property (e.g., $4+5=5+4$ or $2 \times 6=6 \times 2$)	

	Confuses the order in division (e.g., is it 4 divided by 2 or 2 divided by 4?)	
	May not understand the mathematical language used in calculations or procedures.	
	Irregular sequencing on the page, writing numbers in the wrong place value.	
	Struggles with rounding numbers.	
	Difficulty in understanding and remembering multi-digit operations.	
	Difficulty in explaining the answer or method.	
	Mechanically follows procedures without understanding them.	
	Unable to logically reason (e.g., $38+38=76$ so what is $38+37$?)	
	May not use visual images and therefore may find spatial reasoning difficult.	
	Struggles to calculate change in money problems.	
	Difficulty in selecting the correct operation in word problems.	
	Continues to struggle with simple algebraic equations (e.g., $2 + x = 6$ or $3x + 1 = 7$) into KS3.	
	Difficulty in simplifying equations in Key Stage 3, for example, $(3x + 2) 2 + (2x + 1) (4x + 2) =$	
Additional learning sources:	<ul style="list-style-type: none"> - Fu, S. H., & Chin, K. E. (2017). An online survey research regarding awareness of dyscalculia among educators in Sandakan district, Sabah. <i>International Journal of Academic Research in Progressive Education and Development</i>, 6(2), 1-10. 	

	<ul style="list-style-type: none">- Emerson, J., & Babbie, P. (2014). The Dyscalculia Assessment: A practical guide for teachers. Bloomsbury Publishing.- English video: https://youtu.be/02MB3zl5iNI- Turkish video: https://www.youtube.com/live/5Hcnr5ZADd4?si=3bXBChKZbo96FJs4
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Module 3: Teaching methods and techniques on the education of students with different learning levels

“Module 3: E-learning” is about activities which could be useful to teach dyscalculic students. There will be an overview of teaching and professional skills needed and how to educate dyscalculic students. Methodological competences are presented in order to use different approaches and practices, activity examples, teaching methods and techniques for the education of students with different learning levels. Finally, the outline of how educators can develop their capacity in the long term will be given in Module 3.

Title:	Module 3: Teaching methods and techniques on the education of students with different learning levels
Aim of Module 3:	In education classes, acknowledging and accommodating individual differences is key. Teachers can elevate their lessons by incorporating practical activities like group projects, integrating innovative tools and methods, and keeping students engaged through motivation strategies. Modernizing teaching styles through ongoing professional development ensures adaptability to diverse learning needs. By covering a range of activities, from differentiated instruction to tailored training programs, educators create an inclusive and dynamic learning environment that caters to individual differences.
Learning Outcomes	
Knowledge:	<ul style="list-style-type: none"> • Understanding of various teaching methods and techniques tailored to the education of students with different learning levels. • Knowledge of strategies for educating students based on their individual differences in regular classroom settings. • Familiarity with a range of activity examples suitable for daily lesson plans, addressing students' varying needs. • Awareness of practical and innovative teaching applications. • Knowledge of modernization concepts related to teaching styles. • Understanding of the importance of motivation and engagement in student learning. • Knowledge of how to create training programs that accommodate individual differences.
Skills:	<ul style="list-style-type: none"> • Instructional Skills: Proficiency in employing effective teaching methods and techniques for students with different learning levels. • Differentiation Skills: The ability to adapt instruction according to students' individual differences within a standard classroom.

	<ul style="list-style-type: none"> • Activity Design Skills: Competence in creating engaging and purposeful activities for daily lessons. • Practical Application Skills: The capacity to implement teaching methods in real classroom settings. • Innovation Skills: The ability to introduce creative and novel approaches to teaching. • Motivational Skills: Skill in motivating and engaging students in the learning process. • Modernization Skills: The capability to update and improve teaching styles and methods.
Competences:	<ul style="list-style-type: none"> • Pedagogical Competence: The proficiency to choose and apply appropriate teaching methods and techniques that cater to diverse learning levels. • Differentiation Competence: The skill to adapt instruction to the unique needs and abilities of each student in a regular classroom. • Program Development Competence: The skill to create training programs that accommodate individual differences and promote effective teaching practices.
Activity 7	
Title:	Exploring teaching methods and techniques on the education of students with different learning levels
Learning Time:	4-5 hours
Content:	<p>Introduction (20-30 minutes)</p> <ul style="list-style-type: none"> - Overview of Module 3 objectives and learning outcomes - Discussion about strategies helping to overcome dyscalculia - Discussion about activities helping to overcome dyscalculia <p>Knowledge enhancement (45 minutes)</p> <ul style="list-style-type: none"> - Exploration of strategies helping to overcome dyscalculia - Discussion on methods adaptable to different learning levels - Discussion on various activities adaptable to different learning levels - Sharing insights into the needs and challenges faced by students with varying levels of learning <p>Skills development (2 hour)</p>

	<ul style="list-style-type: none">- Prepare four working stations- Let the participants choose one of the working stations- The number of participants per station should be equal- Each station is about activity and contains several tasks for the participants <p>1) Teaching skills station:</p> <ul style="list-style-type: none">* Discussion on lesson planning activities tailored for dyscalculic students* Role-play scenarios to practise using activities for dyscalculic students* Save the results in a collaborative tool or cloud <p>2) Professional development skills station:</p> <ul style="list-style-type: none">* Discussion on strategies for helping to overcome dyscalculia* Choose a strategy helping to overcome dyscalculia and explain in what ways it could be useful to teach dyscalculic students* Save the results in a collaborative tool or cloud. <p>3) Methodological skills station:</p> <ul style="list-style-type: none">* Discussion on how to enhance methods and activities used for dyscalculic students for different learning levels* Save the results in a collaborative tool or cloud. <p>Competence integration (1 hour)</p> <ul style="list-style-type: none">- Pedagogical competence: Collaborative development of inclusive teaching strategies aligned with educational goals. Save the results in a collaborative tool or cloud.- Collaboration Competence: Group activity focusing on effective teamwork, communication, and collaboration among teachers, parents, and stakeholders. Save the results in a collaborative tool or cloud.- Communication Competence: Discussion on effective communication techniques with students, colleagues, and families. Save the results in a collaborative tool or cloud. <p>Quiz (10 minutes)</p> <ul style="list-style-type: none">- Provide the opportunity for the participants to assess themselves through a short quiz
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	<p>Reflection and Action Plan (15 minutes)</p> <ul style="list-style-type: none"> - Individual reflection on key takeaways from each part - Development of a personal action plan for implementing newly acquired competences in daily teaching practices
<p>Additional learning sources:</p>	<ul style="list-style-type: none"> - Additional text: Dyscalculia: What We Must Know about Students Learning Disability in Mathematics? Universal Journal of Educational Research <p>Link: http://www.hrpub.org</p> <ul style="list-style-type: none"> - Additional video in English: “Dyscalculia Teaching Strategies: What is Dyscalculia?” <p>Link: https://www.youtube.com/watch?v=etOT1uFckTY</p>

Module 4: Inclusiveness in all areas of education and training

Inclusiveness in education and training for individuals with dyscalculia involves creating an environment that recognizes and accommodates diverse learning needs. This approach ensures that students with dyscalculia have equal access to educational opportunities, receive appropriate support, and can actively participate in various learning activities.

Title:	Module 4: Inclusiveness in all areas of education and training
Aim of Module 4:	Ensuring the social integration of dyscalculic students and improving overall education quality require strategies rooted in inclusivity. This involves fostering a supportive social environment, implementing inclusive practices in lesson plans, and promoting collaboration among teachers, support staff, and parents. These efforts collectively contribute to a more inclusive and enriching classroom experience for all students.
Learning Outcomes	
Knowledge:	<ul style="list-style-type: none"> • Understanding of the principles and importance of inclusiveness in all aspects of education and training. • Knowledge of the challenges faced by dyscalculic students in terms of social integration and classroom adaptation. • Awareness of the factors that contribute to the quality of school education. • Familiarity with inclusive practices in education and their role in enhancing educational quality.
Skills:	<ul style="list-style-type: none"> • Social Integration Skills: Proficiency in facilitating the social integration of dyscalculic students and helping them adapt to the classroom environment. • Strategic Development Skills: The ability to develop strategies aimed at improving the overall quality of school education, with a focus on inclusiveness. • Inclusive Education Strategy Skills: Competence in designing and implementing strategies that promote inclusive practices and enhance educational quality.
Competences:	<ul style="list-style-type: none"> • Inclusive Education Competence: The proficiency to ensure that education and training are inclusive in all areas, fostering an environment where every student, including dyscalculic students, feels welcome and supported.
Activity 8	
Title:	Less-More, Big-Small Awareness
Learning Time:	20-30 minutes

<p>Content:</p>	<p>Students with dyscalculia can often confuse the concepts of size and smallness of objects and the concepts of more and less. This confusion can also be seen in students who have just started primary school. Especially in the first years of primary school, visual activities aimed at comparison as a comprehensive study will enable students to understand the differences between big and small and more or less.</p> <p>For this purpose, images and similar ones in Form-1 and Form-2 can be used.</p> <p>These visuals are reproduced according to the number of students and distributed to all students. You are instructed to mark the larger number. In addition, the permanence of the intended gains can be increased by the student coloring in a number of boxes that represent the value of the number, as in the visual in Form-2.</p>
<p>Additional learning sources:</p>	<ul style="list-style-type: none"> - Elkaan, G. (2022). <i>Examination of basic number proficiency and visual perception skills of students with good and poor mathematics performance (Master's thesis, Hasan Kalyoncu University).</i> - https://www.youtube.com/watch?v=cshehFbVPV0
<p>Activity 9</p>	
<p>Title:</p>	<p>Completion activity</p>
<p>Learning Time:</p>	<p>15-20 minutes</p>
<p>Content:</p>	<p>It is very important for children with dyscalculia to understand the relationship between the amount of objects and numbers. These visuals are reproduced according to the number of students and distributed to all students. In a table consisting of a certain number of boxes, as in the picture in Form-3, a certain number of boxes are colored and then this table is shown to the student once and removed. Afterwards, the teaching of basic numbers, addition and subtraction can be achieved through gamification by asking the student questions such as how many boxes are in the table in total, how many boxes are colored in the table, how many more boxes need to be colored in order for all the total boxes to be colored.</p>
<p>Additional learning sources:</p>	<ul style="list-style-type: none"> - Avci, A. (2020). <i>Evaluation of teaching practices for primary school students with mathematics learning difficulties (Master's thesis, Institute of Educational Sciences).</i>

Activity 10	
Title:	Development of Attention
Learning Time:	15-20 minutes
Content:	<p>Distraction and focus are important problem areas in children with dyscalculia. Activities aimed at gathering students' focus and attention will be effective.</p> <p>By preparing study cards similar to the examples in Form-4 and Form-5, it is aimed to improve the attention skills of students with dyscalculia. Thanks to these types of activities, students make progress in distinguishing letters and numbers that are so similar that they can be confused with each other.</p> <p>In Form-4, students are asked to find how many numbers 5 are in the visual and circle them. Finding time is given as 1 minute. Even if a minute has passed, all students are asked to find the fives. Students who find fives missing or wrong are asked to notice the difference between 5 and S.</p> <p>In Form-5, students are asked to find the numbers 6 and circle them. When students confuse the numbers 9,6 and G, they are encouraged to notice the difference.</p>
Additional learning sources:	<ul style="list-style-type: none"> - Avci, A. (2020). Evaluation of teaching practices for primary school students with mathematics learning difficulties (Master's thesis, Institute of Educational Sciences). - https://www.youtube.com/watch?v=1W17IfnBFDc
Activity 11	
Title:	Simple Addition Activity
Learning Time:	15-20 minutes

<p>Content:</p>	<p>Concretization of mathematical concepts is an auxiliary method in teaching children with dyscalculia. For this purpose, it is aimed to concretize the operation with fingers while doing addition, as in the activity examples in Form-7.</p> <p>The visuals in Form-6 are given to the students and the students are asked to write the number of fingers of the hands in the visual in the boxes and make the sum using numbers and hand drawings. Then, the teacher shows the number of fingers on their own hands to the students and asks them to write these numbers in their notebooks. The total score is again displayed with numbers and finger drawings.</p> <p>In the rest of Form-6, they are asked to write the point total numbers in the boxes.</p>
<p>Additional learning sources:</p>	<ul style="list-style-type: none"> - Mutlu, Y. (2016). Mathematics learning disability (developmental dyscalculia). Theories in Mathematics Education. Ankara: Pegem Akademi - https://www.youtube.com/watch?v=7mvvj75holc
<p>Activity 12</p>	
<p>Title:</p>	<p>Number Puzzle Activity</p>
<p>Learning Time:</p>	<p>15-20 minutes</p>
<p>Content:</p>	<p>It is an important skill for children with dyscalculia to distinguish the shape differences of numbers. Especially colors can be used as an important tool for them to notice this difference. Form-7 is copied according to the number of students and distributed to all students.</p> <p>Students are given activity cards similar to the one in the picture in Form-7 and asked to write the numbers in the picture in the boxes according to their colors.</p>
<p>Additional learning sources:</p>	<ul style="list-style-type: none"> - Toptaş, Olkun, Çekirdekçi and Sarı (2020) Teaching Mathematics in Primary School, Vizetek Publications https://www.youtube.com/watch?v=7mvvj75holc - https://www.youtube.com/watch?v=Gt75jzMzpSg
<p>Activity 13</p>	
<p>Title:</p>	<p>Square Scribble Activity</p>
<p>Learning Time:</p>	<p>15-20 minutes</p>

Content:	It is very important to realize the relationship between object quantity and number expression in children with dyscalculia. For this purpose, in teaching numbers, students are asked to colour in as many boxes as the number written in each section by preparing study cards as shown in the Form-8 picture.
Additional learning sources:	<ul style="list-style-type: none"> - Mutlu, Y. (2016). Mathematics learning disability (developmental dyscalculia). Theories in Mathematics Education. Ankara: Pegem Akademi.
Activity 14	
Title:	Finding the Right Direction Activity
Learning Time:	15-20 minutes
Content:	Children with dyscalculia often encounter problems with writing and seeing the direction of numbers correctly. Especially the numbers 5, 2, 9, 6 and 7 are confused. Practicing to find the direction of numbers, as in the visuals in Form-9, Form-10 and Form 11, has obvious benefits in improving students' ability to perceive the direction of numbers correctly. The forms are copied according to the number of students and distributed to all students. Have students find the numbers facing the correct direction and circle them.
Additional learning sources:	<ul style="list-style-type: none"> - Mutlu, Olkun, Akgün and Sarı (2020) Dyscalculia: Definition, Characteristics, Prevalence, Causes and Diagnosis of Mathematics Learning Disability <ul style="list-style-type: none"> - Pegem Academy - https://www.youtube.com/watch?v=_radX5wjaPE



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