

**UNIVERSITY OF CORDOBA**

**Faculty of Education**



PhD Thesis

**Adaptación curricular para trabajar la dislexia en educación primaria a través de la música.**

**Adaption of the curriculum through music on children of Primary Education with dyslexia.**



Doctoral thesis of the Doctoral Program in Social and Legal Sciences

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**TÍTULO DE LA TESIS:** ADAPTACIÓN CURRICULAR PARA TRABAJAR LA DISLEXIA EN EDUCACIÓN PRIMARIA A TRAVÉS DE LA MÚSICA

**DOCTORANDO/A:** FOTEIN BOULOUKOU

**INFORME RAZONADO DEL/DE LOS DIRECTOR/ES DE LA TESIS**

El trabajo realizado por la doctoranda ha seguido los pasos y cauces propios del desarrollo de una tesis doctoral realizada principalmente en modalidad online, dado el lugar de residencia del doctorando (Grecia).

Se han llevado a cabo sesiones “enlatadas” de tutoría vía Skype, así como conversaciones vía WhatsApp y presenciales durante la estancia realizada por el doctorando en Alicante en 2018 y 2019. Todo ello ha permitido acercar mutuamente a la doctoranda y a los directores.

La redacción del marco teórico que sustenta este trabajo de investigación ha sido constante y se encuentra actualizada en la temática que se investiga. Se bebe de fuentes tradicionales en el ámbito de las creencias del docente hasta llegar a las últimas tendencias tanto teóricas como investigadoras. La búsqueda de la información, por tanto, ha sido continua y fluida, poniendo de relieve que es un campo en evolución y crecimiento.

La implicación de la doctoranda ha sido correcta en la búsqueda de la muestra y de la recogida de los datos, si bien se ha tenido dificultad en su acceso dado el marco jurídico vigente en Grecia en torno al acceso a estudiantes menores de edad y la temática tan concreta de música y educación inclusiva, en concreto trabajar la línea de la dislexia.

Las pruebas realizadas en torno a los datos estadísticos son pertinentes dando respuesta a las hipótesis planteadas, así como a los objetivos, permitiendo la redacción de las evidencias y conclusiones derivadas.

Por otra parte, a fecha de hoy se ha conseguido un indicio de impacto en la revista *International Journal of Education and Practice* con un ID de 7.4 (<http://miar.ub.edu/issn/2310-3868>) y un posicionamiento en SJR de Q3 en 2019, fecha en que se mandó el artículo y de Q4 en la última actualización en 2020 (<https://www.scimagojr.com/journalsearch.php?q=21100886411&tip=sid&clean=0>)

Por todo ello, se autoriza la presentación de la tesis doctoral.

Córdoba, 22 de enero de 2022  
Firma de los directores

Fdo.: VERÓNICA MARÍN DÍAZ & NOELIA N. JIMÉNEZ FANJUL

## Abstract

Research has shown that children with dyslexia also have difficulty perceiving rhythm. That being said, there is a lot of research that focuses on and observes the importance and positive effect of music on learning difficulties. The purpose of this research was to investigate the effectiveness of an interventional music program in relation to the curriculum of the music course in Greece, for students with dyslexia. For this purpose, research was conducted on primary school students. Sixty-four students of the 4th Elementary class, thirty-two diagnosed with dyslexia and thirty-two typical students, participated in the study. The LAMDA (Learning Skills and Weakness Detection Software) test, a weighted tool for automated detection of learning difficulties in written and oral language, was used to assess the improvement of children. The assessment showed that the interventional music-training program improved students' performance in areas such as word recognition, grammar spelling, visual sequences and rhythm reproduction. The positive results in the various fields of the LAMDA test show that the creation of a new analytically adapted music program suitable for the specific student population but also the use of music as a systematic treatment would have positive effects on students with dyslexia.

## Spanish Summary

La dislexia es una discapacidad de aprendizaje debido a la falta de capacidad para decodificar palabras y normalmente se refleja en la capacidad de procesar sonidos. Esta capacidad de decodificación no está directamente relacionada con elementos como la inteligencia, la edad, las habilidades sensoriales, otras habilidades cognitivas o los trastornos generales del desarrollo (Adlof y Hogan, 2018; Blackburn, 2018). La dislexia se manifiesta con dificultades para reconocer las palabras con precisión y mal rendimiento en la lectura y la escritura. Se trata de un trastorno, caracterizado como neurodesarrollo, que a menudo se presenta en escolares y adolescentes (Adlof & Hogan, 2018; Wagner, et al., 2020). En general, un gran porcentaje de alumnos en edad escolar desarrolla este trastorno, pero también se produce con mayor frecuencia en los chicos (Goswami, et al., 2011; Habib y Giraud, 2013; Ahmad, Ali y Salehuddin, 2018).

Los investigadores han descubierto que la dislexia en niños puede estar relacionada con problemas genéticos, daño cerebral, displasia cerebral, malnutrición, etc. (Rüsseler, et al., 2018). Los niños con dislexia se quedan por detrás de los niños de desarrollo normal y muestran poca motivación para el aprendizaje (Cardillo, et al., 2018; Snowling, Hulme & Nation, 2020). Factores externos como la escuela, el entorno familiar, la educación de los padres y el entorno de vida también pueden afectar a las habilidades lectoras de los niños.

Las investigaciones han demostrado que los niños con dislexia tienen también dificultades para percibir el ritmo. Se puede ver que el uso de la educación musical para la rehabilitación de niños con dislexia y trastornos del lenguaje se basa tanto en evaluaciones teóricas como en resultados experimentales. Si existen procesos subyacentes comunes entre la música y el lenguaje, especialmente entre la percepción de la música y la percepción del habla, es razonable argumentar que mejorar algunos de los procesos involucrados en la percepción de la música puede ayudar simultáneamente a mejorar las habilidades de lectura y lenguaje (Corrigall Y Trainor, 2011; Cumming, Wilson, Leong, Colling y Goswami, 2015; Frey et al., 2019; Lifshitz-Ben-Basat y Fostick, 2019).

Dicho esto, existen muchas investigaciones que se centran y observan la importancia y el efecto positivo de la música en las dificultades de aprendizaje. Teniendo en cuenta

esto y teniendo en cuenta que en Grecia no se ha creado ningún currículum personalizado para estos estudiantes, se investiga a través de un programa innovador-intervencionista de música y se comprueba el efecto de esta mejora rítmica en otros ámbitos según el "LAMDA". "prueba de evaluación.

En general, se acepta que al identificar y reconocer una dificultad en cualquier área, distinguirla y comprenderla, avanzamos hacia su resolución de una manera más segura y eficaz. Enseñar música a niños con dislexia es sin duda uno de esos casos.

El propósito de esta investigación es mejorar la educación rítmica de los estudiantes con dislexia en las lecciones de música, a través de métodos de enseñanza invasivos con el fin de enfatizar la necesidad de diseñar un currículum musical para estos niños. Esta investigación se considera importante ya que el aumento en el porcentaje de estudiantes con dislexia es uno de los problemas más importantes que se observan en la actualidad no solo en Grecia sino también en el resto del mundo. Según muchas investigaciones modernas, resulta que la percepción del ritmo es importante tanto para el habla como para la música. Por tanto, el objetivo principal del estudio es investigar la efectividad del proceso educativo existente y mejorar al máximo a los estudiantes con dislexia.

Las preguntas importantes que serán respondidas por esta propuesta de investigación son:

- Existe una conexión entre el idioma y la música?
- Hay una mejora en los estudiantes con dislexia que asistieron al programa de intervención?
- Hay una mejora en los estudiantes con dislexia que asistieron al plan de estudios?
- Hay una mejora en los estudiantes típicos que asistieron al programa de intervención?
- Hay una mejora en los estudiantes típicos que asistieron al plan de estudios?

Los resultados de la investigación mostraron que los estudiantes con dislexia que asistieron al programa de intervención tuvieron una mejora significativa en las

siguientes áreas de la prueba lambda, a saber, reconocimiento de imágenes, reconocimiento de palabras, ortografía histórica, ortografía gramatical, selección de imágenes, rango de letras, secuencias visuales. , finalización del patrón y reproducción del ritmo, pero no parece que el género pueda diferenciar estos efectos y ha habido algunos cambios notables debido a esto.

Además, hay una mejora significativa en los niños con dislexia y no, en la reproducción rítmica, el último tramo de la prueba Lambda, que revela los resultados positivos de una lección rítmica intervencionista adaptada a las necesidades de los niños. Las actividades especializadas, el carácter agradable de la lección pero también la forma alternativa de aprendizaje parecen afectar el desempeño de los estudiantes y no solo en el campo de la música. Además, la música y específicamente las actividades musicales que incluían la mejora de la memoria auditivo-visual, la atención, la concentración pero también la mejora de la capacidad verbal parece haber afectado positivamente los resultados de los niños en las respectivas áreas de la Lambda. prueba.

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## Introduction

Dyslexia is a learning disability due to a lack of ability to decode words and is usually reflected in the ability to process sounds. This decoding ability is not directly related to elements such as intelligence, age, sensory abilities, other cognitive abilities or general developmental disorders (Adlof & Hogan, 2018; Blackburn, 2018). Dyslexia is manifested by difficulties in accurately recognizing words and poor performance in reading and writing. It is a disorder, characterized as neurodevelopmental, that often occurs in school children and adolescents (Adlof & Hogan, 2018; Wagner, et al., 2020). In general, a large percentage of school-age students develop this disorder, but it also occurs more often in boys (Goswami, et al., 2011; Habib & Giraud, 2013; Ahmad, Ali & Salehuddin, 2018).

Researchers have found that dyslexia in children can be related to genetic problems, brain damage, brain dysplasia, malnutrition and so on (Rüsseler, et al., 2018). Children with dyslexia lag behind children of normal development and show low learning motivation (Cardillo, et al., 2018; Snowling, Hulme & Nation, 2020). External factors such as school, family environment, parental education and living environment can also affect children's reading skills. Children's living and learning environment has significantly affected their learning skills (Rodriguez & Tamis-LeMonda, 2011). Also, factors such as disharmonious family relationships, family dysfunction and also harsh parenting patterns can trigger anxiety in children (Karande et al., 2009).

With this in mind and taking into account that in Greece no customized curriculum has been created for these students, research is carried out through an innovative-interventional program of music and the effect of this rhythmic improvement in other areas is checked according to the "LAMDA" assessment test.

Important questions which will be attempted to be answered from the searching proposal are:

- o There is a correlation between the development of rhythm and language
- o How music teaching can induce positive results in an many difficulties as possible causes by dyslexia
- o More particularly how teaching music focuses on the rhythm perception can improve the arrhythm reading of a dyslexic child

The review of the findings highlights the direct relationship of music with language since the cooperation of many different mechanisms such as the need for coexistence of memory, expectation, motor mechanism, attention, vision, hearing is necessary for their creation. The results show that the improvement of rhythmic perception has positive results and improvement in children with dyslexia. Finally, further research is needed on the use of music as a therapeutic tool through innovative educational programs designed specifically for people with language disorders.

# 1 Chapter I: Conceptual dimension of the study – Theoretical framework

## 1.1 Definitions of dyslexia

Dyslexia, as a disorder is one of the most important issues that affects all areas of student development and not only in the field of learning. In other words, it affects the cognitive culture of the individual, his personality and his mental health. Children with dyslexia have low academic grades and unstable emotions, and often feel inferior. Therefore, it is important to understand the behavior and personality traits of children with dyslexia and to further explore the factors associated with dyslexia. (Tam & Leung, 2019; Tilanus, Segers, Verhoeven, 2019; Bergstresser, 2018; Kachong'u & Muzata, 2020; Elbeheri, 2020; Uzoekwe Helen & Ezeani Nneka, 2018; Majer, 2019; Knight, 2018; Tibbetts, 2020).

Depending on the area in which students face problems, there are six different subcategories of learning disabilities. These areas are for reading, writing, and math: reading level, reading comprehension, reading fluency, math and reading, and math and writing. These are different areas where students with learning disabilities are likely to have difficulty (Reid, Lienemann & Hagaman 2013). Difficulties in reading can take many forms (eg, difficulty in comprehension and / or comprehension) and have multiple underlying causes. Students with dyslexia tend to have deficiencies in word recognition, fluency, phonological awareness, and spelling (Vellutino & Fletcher, 2007; Fletcher, 2009). This is probably the most well-known special learning disorder, the main features of which are analyzed in the following paragraphs. Dyslexia as a learning phenomenon has been the subject of research by doctors, psychologists, educators, speech therapists, neurologists. Its inclusion in medical science is not an irrelevant affair, in the sense that the brain is a place of reception and the acoustic tool of utilization of the word, through which the dyslexic phenomenon is created.

Since the introduction of the concept of dyslexia in academia and medicine, many definitions and different views have been formulated in order to describe the phenomenon of dyslexia and its characteristics. The multiplicity of its features makes the identification and evaluation of this learning disorder more difficult, while causing skepticism about its existence. A reason for the existence of many different definitions is that experts use different procedures, assessment tools and criteria to determine their

sample. All of these differences can be traced in part to the variety of definitions of "dyslexia" used by researchers (Landerl et al., 2013).

Dyslexia is a specific learning disability of neurobiological origin, as pointed out by Sümer Dodur and Altındağ Kumaş (2020), characterized by difficulties with accurate and / or flawless word recognition and poor spelling and expression skills, and occurs in one in five children. Teachers' pedagogical knowledge plays an important role in educating students with dyslexia. Dyslexia is a very new issue in Turkey. For this reason, scientific research in the field of dyslexia in the country is currently very limited and teachers have very limited knowledge about dyslexia. Due to the lack of such studies, this study was conducted with teachers who worked directly with people with dyslexia. The aim of this study was to analyze the knowledge levels of 260 teachers about dyslexia and factors that may be related to it, as determined by their grades in knowledge and beliefs about the developmental dyslexia scale. The results show that these teachers did not know enough about dyslexia and did not feel ready to teach students with dyslexia. For this reason, it would be useful to pay attention to the professional development of teachers by improving their knowledge through educational programs, seminars and conferences.

The International Classification of Diseases (ICD 10) is designed as a health care classification system, providing a system of diagnostic codes for classifying illnesses, including nuanced classifications of a wide variety of signs, symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or disease. Dyslexia, also known as reading disorder, is characterized by a problem with reading despite normal intelligence. Different people are affected to varying degrees. Problems may include difficulties in spelling words, reading fast, writing words, "sounding out" words in the head, pronouncing words when reading aloud and understanding what one reads. Often these difficulties are first noticed at school. When someone who had previously been able to lose their ability, it is known as alexia. The difficulties are involuntary and people with this disorder have a normal desire to learn (World Health Organization, 2009).

The continued engagement of researchers and scientists over recent years on learning difficulties has brought about changes in the definition of dyslexia. By analyzing modern bibliography, it is easy to observe a variety of views on one of the most basic

problems of pupils when they start in the educational process. Student difficulty in reading and spelling, which cannot be explained by the late development of cognitive skills or low intelligence, is a neurodevelopmental disorder that adversely affects the speed and accuracy of word recognition and therefore prevents readability and understanding of the text.

Reading one of the basic skills that a child is called to conquer is a complex and slowly learned skill that requires the integration of multiple visual, linguistic, cognitive and cautious processes. The difficulty in learning this is one of the most common problems faced by children with dyslexia. Although the causes are not fully understood, children who do not acquire reading skills at a regular pace need careful monitoring and support during the early years of school. According to Vellutino & Fletcher (2007), the main component is the removal of general descriptions of "reading disorders" to specific types of reading problems that may involve (1) decoding single words (dyslexia) ability to read words and text automatically in the absence of a word reading problem (fluency), or (3) a comprehension problem when decoding and fluency skills are intact. A person with dyslexia typically has problems with all three domains because of the word reading bottleneck, but smaller groups of children experience difficulty primarily with fluency and / or comprehension. This distinction is important because the neuropsychological and neurobiological correlates will vary depending on the nature of the reading problem.

It is clear that above definitions agree with the fact that the main difficulties of dyslexia are related to the processing of the structure of language, known as phonological processing. Dyslexia is defined as a language-based disorder that can result from neurological and genetic abnormalities (Lyon, Shaywitz & Shaywitz, 2003). Difficulty learning to read is not associated with lower intelligence. However, behavioral manifestations may be modified through the application of certain teaching strategies or through appropriate environmental interactions (Lyon, Shaywitz & Shaywitz, 2003). The quality of life of children with learning disabilities is worse than that of children of normal development and the severity of learning disabilities is positively correlated with a poor quality of life (Karande & Venkataraman, 2012), where children with dyslexia also exhibit emotional problems and aggressive behavior. These difficulties affect social contact, low level of acceptance by peers and self-knowledge. Children

with dyslexia have negative feelings about both their own image and the relationships they build with their peers and families. In general, the problems they present in the learning sector significantly affect the wider social interaction. In the area of social interaction, children with dyslexia are found to have low social skills due to stress or low self-esteem and have many problems with socially adaptive behaviors. (Karande & Venkataraman, 2013).

The aim of this work is to present the relevant literature in the form of a literature review. The relevant literature will be reviewed in order to highlight the research field for dyslexia and the effect of music on it. Bibliographic reviews are secondary publications that aim to aggregate data that have already been published, in order to explore an object from a range of different perspectives, to compare and group results from different studies, and to highlight the specific issue in all its aspects. dimensions, according to the international literature (Day & Gastel, 2012; Siddaway, Wood & Hedges 2019).

The main categories of bibliographic reviews are (a) descriptive (or narrative) and (b) systematic reviews, as reported by Day and Gastel (2012). They also add in order to clarify the concepts that the descriptive review to some extent follows the methodology of the systematic review, but some steps are omitted, giving the works a more narrative character. At the other end of the tug of war, the systematic review follows strict rules, and its elaboration is based on a specific methodology, while finally numerical, quantified, data are extracted (Siddaway, Wood & Hedges 2019).

The introductory chapter will present the theoretical framework, which will refer to dyslexia (definitions, types, etiology, symptoms, diagnosis, treatment and intervention) and music. Also, music will be linked to dyslexia and the results of relevant research will be presented. Finally, the main conclusions of the work will be reported.

## 1.2 Types of dyslexia

Two major categories distinguish, distinguishing dyslexia first from an acquired and evolutionary one. Acquainting is about people who have acquired the mechanism of reading, writing and spelling, but have difficulty or inability to write the word because of brain damage. Cerebral lesions may be caused by brain injuries in the lateral-temporal state of the left hemisphere, from illnesses and infections (Stasinios, 2020).

People with acquired dyslexia read normally, without any problems or difficulties, but because of injury or tumor in the brain, their reading capacity has been significantly reduced or decreased.

Evolutionary dyslexia is the one that follows the person from his birth and has a hereditary background and so he has never developed satisfactory reading ability, resulting in reading very slowly and with mistakes throughout his life. Johnson and Myklebust argue that deficits in this case may be in their nature acoustically or visually. They distinguish between two types of dyslexia: visual and acoustic (Stasinis, 2020).

Optical dyslexia is the most widespread form of dyslexia characterized by deficits in visual perception, visual distinction and visual memory. The difficulty of dyslexics with visual dyslexia arises with difficulty in learning, mainly through visual function. This has nothing to do with the vision of the individual and has been established by tests performed on children with visual dyslexia and showed that their visual ability is working at normal levels (Stasinis, 2020). The "magnetocellular theory" of dyslexia suggests that a deficit in the optic magnetocellular pathway that transmits information from the retina to the visual cortex, and from there to the posterior parietal cortex, is characteristic of dyslexia (Gaggi, et al., 2012). Persons with visual dyslexia have difficulty in the perception and reproduction of visual sequences as well as in the division of complex plans. They present a confused understanding of written symbols and clumsiness in general mobility. They have difficulty distinguishing words or letters that have a visual similarity and treat words as if they were seeing them for the first time, so they have difficulty reading the words altogether. So, they use in the reading of the words the analytical processing where they analyze and compose the words to be able to read them even if they are pseudo-false. It is worth mentioning that the regular reader to read a three-line sentence needs about three minutes. Conversely, a student with visual dyslexia needs at least fifteen minutes (Stasinis, 2020). In addition to the theories of phonological difficulty of children with dyslexia, they have been found to have a magnetocellular deficiency by focusing visual paths traveling on the lateral nucleus (LGN), then it is a visual rather than lingual disorder (Jones, Branigan & Kelly, 2008). They argued that instability in visual attention at points of the text leads to inaccurate processing, a basic symptom that intensifies during rapid processing and a

large load of information. This is a matter not only of visual processing but also of cognitive process.

Acoustic dyslexia or otherwise the difficulty in phonological awareness is considered to be a more difficult form of dyslexia as it is more difficult to cope with it and is characterized by a lack of a person's ability to represent in his mind the distinctive sounds of the spoken language to manage the sounds, to name faces and things and to observe the acoustic sequence. The latter is very important because it is related to the ability to memorize relevant information, always keeping the proper order and order. Acoustic dyslexia has nothing to do with the child's acoustic acidity since it has been found that most children with auditory dyslexia have normal hearing (Stasinios, 2020) People with acoustic dyslexia have difficulty in analyzing words in syllables, syllables in words with content and in the distinction of acoustic details and in the reproduction of sound ensembles (Stasinios, 2020). A child with acoustic dyslexia has a lower performance in writing and spelling than in his reading performance. This is because it can not recognize small differences between sounds that correspond to vowels or accords. Can not associate the special sounds with their corresponding written symbols. We can find this when asking a child to write a dictated text. People with acoustic dyslexia are definitely not hearing correctly the words or phrases of a text. So, they feel the need and ask for repetition of the dictation continually. Indicatively, a child with acoustic dyslexia needs at best three to five minutes to write a simple sentence in dictation (Stasinios, 2020).

Phonological dyslexia can be divided into two subcategories: in cases of poor reading ability but physiological repetition of pseudorabies and in cases with normal reading ability but reduced ability to repeat pseudo-words. The development of phonological awareness begins from a very early age with rhythmic exercises and games about it. The successful emergence of phonological awareness is a very strong predictor for later language and reading skills (Stasinios, 2020).

Recent imaging studies have shown that phonological impairments in dyslexics are associated with significant abnormalities not only in cerebral connectivity, but also in the cortical structure, particularly involving the left hemisphere language network (Catani & Mesulam 2008; Plaza & Cohen, 2004)

Finally, it is almost impossible to identify cases that are purely visual or acoustic or dyslexic. It is common for every dyslexic person to have data from both cases (Stasinos, 2020). We thus have a mixed dyslexia group resulting from the admixture of the two previous types of dyslexia. This group includes children with mixed visual and auditory difficulties and represents about 22% of the dyslexic population. These people have difficulty learning full words and using their voice analysis.

### 1.3 Etiology

Although dyslexia is one of the most common learning difficulties, the causes have not yet been elucidated due to inherited or environmental factors. Studies have shown that there is some dysfunction in the brain regions. The human brain consists of 100 billion neurons, essential cells of the nervous system - specialized in the transmission of messages through electrochemical processes. It is divided into two parts, the right and left hemispheres respectively, which are connected together by a dense nerve fiber zone called a mesolimb. Each hemisphere is specialized for specific functions and behaviors. More specifically, the left hemisphere is responsible for linguistic, mathematical and logical thinking while the right hemisphere is responsible for visual perception of space, emotions, imagination. More specifically, the left hemisphere is responsible for the perception and production of speech, processing information in a linear, analytical and methodical way, by a productive or inductive method. It analyzes, judges and focuses more on the problem. It has the characteristic features of organization, logical processing and settlement. The memory and processing of thought in the left hemisphere is verbal, that is, thinking with language. The left side of the brain is responsible for understanding the symbols (letters-words), numbers and mathematical definitions (Stasinos, 2020). According to (Ying-Fang Sun, 2009), during a rheumatic auditory test and using one of the most well-known methods of brain imaging, fMRI found that people with dyslexia activated less the left temporal cortex compared to non-dyslexics. The meta-analyses showed that the left side of the brain is the one that was activated in normal readers during the test and right in the dyslexic.

#### 1.3.1 Neurological factors

The brain can be considered as a significant factor in the reading and writing processes, as all data is processed and stored in the brain. The brain is divided into two hemispheres, the left and the right, in which different functions take place. The left

hemisphere has four areas involved in different areas of language, such as language comprehension and processing and speech production (Snowling, 2005). Research data suggest that dyslexic readers show impairment in the functions of a large part of the posterior cortex of the brain, which includes fixed visual and lingual areas (Lyon, et al., 2003). Other studies have shown that areas of the brain that are activated in a simple reading process can significantly predict students' subsequent reading skills. In essence, these areas are likely to show differences in brain function, which are causally related to children's reading ability (Ramus, 2004).

### 1.3.2 Genetic factors

Dyslexia is considered to be an inherited disorder. Findings from studies suggest that it is imperative that genetic factors be considered in the study of dyslexia (Becker, et al., 2017). This learning disorder tends to occur in families and can be inherited by one of its members. For example, if there is a dyslexic child in the family, there is a high chance of dyslexia in another member (Snowling, 2005). Those children who have a first-degree relative who is dyslexic are at genetic risk of developing dyslexia. If one or both parents are dyslexic, their children are more likely to be dyslexic, as genes play an important role in this type of learning disorder. Thus, when the teacher notices that the child is dyslexic, it is good to ask him questions about the historical family background (Landerl et al, 2013).

However, the genetic origin of dyslexia must be compared with other factors. There are many non-biological causes, which can positively or negatively affect the expression of genetic factors. Even if the diagnostic criteria of dyslexia exclude socio-educational deficiencies, the role of the socio-cultural environment in reading disorders is recognized (Simmons & Singleton, 2008). Indeed, the socio-cultural level of the child plays a role in the severity of the disorder, as it makes coping more difficult. According to Lyon et al (2003), dyslexics from disadvantaged backgrounds have more difficulty in using coping strategies.

### 1.3.3 Environmental factors

In addition to genetic influences, environmental factors, sometimes in combination, contribute to a child's subsequent reading difficulties. It is known from epidemiological studies conducted since the 1970s that dyslexia occurs more often in children from more disadvantaged socioeconomic conditions (Vellutino & Fletcher, 2007). At the same

time, conducting activities at home that are directly related to literacy, as well as the educational level of the mother, are factors that shape the reading environment provided to children (Vellutino, Fletcher, Snowling & Scanlon, 2004). Some researchers have suggested that this may have a greater impact on reading comprehension than on decoding skills (Vellutino et al., 2004).

#### 1.4 Symptomatology and characteristics

Symptoms of dyslexia do not appear all and to the same extent but are varied in terms of reading, writing, spelling, language, short- and long-term memory, coordination, organizational difficulties, difficulties in the process of recruiting information and phonological difficulties. It is not necessary to co-exist all the symptoms to characterize a person as dyslexic, but not a single symptom to justify the characterization (Reid, 2016).

From infancy we can recognize some of the symptoms of dyslexia, since the child from just 2 years of age experiences problems in speaking or even delaying his speech. At the age of 3, it is difficult to remember rhythmic songs compared to other children of his or her age. In early childhood he has difficulty recounting events in a logical sequence but also coordinating some of his actions such as tying his shoe cords, singing and walking etc (Reid, 2016; Frith, 2017; Στασινός, 2020).

According to Willburger & Landerl (2010), the reading disorder is characterized by a reduced reading speed. Children with dyslexia need two and three times to read something about, but later on the speed of reading and difficulty in understanding text, especially when the sentences are large enough and the words complex and polygonal. Further difficulty is observed in the association of individual letters with their respective sounds, which results in reading other words in similar letters. This disorder also manifests strongly in learning foreign languages. People with dyslexia have an increased number of spelling mistakes.

According to Panteliadou (2011), a deficit in phonological awareness, knowledge and use of language phoneme is considered to be the most important predictive factor for learning disability. The basic difficulty of children with dyslexia is their poor phonological awareness, which is very important in reading and writing (Boada & Pennington, 2006). Phonological awareness or otherwise awareness - consciousness is

the ability to match letters with the phonological significance they represent. Difficulty is manifested in the realization that the proposals consist of words and words from syllables and phonemes resulting in a deficiency in the analysis of the oral speech in the individual phonemes (Polychroni, 2011a, 2011b; Polychroni, Chatzichristou & Bibou, 2006).

Investigations were conducted in order to understand the reasons for this deficit. It has been found that the difficulty in phonological awareness of dyslexic patients is due to their inadequate acoustic perception and treatment (Blomert & Mitterer, 2004). Additional support in the above position came with the research by Ziegler et al (2009) where there was a lack of speech perception in children with dyslexia to identify a vowel - vaginal stimulus when it was presented under different conditions with noise, while the deficit did not exist when the same stimulus was present in silence. The researchers argued that the lack of perception does not appear in silence, as the speech signal contains many unnecessary audio information, but the burden of additional environmental noise is likely to show deficits in perception (Polychroni, 2011a, 2011b; Polychroni, Chatzichristou & Bibou, 2006).

Acoustic processing is the ability to analyze, synthesize and distinguish acoustic stimuli as well as their processing. It is noted that the deficient audio capacity can be combined with incomplete phonological coding and phonological awareness (Polychroni, 2011a, 2011b; Polychroni, Chatzichristou & Bibou, 2006). Children with dyslexia did not differ greatly from the control group in acoustic treatment, acoustic treatment did not appear to affect the phonological process, reading and spelling alone, and some cases of dyslexic children showed a deficit in acoustic treatment (Polychroni, 2011a, 2011b; Polychroni, Chatzichristou & Bibou, 2006).

*Table 1: Possible difficulties in the reading process in people with dyslexia.*

<b>Difficulty</b>	<b>Definition</b>	<b>Example</b>
Phonological awareness	Ability to handle the phoneme.	Say the word without without the / g / -What word is created by the sounds / π / - / ε / - / ? / ? - Say a word that makes the word happiness
Reading ability	Ability to read words individually or in textual form with sufficient accuracy and	- Read aloud a list of common words or pseudo-sentences quickly and accurately

	speed to understand their meaning.	- Read loud, fast and accurate paragraphs of increasing complexity
Rapid automated naming	Ability to quickly express a number of known stimuli, reflecting the effective visual-verbal connection	Name as quickly as possible an array of 10 × 5 with 5 random repeating objects, colors, letters or numbers

Dyslexia in terms of functional levels of language have specific characteristics. As for the phonological level, it appears as a difficulty in phonological integration, as for the morphological level it appears as an inability to connect between form and meaning, as for the syntactic level it appears as a difficulty of applying the syntactic rules and as for the semantic level it appears as a difficulty connection between acoustic and graphic image (Gaab, et al., 2005; Pierangelo & Giuliani, 2008).

It is a common phenomenon for teachers who have children with dyslexia in their classes to give more weight to specific cognitive functions such as reading skills and phonological awareness, as children with dyslexia show poor phonological awareness. This approach, although it offers a wealth of information in the assessment process, does not, however, promote an integrated approach to the student's learning profile, as it fragmented him into a set of sub-skills and competencies (Riddick, 2006).

It is important, however, that students be treated as integrated learning units, with cognitive and emotional needs, which must be met within and outside the school context. Research has suggested a variety of learning strategies that can be particularly supportive of students with dyslexia, including elements related to the classroom environment, teaching methods, tools and new technologies, and emotional support. of students, in collaboration with family school, etc. (Wagner, et al., 2020; Snowling, Hulme & Nation, 2020).

It has been observed that children with dyslexia often, in addition to cognitive difficulties, also face emotional difficulties, such as low self-esteem, indecision, lack of initiative and low levels of commitment (Burden & Burdett, 2005). Education in competitive learning environments further complicates the above problems, thus highlighting the need to turn to inclusive practices that will focus on empowering the individual by favoring both determination and collaboration (Riddick, 2006).

## 1.5 Diagnosis and the need for early diagnosis

Diagnosis can begin from pre-school age, but it is common to be observed by parents or educators during the early years of schooling when the individual fails at school. The sooner dyslexia is diagnosed, the sooner the intervention is performed by specialists, and the child quickly follows a personalized support program from a special education teacher, which is more likely to face its potential difficulties (Reid, 2016).

Already from pre-school and early school age the child has managed to conquer (Reid, 2016):

- The language i.e. the phonological, morphological, syntactical and semantic rules of the language that correspond to its age and allow it to communicate and express itself
- Movement means the means and capabilities that allow it to move and perform the Thin Mobility activities, balance, control and direct the objects it uses
- The attention, the control and the selective process of knowing to listen, observe and perceive as well
- Intelligence, ie the process of digesting, understanding and processing any stimulus it accepts.

According to the above, we conclude that if the child does not meet these requirements, then he or she has a certain disruption in the developmental delays of reading such as dyslexia, dysgraphia, or learning disabilities in general. The sooner the diagnosis is made, the more quickly and thoroughly the dyslexic student will be reinforced. When the diagnosis of dyslexia occurred in the first two grades of elementary school, more than 80% of the students managed to shift to the normal teaching program in in the classroom. In this case it is considered necessary to diagnose a specialist. Significant diagnostic elements for each specialist are (Reid, 2016):

- Completing the estimated diagnosis before the intervention program starts.
- At the same time achieving assessment and retraining as a single intervention.
- The variety in the diagnostic-therapeutic approach depending on the type of communication disorder according to the problems that are subject to case.

During the diagnosis procedure the specialist (Stasinos, 2020):

- Collect relevant data, including information on appropriate approaches and objectives per case study.
- Evaluates all symptoms through examinations and observation.
- Associates linguistic verbal differences with causal factors in order to obtain the most accurate explanation of unusual behavior.
- Forms his assumptions for proof and formulates the prognosis.
- Identifies techniques and treatments that are included in a recovery program that is indicated.

In order to diagnose a person with dyslexia, a Psychological Assessment should be done to measure his mental capacity through the intelligence test. It should be excluded from this assessment that Special Learning Difficulties are due to mental retardation, sensory impairment, emotional disturbances and environmental deprivation (Polychroni, 2011a, 2011b; Polychroni, Chatzichristou & Bibou, 2006).

Then, since medical examinations have excluded any medical problem of vision or hearing, the school performance will be assessed. The evaluation includes a detailed analysis of reading and spelling mistakes, through weighted or unmatched tests, in order to obtain accurate results on the progress of the child. Finally, the assessment of cognitive processes and mental health must be done (Polychroni, 2011a, 2011b; Polychroni, Chatzichristou & Bibou, 2006). Therefore, in order to diagnose dyslexia, we should present the family history of the child as well as the differences between non-verbal and oral intelligence, as well as the ability to read it. Assessment and diagnosis can be carried out with simple tests of letters and phonological awareness in the early stages of reading. early diagnosis is much more effective than expecting parents or teachers to suddenly start failing to read more and more. Such examinations could provide a good indication of the risk of dyslexia in children (Snowling et al., 2020). Assessment and diagnosis are a basic prerequisite for treating dyslexia. There are too many tools that are used to diagnose dyslexia, many of which are weighted, many not. It is necessary to use more than two tests to assess the different weaknesses of these individuals.

Studies in both children and adults with dyslexia have shown that in most cases the diagnosis is made too late. All subjects in these studies wished to have been diagnosed

earlier, and to seek help and support regarding the learning disabilities they were experiencing. If an early diagnosis had occurred, their lives could have been easier, and they probably would not have felt much frustration and anger during their school years (Reid, 2016).

The earlier the diagnosis is made, the faster and more completely the student with dyslexia will be strengthened. According to a study by Badian (1988, cited in McKeown, 2014), when dyslexia was diagnosed in the first two grades of elementary school, more than 80% of students were able to return to the regular curriculum within in the class. Stag research (1992, cited in McKeown, 2014) suggests similar rates. According to it, 82% of children diagnosed in the first and second grade of primary school manage to cover the difference with their classmates, compared to 46% of third grade students, and the even smaller percentage (10 -15%) of 6th grade students (Stag, 1992, cited in McKeown, 2014).

#### 1.6 Treatment of dyslexia

As already mentioned, dyslexia as a neurological disorder with apparent symptomatology in the audio-visual analysis of syllables and words without the existence of mental retardation, unfortunately it is not cured. However, several scientific disciplines, whose speech therapy, occupational therapy, and special educators are concerned with ways to improve these symptoms. Dyslexia is a heterogeneous syndrome since each dyslexic child presents his / her own particularities of the combination of his / her difficulties and their sources, which are found after detailed diagnostic analysis and assessment. Thus, with reference to the perspective of a therapeutic approach to the problem, it is always a matter of applying a combination of techniques and tools that is the most appropriate and effective for the particular child. It is precisely this combination that establishes the concept of an individual support program (Stasinos, 2020).

Initially restoration begins by clarifying the symptoms - difficulties for parents and then for the child itself. The role of the parent is very important both for the child and his development. Perhaps he is the first to realize the child's weaknesses and will appeal to the experts. It is he who will create a relationship of mutual trust and mutual trust with the child's teacher. Parents should be supportive, patient, child-friendly, offering their

help but also reinforcing their self-confidence. After all, restoration of dyslexia has two elements: the treatment of the difficulties of reading and spelling, as well as the treatment of possibly common psychological disorders. This is why the child needs to be protected but does not feel overprotected in order to be able to take initiatives at any given moment. The development of common sense by the whole family is considered necessary to create the feeling of stability and receptivity of the family itself to the child (Stasinios, 2020).

The mode of treatment depends on the severity of the symptoms of both dyslexia and the psychological condition of the person being infected. Rarely, the use of medication is a therapeutic unless it is co-vascular, such as dyslexia and hyperactivity (Gerd Schulte-Körne, 2010). Once the diagnosis has been made, therapeutic intervention should be designed appropriately and carefully to respond to the child's rhythms and not to create anxiety. The threefold role of the teacher, cohabitation, collectivity and consciousness is considered important, since he is also the one who will be asked to implement the child's intervention program. By designing the therapeutic intervention, the lesson should be enjoyable and entertaining, motivating and stimulating the sense of self-confidence through a climate of security and encouragement both at home and by the trainer himself. Cultivating and promoting a friendly school climate should be ensured both by the class teacher and by the manager himself.

### 1.7 Teaching methods and learning approaches

Dyslexia is a learning disorder, as confirmed by Marshall (2021) that affects a person's ability to understand the relationships between letters and sound, which in turn affects their ability to decode words. This can affect a person's ability to read accurately and effectively, limiting comprehension of the text. Starting around the third grade, significant amounts of information are gained through reading. Since dyslexia affects a person's ability to read and understand, this can negatively affect academic performance. It can also have a detrimental effect on social and emotional well-being. This study investigated the social and emotional impact that dyslexia has on students to determine the need for social and emotional support in conjunction with interventions and to investigate its effectiveness. Research shows that the negative social and emotional effects of dyslexia can affect students through adulthood. This article describes what dyslexia is, how it can affect students' social and emotional well-being,

and provides seven research-based interventions and their effectiveness in supporting students with dyslexia in the classroom. Dyslexia also has a very personal element to the author. As a student and now an adult with dyslexia and a student teacher have the same diagnosis, the researcher is committed to providing academic interventions while knowing the negative impact on students' social and emotional well-being. Complementing academic interventions with positive social and emotional support can offer lasting benefits to people diagnosed with dyslexia.

Regarding the treatment of dyslexia, this may include therapeutic (speech therapy) teaching, psychomotor and graphokinetic programs and psychotherapy. At the level of teaching, which is a core of interest, the motivating factors and the positive-emotional atmosphere are important. Basic principles are to avoid teaching parallel letters that are confusing, to accompany pictures, to read aloud, to understand what is being read rather than to reproduce it mechanically, and to use games such as writing in the sand (Daloiso, 2017; Stuart & Yates, 2018).

The general categories of learning theories are behavioral, cognitive, constructivist, and sociocultural. In behavioral theories, learning is a change that occurs through experience. Cognitive theories are about thinking, making decisions, memory, creating and solving problems. Teaching strategies are based on information processing, emphasizing the importance of attention, organization and practice in learning. The emphasis is on what is going on inside the student's head. In constructivist theories, learning is the construction of knowledge. Individuals create knowledge, they do not internalize it from the external environment. Problem-solving research and learning and collaborative learning are standard teaching strategies that are consistent with constructivist approaches. The essence of this approach is that it places the efforts of the students themselves at the center of the educational process. Sociocultural theories recognize the importance of the social and cultural context (Daloiso, 2017; Stuart & Yates, 2018).

Differentiation may be the key to the needs of students with learning disabilities (Inglebret, et al., 2016). Differentiation is a philosophy, a way of thinking about teaching and learning that values the individual and responds to diversity among students in the classroom (Inglebret, et al., 2016). Differentiated pedagogy is a didactic and learning approach that allows individual differences to emerge on the surface,

embraces them and ensures that each student learns in the most appropriate way according to his needs (Darrow, 2015).

Methods of teaching reading need to include visual approaches, acoustic, kinesthetic-tangible and combinatorial (Ott, 2007). Multisensory philosophy aims to help students learn using more than one sense. Therefore, they are given the opportunity to use their personal potential areas. Effective learning is achieved when the material taught uses more senses as more memory pathways are built (Reid, 2012). Multisensory methods show that a combination of visual, tactile, phonetic and meaningful codes can successfully aid spelling learning in dyslexic children (Reid, 2012). Simultaneous oral spelling with the introduction of acoustic, visual and motor elements can effectively support spelling learning in children with difficulties (Reid, 2012). The multi-sensory approach is also explained biologically. If cells that respond to visual stimuli and at the same time cells that react to headphones light up at the same time, they are probably reacting to the same event. Hebb's law says: Cells that fire together wire together. The connection between them becomes stronger and for this reason a cell connection may be created in due time (Nicolson et al., 2010).

Students with dyslexia use multimodal approaches more often and perhaps for this reason they benefit from multisensory methods. Neurofunctional studies (Vlachos, et al., 2013) have shown the effectiveness of these methods in dyslexic populations, which have found increased activity in the left hemisphere after intensive multisensory intervention programs.

Continuous practice is also an important teaching method as the same words and skills need to be taught in different situations. If a new word is learned, it should be used in other contexts. The aim is to achieve automation, the acquisition of the mechanism of reading and writing to be achieved automatically. The material for this purpose needs to be combinative, below their level for practice and assistance in automation and above that for the development of understanding (Reid, 2012).

Collaborative learning has positive effects on interpersonal relationships, academic success and social development. The class is divided into heterogeneous learning groups, they work together for a common purpose and the group members are paid. Placing students in the same context does not in itself mean progress and acceptance. It

is how well the environment is structured to produce good performance. In collaborative learning, students take on more responsibilities for themselves and their learning as they are asked to take an active part in activities (Stasinos, 2020).

One practice in relation to the practice of spelling is visual-mnemonic flashcards where a word is written with a kind of visual symbol that shows its meaning. Although used in acquired dyslexia, it has also been used in cases of developmental dyslexia (Rowse & Wilshire, 2007). Research (Feeney, 2003) has shown that interactive multimedia that encourage multisensory learning pathways help dyslexic and non-dyslexic students, in accuracy, response time and a sense of excitement. Dyslexic students are more likely to succeed using multimedia. Teachers and students can select a text at the touch of a button or enlarge the font if needed (Long & Szabo, 2016). Students today have the whole world in their hands thanks to technology. Therefore, teachers need to use it in the lesson as the use of technology increases students' engagement in activities and its integration into the daily teaching of reading has the potential to change the attitudes of non-mobilized readers (Long & Szabo, 2016).

Everyone has a learning style they prefer. Knowing and understanding our learning profile helps us learn more effectively. This is true for people with learning disabilities due to the different ways of learning. However, research in Greece by Vlachos et al. (2013), showed that adolescents with dyslexia do not show different learning profiles compared to typical readers but only a higher preference of students with dyslexia in audiovisual education. It is important to develop visual alphabet skills in students with dyslexia. Visual literacy is the ability to interpret and produce images in order to communicate ideas and concepts and is a critical component in effective learning. It is widely believed that teachers should utilize the sense of sight through the cultivation and development of visual literacy (Vlachos, et al., 2013).

## 1.8 Music education in Greece and dyslexia. Theoretical background – Law 3699/2008

According to the latest law 3699 (Government Gazette A, 199 / 2-10-2008) on special education, Greece adopts a new education system for people with difficulties adapted to that of the European system. Specifically, it is stated that "Special Education and Training (EAE) is the set of educational services provided to pupils with disabilities and identified special educational needs or to pupils with special educational needs. The state is committed to continuously enhancing and upgrading the compulsory nature of special education and training as an integral part of compulsory and free public education and to provide free public education and training for disabled people of all ages and for all stages and educational levels. It also pledges to ensure that all citizens with disabilities and identified special educational needs, equal opportunities for full participation and contribution to society, independent living, economic self-sufficiency and autonomy, with full rights to education and social and occupational integration, are guaranteed equal opportunities. "

Thus, Special Education and Education becomes compulsory, public and free as it exists in general education. This requires the proper functioning of specialized centers for the diagnosis of these difficulties, such as the Centers for Differentiating, Diagnosing and Supporting Special Educational Needs (KEDDY), as well as the correct intervention by appropriate teachers with customized training tools.

According to Article 3 of Law 3699/2008 "Students with disabilities and special educational needs are considered as having significant learning difficulties during their entire or part of their school life due to sensory, mental, cognitive, developmental, mental and neuropsychiatric disorders which, according to the interdisciplinary assessment, influence the process of school adaptation and learning. Students with disabilities and special educational needs include those with mental disabilities, sensory impairments (blind, low vision), sensory hearing impairments (deaf, hearing impaired), motor disabilities, chronic irreversible illnesses, speech-to-speech disorders, learning difficulties such as dyslexia, dysgraphia, dysquiagnosis, dysangia, dysarthria, attention deficit syndrome with or without hyperactivity, diffuse developmental disorders (autism spectrum), mental disorders and multiple disabilities. In the category of pupils with disabilities and special educational needs, students with low school performance

that are related to exogenous factors such as linguistic or cultural specificities are not included. "

The training of these specialists can be carried out in Schools for Special Education and Training (SEDAE) as well as by inclusive education in general schools by implementing specially tailored educational programs according to the needs of the students. In 2008, the pedagogical institute and in particular the special education department completed the curricula for learning difficulties. Experts and special educators adapted curricula for the language, mathematics and natural sciences with appropriate modification of the teaching modules per subject for the purpose of diversifying the teaching of students with learning disabilities. In the music lesson, there is currently no proposal to modify the curriculum for learning difficulties, but there are customized music programs for children with moderate and mild mental retardation and autism.

### 1.9 Curriculum

The existence of an integrated and valuable curriculum is necessary for both primary and secondary education. In Greece, in the last few years, the cross-curricular single music curriculum has been applied to general education. It is the creation of an interdisciplinary teaching program, i.e. the creative synthesis between two or more sciences (DEPPS-APS, 2003).

According to the curriculum, some of the objectives of general education music education are:

- Perform rhythmical and melodic patterns from memory and symbols.
- To express feelings by singing a range of songs from different sources, paying attention to intensity and orthophony.
- Develop the ability to control sounds in a variety of musical instruments.
- Share music with different audiences. Perform executions responding to signs, symbols, slogans and memory.
- Sing a wide range of songs with increasing control of tone, rhythm, orthophony, musical expression and intensity.
- To play, with increasing control of the technique, many instruments rhythmically and melodically.

- Understand the need for effective communication with their listeners during musical performance
- Perform, interpret more complex musical symbols, perform more complex commands, and understand musical elements more satisfactorily.
- Sing and play tracks from different seasons, places and cultures, with increasing control of musical elements, including sound color.
- Perform as a group just music tracks, independently of another group.
- Show performances effectively either by conducting or following the conductor.
- Respond to musical elements and distinguish differences, including melody
- To listen carefully to music, to respond and to recognize musical elements such as height, duration and rhythm.
- Investigate, select and combine sounds produced by the voice, body and musical instruments to produce simple compositions.
- Design and show performances for different species

Due to my further research on one of the basic elements of music, the rhythm and its combination with the Greek language will be followed by a detailed analysis of the music teaching and its main gaps for children with dyslexia. The analysis will be carried out for the first grades of primary and third grade and the sample selected will be from 7 to 11 years old.

According to the curriculum and the thematic units, the teaching of the rhythm follows the next stages:

- Control of sounds through skills in singing and playing organs- Skills of execution
- Song with pure expression of speech, control of the tonal height, sense of musical phrase and musical expression.
- The play of mathematical and rhythmic instruments with control and rhythmic precision.
- Presentation of executions to the public.
- Creating and developing musical ideas - Creative music activities
- Improvisation, selection, combination and organization of musical ideas within musical structures.

- Improvisation with the development of rhythmic and melding material during execution.
- Response and review-Evaluation skills
- Exploration and explanation of ideas and emotions for musicals, using dance, expressive language and musical vocabulary.
- Improve individual and team work based on the desired result.

### 1.10 Teaching music

Music is an integral part of human life and indicates a particular culture, a society with common values, interests, goals and a common language. It is also a non-verbal means of communication between different cultures, moreover, it has been characterized as a universal language because through music man can express his values, his ideas, his feelings, but also important symbols in a diachronic perspective. It is a cultural symbol that can be learned through official bodies such as Conservatories, schools and through non-official organizations such as television, religion and pleasure. At this point it would be useful to review a brief history of music education throughout the centuries (Jackendoff, 2009).

Since ancient times, there has been the first case of music education at the Sumerian school in 3000 BC. J.-C. The musical process was a key element of this formation (Ματσαγγούρας, 1999). At the same time in Greece, we notice the Cycladic culture. In the islands of the Aegean Sea we find that several musical elements were found, mainly in the tombs as objects that accompanied the dead. Thus, several vases, marble figurines, Cycladic idols representing a man playing the harp, or a player of aulos were found in several regions like Thíra, Amorgos, Naxos, and Keros. One of the earliest musical Greek testimonies, perhaps the most important, is the Keros harp player.

Then we notice the Minoan civilization dating from 2600-1150 BC. AD in Crete taking its name from the mythical king of Knossos "Minoas". During this period several testimonies like instruments or pieces of the instruments that were found, as well as the representations on the old vases, and the frescoes reveal the intense presence of the music like a primordial element of the culture and the tradition Minoan. Some of the musical instruments represented are: the triton, the lyre, the harp, the Archanes seistrón. Also the stone sarcophagus found in the tomb of the Holy Trinity about the burial of a

prince is unique. Finally, the Mycenaean civilization developed during the period 1600-1100 BC. BC, considered the first Greek musical culture because according to the opinion of many historians until 1600 BC. Both continental Greece and its islands were not inhabited by the Greeks. During this period, archaeologists have found only two instruments of music, two lyres.

Moreover, the term ancient Greek music refers us to a Greek musical culture between the 8th century BC. BC and until 700 BC. J. - C. We can also note while looking through these centuries that one refers to "obscure centuries", because the sound, the rhythm, and the melody generally lack music. Of course, we can notice on the monuments of the representations, as well as by the writings found elements that indicate a rich culture.

Music training played a vital role in ancient Greece because it was closely related to people's ethos, but also to the non-verbal part, with therapeutic properties. The goal of music education was harmony - balance of oneself and peace of soul. In ancient Greece music was one of the three main courses with mathematics and grammar. During the Middle Ages the perfecting of the range (five lines instead of four lines used for Gregorian chant) and the conversion of traditional oral music to written music, much like today's, had a great influence to the teaching of music. In the Middle Ages, we notice the first universities where music education played an important role. During the Renaissance we notice the evolution of musical instruments, but also a first classification of musical genres according to the time or place that the music was played. These parameters gradually created new methods and techniques for teaching music.

At the end of the 15th century it became possible to study music at universities. These studies varied according to the university and could have a conservative character or a progressive aesthetic. Thus, one can study music simultaneously and combine it with other philosophical studies or human sciences, such as Greek or Latin literature (Χρυσστόμου, 2005)

In the 19th century, methods of teaching music evolved by exercising auditory skills and through learning to read scores and write music. The musicians of that time

emphasized the importance of the development of hearing ability through music theory, which until today is considered a necessary tool for musicians.

#### 1.10.1 Main methods of teaching music

The child's musical development begins only from the early stages of his life and is influenced by the environment in which he grows. The sound, the rhythm, the duration, the intensity are the first perceived musical elements with which every human being can experiment from the very first years of his life, necessary for the acquisition of the language. The rhythmic perception is observed from the first few months of our life about 2 months, at 7 months we can perceive the concept of measure while at 9 we can easily observe the small differences in timing in bold metric shapes. The improvisation of songs can evolve into the reproduction of children's songs, imitation of melodic motifs, movements in just three years of life. As children grow older, they perceive the pulse, the variation of intensity and the alternation from low to strong, they begin to synchronize with the children's songs that they hear and strike rhythmically, clapping, bouncing on the same foot or alternately, listening carefully and actively participating different musical genres (Gromko, 2012). At the age of 8, they are ready to start any musical instrument since they have gained muscle coordination, fingertips, breath control.

Music education can help each child to communicate with others around him but also with himself. It is very important for emotional, physical, spiritual, social development. With music teaching children come in contact with their deeper feelings, they can express their joy, love, regret, fear, sorrow through many different musical activities even by listening to the singing of musical pieces. By participating in musical group activities, they can not stimulate their minds, fill their self-confidence, socialize, become aware. Music is a way of entertainment, entertainment, a powerful factor to unite different people regardless of nationality, culture, personality, if through it can develop a sense of cooperation, interaction, freedom. At younger ages the lesson of music can help physical development through appropriate motion and dance games. Nowadays, the importance of research has been highlighted, the goal of which is their desire to identify the benefits of musical teaching in the cognitive process (MacDonald, Miell & Mitchell, 2002).

It has been noted that music education helps pupils also in the school process. Children who have received music lessons are particularly trained in acoustic and visual memory, while different features such as patience, persistence, discipline, selective attention, interest, tendency to explore are developed. These are the characteristics that can be an incentive for learning in general (Corrigall et al., 2013). Of course, the musical educational process can create anxiety for the student and become an unpleasant activity. In this case, stress can come from fear created by the teacher himself and his demands during learning. However, music can remain as a pleasant and entertaining educational process with adaptive exercises per pupil.

The benefits of musical activities are connected with the use of the rhythm of music, since most activities are also composed of rhythmic motifs, called as measures. It is commonly accepted that rhythmic activities that are related to the perception and reproduction of rhythmic patterns produce positive results in cognitive function. Improvisation, movement during music listening, performing a musical piece on a musical instrument can be considered a way of fun through the rhythm. Extremely stressful individuals can be entranced by the movement following the rhythm of music (Gander et al., 2010).

The ability of the rhythmic hit at a certain rate requires different cognitive functions like this during reading. Tierney and Kraus (2013) showed that children with rhythmic perception had better memory, attention, coordination of movements, sensory-motor integration. The benefits of musical education in rhythmic education, the adaptation of breathing to the external rhythm of music can affect our emotional state and shape the right conditions that favor the plasticity of the brain. In addition, rhythmic activities, and our synchronization with others through the rhythm, can increase pre-social interaction, trust, co-operation, and feelings of compassion. Besides, from a very young age, during the educational process, we are invited to participate in musical groups and to synchronize by playing different musical instruments. In this way we activate our nervous system. An acoustic rhythmic excitation called (RAS) is an important method that affects a damaged brain (Rodriguez-Fornells et al., 2012; Miendlarzewska & Trost, 2014). In addition, the neurological symptoms of Parkinson's disease can be reduced by the synergy of walking movements with the coordination of walking movements.

The interdisciplinary approach is a method of teaching that can enhance students' interest as the learning process develops the sense of searching, negotiating, reconstructing all knowledge rather than simply transferring information from the teacher to the student, for this reason the cooperation between teacher and student is of paramount importance.

During the educational process of music in children with dyslexia there are several difficulties:

- acoustic,
- Reading,
- Mechanical skills,
- in visual perception,
- Synchronization skills,
- in playing score,
- in kinesiology,
- Dynamics
- in the tint,
- sense of rhythm,
- tonal pitch distinction

Poor coordination of eyes and hands slows the processing of symbolic information during reading of a score and a text. Encoding of optical symbols makes coding of optical symbols more difficult (Miles et al., 2008). Mechanical skills are the ability of the muscles to connect and control the movement of the body members and are divided into two categories, the main skills including movements such as walking, dragging and fine movements such as eye and hand coordination, small objects. During the musical training of a musical instrument, children with dyslexia are confused to place their hands correctly in the musical instrument due to the confusion of directions and their finger movements are hesitant. The difficulty in coordinating and synchronizing movements results in arrhythmias of the hands in listening to a melody or a rhythmic motif as well as inaccurate coordination. Learning the piano as a musical instrument can make it difficult for a student with dyslexia, since the combination of score reading,

decoding information, edge co-ordination multiplies learning challenges (Vladikovic, 2013).

The difficulty of children with dyslexia in visual-spatial skill, ie the understanding of the figures, shapes and symbols associated with writing, is directly related to the study of a piece through a score. The weakness of short-term memory and concentration problems can often make it difficult to read the score if, according to testimonies of dyslexic children, the notes seem to fly in the pentagram. Difficulties also arise in distinguishing different sound colors but also in determining with certainty when changing the intensity (Vambouclis, 2005). The distinction of tonal height is a distinct difficulty since children with dyslexia have a diminished sense of space, concepts such as up and down are likely to confuse them so that the tonal height is not noticeable.

According to Chrysostomou (2003) the main methods of teaching music are as follows:

#### THE DALCROZE METHOD

This method was invented at the beginning of the 20th century and is the most complete system for rhythmic training and movement. Jacques Dalcroze, born in Vienna in 1865-1950, created this method. He had studied music, theater, piano and composition. In 1892 he was hired as a professor of music writing in Geneva where he began to develop this method. In the early 20th century, he observed that the existing teaching method did not help his students discover the elements of music and express themselves through music. He watched the students who played music without understanding it, and consequently without emotion. He therefore considered that the solution to this problem would be to be able to control the contraction and the relaxation of the muscles according to the speed, the duration and the dynamics (nuances) of the sound. He also believed that rhythm and height could develop a system that connected the ear with the brain and the body. Finally, his system is based on three different elements: eurythmy, that is to say, the movement used to express emotions, hearing ability and improvisation. Dalcroze argued that teaching Rhythmic Solfeze using rhythm-based can bring positive results to pupils with reading problems. He created about 100 melodies and 450 rhythmical solo exercises, and gave great importance to the teaching of space mussels.

#### THE KODALY METHOD

Kodaly, born in 1882 in a village a few kilometers from Budapest, began his musical training at an early age, learning piano, cello, and violin. His great interest in music led him to publish books on music training, but also helped him to devise a systematic method appropriate for school curricula from kindergarten to high school, emphasizing rhythm, singing and learning musical instruments.

This method emphasizes the importance of learning musical notation, once the teacher considers that children are ready to learn, write and read music, that is, when the child begins to learn, read and write the alphabet.

He also teaches two-beat rhythmic patterns first, then continues with three-beat rhythms. It also highlights the importance of the minor third interval. He also teaches kinaesthetic learning using gestures made to understand pitch, as well as hearing skills that focus on listening to recognize rhythmic and melodic patterns. These elements formed the core of his method. Finally, improvisation, that is, the child's ability to create melodic phrases and to imitate, played an important role in his method of teaching. Kodaly believed that music education should be based on the musical tradition of each culture.

#### THE ORFF METHOD

Creator of the method is the German Carl ORFF. Being influenced by ancient Greece, he approaches the teaching of music by combining melody, movement and speech, a unit that has also called it elementary music. Having studied piano, he discourages his students from learning to play the piano, because he thinks that the use of percussion can create a need for students, a need to create their own music, their own melodies.

This method is characterized by a combination of speech and rhythm, because he considered that the recitation could be combined with the beatings of the rhythmic hands, with fingers in hand - feet on the floor. Also, the movement that accompanies the rhythm, but also the improvisation on rhythmic or melodic motives on the percussions were essential elements of its method of teaching. He felt that the relationship of the student with the teacher is based on interaction and is variable. He believed that creative play could develop the personality of the child and his contact with art to cultivate free music expression, improvisation. He believed that all children

were able to acquire the musicality and it was enough for them to participate in musical activities corresponding to their level.

## THE SUZUKI METHOD

Suzuki, a Japanese musician and educator, invented the so-called talent education method for teaching string instruments to small children. The main elements of the method are listening to music, developing techniques and encouragement. He believes that every child can achieve a very high musical sensitivity. The development of the capacity of the musical memory through listening, observation and imitation is a key element of the method. The Suzuki method is also referred to as the mother tongue method since its main purpose is to learn music in a straightforward way that one learns the mother tongue. In addition, he believes that audible skills can be exercised before learning musical notation and that the child can play a musical instrument without knowing how to read music while the notation is inserted when the child plays several pieces on the musical instrument he is learning. The musical pieces used by students in the world include carefully selected musical pieces and not craftsmanship exercises to support hearing learning.

### 1.10.2 Relationship of music and language

Music exists in every human society, its role, its meaning and its character differ from culture to culture. Just as languages differ from one another due to geography and time, and they create language varieties, the linguistic musical systems differ from one another. Each language has its own vocabulary, which combines and creates syllables, the syllables make words, and the different meanings are rendered according to the characteristic way that all these relate to each other, so we organize them according to some acceptable rules. There are many different musical languages that are distinguished by its alphabet, namely the octave (Jackendoff, 2009).

Language is a system of rules-based communication codes based on specific operational principles. Language is the result of thought-mind, not the thought itself, and derives from the logical texture of man and his modular ability. It is a system of communication, thinking based on tones, words, sentences, and reflects the distinct conception, organization and expression of the world by a person or a nation. It is an

ability that stems from social life and is determined by it, is a product of culture and social institution (Jentschke, 2015).

Language satisfies the need for communication and understanding among people and thus contributes to achieving harmonious social coexistence. Through it, people come in contact, inform - they are informed, informed and informed and solve their problems. Music is the sound, without this meaning that every sound is music. The rain, the alarm clock, the singing of a bird and generally the sounds of nature are not music but the pleasant feeling they offer us. Music is called the organized structure of the sound created by man to express his feelings. The vocalization of the language is also the mode of expression of emotions, it is the melodic curve that accompanies every linguistic expression and depends on the fluctuations in the height of the voice, which varies according to the frequency of the oscillation. Characteristic is the upward curve at the end of the question as opposed to the downside at the end of the statement. Punctuation, transposing language, and expressive media are key elements of expression (Jentschke, 2015). The same is true of music using rhythm, intensity, the appropriate scale of the major or minor, the correct connection between the notes and the final notes on a piece of music called so-called drops which, depending on the connection, add a different meaning. Of course, simple recording of notes without any rule can not be a musical creation either. Similarly, in the language, the linguistic meaning is made up of two aspects: the meaning and meaning of its content and expression. This bond is based on a social contract that is mandatory for every individual of the community (Jackendoff, 2009).

Language is a means of expressing emotion, helping everyone to enter the psychic world of others, to feel human emotion and to truly express their inner world, with the result that sensitivities are cultivated and man refined in an era of more general desensitization and internal disharmony. It can contribute to the formation of unrelated bonds. Conversely, music is a way of expressing emotions and a way of communicating, as one of the arts offers us a language that allows us to express non-verbally. Many times music listening has a significant impact on perception, emotion and behavior depending on how each individual responds to it. In addition, it is perhaps considered to be the strongest means of causing emotional stimuli to humans whether they are pleasant or unpleasant (Geethanjali et al., 2018) by listening, performing a

piece on a musical instrument or even singing it. It is a non-verbal form of communication beneficial to enhance self-confidence, sensitivity and optimism.

Every music, regardless of its musical system, uses and combines various musical elements that we can call basic music materials such as rhythm, melody, harmony, texture and sound. In most music, all these elements appear, although there are others that may not show the element of melody or harmony, etc. The rhythm is called the organization of time in music and with it we describe the different ways in which the composer organizes his sounds according to their duration and emphasis. The rhythm relates to our own body with the beatings of our heart, with our breath, as all these beats have a periodicity. Measures  $4/4$   $3/4$   $2/4$  of course there are also composite rhythms of  $7/8$ .

Despite the fact that many music and language have different organizational systems, many similarities remain that characterize them. First of all, music and language share the same senses for perception and expression, such as the sense of hearing which is considered necessary for the auditory perception of musical and linguistic phrases respectively. The process of learning each phrase requires the perception of time, the length and breadth of each acoustic representation (Tierney & Kraus, 2013)

Imitation, memory, the ability to simultaneously process and store information, attention, are part of learning and storing the audio performance. With the correct use of the rules in both systems is achieved the easiest processing in the already existing knowledge but also the prediction such as the end of a musical phrase with one of the expected drops as well as the end of a phrase the sequence by changing the volume in voice (Tierney & Kraus, 2013).

The co-operation of many different mechanisms such as the need for coexistence of memory, expectation, motor mechanism, attention, vision, hearing to create speech or music is thus observed. Of course, the interaction of both with social development should not be omitted. Music and speech have been created and continue to form within each culture, place and time. Local music-song as well as language were created by traditions, culture, situations, experiences, interests and personalities of the time.

Another common feature of language and music is the relationship of intensity and rhythm. Rhythmic perception is a key element of music and reading and speech

(Tierney & Kraus, 2013). The rhythmic sequence in language is accomplished with syllables and punctuation, while in music with the fidelity to the musical tempo of each song. Pauses are part of the rhythmic system and are used by both the musicians and the speakers to place the words in the correct phrases to give the feeling of completing the phrase to the listener.

In addition, music as well as language is a means of communication, despite the fact that music is a non-verbal communication tool, it can be directly related to the creation of a "emotional speech", since a musical phrase can be imprinted which, depending on the an emotion that is going to render happy or sad to use major or minor chords respectively.

We can say that music and language development occur simultaneously in a natural way and are inextricably linked. From an early age, children experiment with sounds, muttering, singing, dancing and communicating through their own "musical language", a kind of pre-verbal communication. With their development, their mother tongue is structured and developed, utilizing these non-verbal musical elements. According to European Music Portfolio basic skills of listening, receiving, imitating and creating catalyze the learning processes of both language and music according to recent research on the functioning of the human brain, thus confirming the structural relationship between the two objects (Ludke & Weinmann, 2012). A particularly interesting approach to music can be found in Noam Chomsky's studies of language. Music and language are unquestionably superior cognitive functions, receive audiovisual stimuli, have a complete neural system of perception, processing and reaction with motor activity, are proteinaceous, flexible, shape and form, even have an emotional impact (Chiang et al., 2018).

Music as well as language have coexisted since the birth of man (Kao & Oxford, 2014), in fact the existence of music and musicality precedes language and is its main precursor. In a way, music inspires language and language brings music to life. This close relationship between music and language began with the ancient Greeks who first recognized the close ties, using music to inspire language, creating lyric poetry, sacred poetry, tragedy and comedy (Kao & Oxford, 2014).

The relationship between the neurobiology of speech and music has been researched for over a century, but there is still no consensus on how and to what extent musical perception uses the neural network involved in speech, especially at the cortical level. Distinguished models such as Patel's "Shared Syntactic Integration Resource Hypothesis" and Koelsch's "Neurocognitive Model of Music Perception" suggest a large degree of overlap of neural resources between music and speech, especially in the frontal lobe. distinct representations in the temporal lobe with hemispherical asymmetries (LaCroix, Diaz, & Rogalsky, 2015). The view of Koelsch (2011) is that because music and speech exhibit the same properties, the same neural networks should be shared (Koelsch, 2011). But there are functional and structural differences between oral speech and music. Music is usually more rhythmic than speech and speech becomes more rhythmic when emotions are more intense. The effect of regularity on attention also plays a big role. Increases in rhythm occur at times when attention needs to coordinate actions, such as when we speak (speech) or when we produce music (melody creation) (Hawkins, 2014).

The relationship between music and language and the similarities in their learning are confirmed by various neurophysiological and other researches (Ludke & Weinmann, 2012). which showed that infants are more likely to learn music and language through their familiarity with the rich sound environment in which they live. The basic mechanisms for the development of music and language ability are created already from the first months of human life and even during the last months of pregnancy (Marjanen, 2009 in Ludke & Weinmann, 2012). Due to this parallel interacting development, a child's early vocal formations contain both linguistic and musical characteristics and it is often difficult to identify a purely promotional or pre-linguistic vocal formation (Miendlarzewska & Trost, 2014). A completely different view of the relationship between language and music is held by Brandt, Gebrian, & Slevc (2012), who believe that spoken language is taken by children as a vocal representation and that children first pay attention to the musical characteristics of language. They believe that without the ability to listen to music, it would be impossible to learn to speak and that language is a special kind of music and not music a universal language.

Music offers every child an opportunity for fun, but at the same time it can serve various educational purposes. Numerous studies record its positive effect on students'

development, both enhancing their self-esteem and self-confidence, and significantly improving their learning skills, thus contributing to the development of their academic, social and linguistic level. Music is a language that, despite its diversity, reduces language barriers and individual peculiarities, allowing for experimentation and interaction (Sammler & Elmer, 2020).

### 1.10.3 The effect of music on language

Several investigations deal with the relationship between music and language and the common mechanisms that govern them. The findings of recent research show that both music and language use common areas of the brain, with the result that the improvement of musical ability also improves linguistically.

Brain plasticity, ie the ability of the brain to adapt to the demands, can be excited by environmental influences, repetitive behaviors such as practicing a musical instrument, thinking and emotions, and enhancing existing functions or acquiring new functional possibilities. Significant is the phenomenon of transparability that can be created by music education. Music education can change both the structural and functional properties of the brain and affect its plasticity and the potential for new short-term learning. The results of long-term and short-term education are presented in research by (Herholz & Zatorre, 2012) regarding the acoustic region. In particular, it seems that long-time music education enhances short-term plasticity and enhances engine performance and coordination in complex manual work.

Dyslexia is a disorder that tends to be associated with difficulties in developing reading and vocabulary skills at the expected level of age and education provided (although the individual's mental level is normal). In recent years, the interest of a significant portion of researchers has focused on examining the effect of music education on students with dyslexia. Reflecting the multidisciplinary interest in the broader dynamics of music, the discipline is increasingly used in a variety of everyday therapeutic, rehabilitative, medical, clinical, special education and community settings (Ockelford, Welch & Zimmermann, 2002). Researchers are focusing on examining the broader implications of school music education programs (e.g., MacDonald, Kreutz & Mitchell, 2012) and in particular their potential as a means of providing mass-produced children with acoustic education, leading to the creation of opportunities for all children to have equal access to music education programs in schools (Kraus & Chandrasekaran, 2010).

Studies focusing on reading difficulties in children with dyslexia correlate children's ability to read with their ability to accurately distinguish tone (Magne et al., 2006; Besson et al., 2007; Loui et al., 2011), supporting the existence of a strong relationship between basic auditory perception and reading skills. According to one of the initial studies that took place on the issue under consideration, (Anvari et al, 2003) significant correlations were found between the musical skills, phonological awareness and reading ability of children aged four and five years. It has been argued that improvements in reading skills are associated with two distinct forms of music education:

- Multisensory, developmental activities, including singing or playing a musical instrument, and
- Participation in a choir, band or orchestra, which require reading skills, musical skills and extensive practice to achieve the acquisition of specialized skills

The relationship between music and learning disabilities is now commonly accepted by the scientific community. It is a useful material for occupational therapists, speech therapists and educators, which is why music is now attracting more and more researchers to conduct research on the central theme of music therapy (Bonacina et al., 2015). Recent neuropsychological studies confirm that music can improve a wide range of cognitive functions such as auditory perception, attention, learning, memory (including reasoning, problem solving, and decision making).

The benefits that can result from music therapy for children with dyslexia are:

- Stimulation of the brain (Schlaug, 2005).
- Enhance memory recall (Parbery-Clark et al., 2009; Janata, 2009).
- Trigger motion at a pace, thus helping coordination (Corriveau & Goswami, 2009; Slater et al., 2013).
- Improving auditory skills (Putkinen, 2013; Frey et al., 2019).
- The contribution of listening and participating in musical activities in enhancing children's ability to split words, a process particularly difficult for dyslexics (Tierney & Kraus, 2013).
- Attract attention (Tierney & Kraus, 2013).

- Help and benefits in speech processing (Patel, 2014; Lifshitz-Ben-Basat & Fostick, 2019).
- Increased attention (Dewi et al., 2015; Putkinen et al., 2013).
- Probably an increase in school performance (Slater, 2013)
- Production of chemicals (dopamine) in the brain that cause happy emotions (Salimpoor et al., 2013).
- Encouraging social skills (Gerry et al., 2012).

Several studies have shown that music education through a musical instrument can benefit both the sensory and motor system as well as the acoustic. A survey by Verrusio et al. (2015), revealed that listening to specific music, which follows specific rules and has a particular structure, can positively affect mood, modify cardiovascular abnormalities by regulating heartbeats, produce beneficial effects on epilepsy by reducing seizures and regulating blood pressure. In addition, reducing stress and tension, increasing efficiency are basically beneficial features of this music listening.

Further research shows changes related to musical education and related to the auditory cortex, contributing not only to functional but also to anatomical. The enhancement of blood oxygenation in acoustic regions indicates swelling in the thickness of the auditory cortex (Bermudez et al., 2009). Taking this into account, Foster and Zatorre (2010) linked the anatomical characteristics of the brain to behavioral performance, with the aim of future new activities-tests.

### 1.11 Previous Research

Developmental dyslexia is one of the most common neurobehavioral disorders affecting children, but prevalence data in this condition are negative, as reported by Barbiero et al (2019). The aim of the present study was to determine the prevalence of dyslexia in Italy in an unselected school population, using clearly defined diagnostic criteria and methods. Cross-sectional study carried out in nine Italian regions. Three consecutive levels of screening were performed: the first two at school, for population screening and the identification of children with dyslexia, and the last at centers with multidisciplinary staff specialized in learning disabilities to confirm the diagnosis. The main measurement result is the prevalence of dyslexia, defined as the ratio between the

number of children confirmed positively in the third level of screening and the total number of children enrolled in the study.

Finally, 11094 children aged 8–10 years participated in the research, of which 9964 were the final sample of work after the application of exclusion criteria and including only children who received parental consent to participate. The prevalence of dyslexia in the whole sample was 3.5% (95% CI 3.2-3.9%), with small differences between Northern, Central and Southern Italy (3.6%, 3.2% and 3, 7% respectively). In almost two out of three children with dyslexia the disorder had not been previously diagnosed. This study confirmed that dyslexia is widely underestimated in primary school children aged 8-10 in Italy. Reliable data on the prevalence of dyslexia are required to allocate the necessary human and financial resources to both Health Services and Schools, ensuring timely support to children and families.

The aim of Rontou (2021) research work was to explore the beliefs of a teacher teaching a second language (case study) about teaching and learning and its practices in relation to a student with sociocultural dyslexia. It first referred to studies on teachers' beliefs and practices, then defined the concepts of mediation, scaffolding and the nearest development zone, and examined studies on mediation and scaffolding. The data from the interview with the teacher and the observations in the classroom were analyzed and compared. The study showed that the teacher's practices were not always consistent with his beliefs about how students with dyslexia learn better. Teaching practice did not always have the theoretical idea as a basis. The observation of the lessons showed that an effective use of multi-sensory methods, actions, objects and scaffolding for the mediation of the student is necessary. At the end of the research, suggestions are provided for teachers who teach students with dyslexia based on the data.

The purpose of the research review by Stuart and Yates (2018) was to analyze the literature on dyslexia and to identify and evaluate a number of strategies in the inclusive classroom that can affect the educational achievement of students with dyslexia. Tunmer and Greaney (2010, cited in Stuart & Yates, 2018) define dyslexia as persistent learning difficulties that occur in otherwise typically developing children, despite exposure to high quality, based on presumptive instruction and intervention. The difficulties arise due to the lack of phonological awareness, basic skills required to access literacy. The research review by Stuart and Yates (2018) provides an analysis of

four studies followed by an evaluation of strategies proposed to improve learning outcomes for students with dyslexia. It concludes with basic recommendations for inclusive practices that teachers could use to ensure that students with dyslexia have the same opportunities as their peers to succeed. In recent years, researchers in the field of music, education and psychology have shown that music facilitates the overall development of the individual. More specifically, music education facilitates communication skills and with the help of music therapy, allows the harmonization of interpersonal relationships between students with integration difficulties (Gooding, 2011; Hallam, 2010; Ritblatt, Longstreth, Hokoda, Cannon & Weston, 2013). In addition, it is a privileged tool for the development of kinesthetic skills (Root-Bernstein, 2001), spatio-temporal skills (Črnčec, Wilson & Prior, 2006), perceptual and mental skills (Bidelman, Hutka & Moreno, 2013; Corrigan, Schellenberg & Misura, 2013; Kaviani, Mirbaha, Pournaseh & Sagan, 2014) and cognitive contributing to improving their academic and school performance (Arnaud.Cabanac, Perlovsky, Bonniot-Cabanac & Cabanac, 2013; Wetter, Koerner & Schwaninger, 2009).

Early involvement with music and acquiring music education can help improve students' school performance as well as maintain it at a high level, according to research by Wetter, Koerner and Schwaninger (2009) and Arnaud Cabanac et al (2013) compared to students who do not receive any music education, with the result that their grade point average is much lower. Babo (2004) argues the same, as his research has shown that students who are taught musical instruments had much higher grades, mainly in language lessons, but also in mathematics. Thus, participation in musical activities or learning music enhances academic performance in addition to the subject of reading and that of mathematics (Diamantes, Young & McBee, 2002; Register, Darrow, Standley & Swedberg, 2007).

In addition, music as an intervention program improves the physical functions such as sound discrimination, eye movement and cognitive functions memory, concentration, attention, perception, knowledge. According to Sze and Yu (2004) it is a cognitive, linguistic, social and psychological therapy for children with mild educational needs, while affecting heart rate and rhythm improves attention, concentration, social function, self-esteem, self-expression, memory, while Sausser and Waller (2006) add that it

facilitates creativity, independence, success, motor skills and visual-motor coordination.

In an article by Patel (2011), the following OPERA model is proposed to clarify the musical benefits of many language functions. Thus, it says that Overlap: it is an anatomic which processes the acoustic characteristics used both in music and in language, Precision music places higher demands on these shared networks than does speech; Emotion: musical activities can create strong positive feelings, Repetition: musical activities can be used to enhance the ability to repeat Attention: many musical activities are associated and strengthen the focus. According to the hypothesis According to the OPERA hypothesis, when these conditions are met, the plasticity of the brain is widened, with the help of communication speech.

Halwani et al (2011) examined the anatomical difference of arcuate fasciculus among music organists, singers and non-musicians, and demonstrated that long-term music education can increase the volume of arcuate fasciculus, possibly due to the need for singers to strongly link frontal and temporal brain areas of the brain and temporal brain regions. Of course these areas are involved in the process of speech.

The ability to perceive the rhythm is of major importance in both music and language. An important difference between the rhythm of music and the rhythm of language is that the rhythm of music is characterized by regularity, while the rhythm of language from a more free flowing rhythm, that of speech. This is observed several times in live music performances in which the rhythm is formed around the free speech rhythm, although listeners have no difficulty in understanding the pulse of music.

Furthermore, Moritz, Yampolsky, Papadelis, Thomson and Wolf (2013) found that rhythmic musical activities were related to phonological skills, proving that children who received more music education during kindergarten showed improvement in almost the entire range of skills. phonological awareness at the end of the year, compared to children who received less or no music education. Research in music education and language learning has shown that there are links between the processing of musical and linguistic information. More specifically, Bolduc (2009) demonstrated that tonal and rhythmic skills are correlated with word recognition skills, while helping to improve the phonological awareness of students who participated in the music

intervention group. In fact, findings from other studies showed that poor readers compared to normal readers had difficulty in reproducing rhythm, proving that reading ability is directly related to rhythm, which plays a strong role mainly in decoding and word recognition (Anvari, Trainor, Woodside & Levy, 2002; Tsang & Conrad, 2011). Through research by Gaab et al (2005) it seems that music improves the auditory processing, something that leads to the development of phonemic awareness and this in turn to the development of reading. Music helps in language development, because through rhythm, pauses and musical phrases, song and music can give a clear meaning to a series of incomprehensible words and consequently form sentences with meaning and content (Miendlarzewska & Trost, 2014; Kraus & Slater, 2015).

Another study by Corrigan and Trainor (2011) on students aged 6-9 found a high correlation between the duration of music education and reading comprehension, emphasizing that music experience and training contributes not only to students' reading ability, but more generally to academic performance, as music education teaches self-discipline and attention skills that help students stay focused for longer periods of time, as concluded by Schellenberg (2011). The study of Roden, Könen, Bongard, Frankenberg, Friedrich and Kreutz (2014) looked at visual attention and information processing speed in students receiving music education (experimental group) and science (control group) for eighteen (18) consecutive months. The results showed that the music group had significant increases and improvements in the speed of information processing, but in terms of visual attention, although it had improvements during and after the intervention, it did not exceed the control group. In addition, two other studies examined the effect of music intervention on auditory and visual memory; the results showed that there were significant improvements in auditory memory but not in visual memory (Ho, Cheung & Chan, 2003).

Comparisons of groups of children with high and low musical perception skills in preschool reveal that high-musical groups perform better in mimetic speech, can sing better, and have enhanced memory and performance of music and lyrics (Hallam, 2010). The fact is that research conducted in recent years on whether the brains of children with or without special educational needs are affected by music, have shown that music clearly affects the function of the brain and therefore their body. In the last decade, one can distinguish the applications of music in medical science, finding that

its future is bright, especially in the field of preschool children with any special needs (Macferran & Elefant, 2012).

In the study of Slater et al (2013) used continuation and pacing examples to assess beat retention skills, perception of rhythm tonicity and improvisation, in a group of children who received one year of music education, compared with a control group. It has been hypothesized that music training enhances basic timing skills, resulting in greater accuracy in maintaining a rhythm in music-trained children. The training group (29 children with an average age of 8.3 years) started music lessons with the Harmony program in August 2011 and the control group (31 children with an average age of 8.2 years) started music classes in the summer of 2013. The performance level of children considered "at risk" for the presence of learning disabilities who received this music education was significantly higher than the corresponding controls in the synchronization tests.

In the study of Flaugnacco (2014) involving 48 children aged 8-11 years with a diagnosis of developmental dyslexia and selected based on specific criteria, it was found that between rhythm production and perception tests, as well reading accuracy and phonological processing in people with dyslexia. This study investigated whether and to what extent the different levels of temporal processing are related to reading and phonological abilities. They concluded that their results strongly encourage the use of music education in the restoration of dyslexia, and in particular they themselves recommended focusing more on rhythm than on tone accuracy, as is often the case in classical music pedagogy. Going one step further, Przybylski et al (2013) examined the effect of rhythm perception on editorial processing. They presented a rhythmic test to children with reading difficulties, followed by an oral phrase that was syntactically correct or incorrect. The results clearly showed superiority for normal and irregular rhythmic patterns in children's performance in editorial work. Based on these results, the authors proposed to use rhythmic stimulation in rehabilitation protocols designed for children with reading and writing disorders.

In another recent study, Cogo-Moreira et al (2013) argued that music training had a positive effect on reading skills and educational performance in children and adolescents with dyslexia. This research focused on addressing the effectiveness of music education in improving reading skills and academic achievement in children with

reading difficulties, aged 8-10 years. 235 children with reading difficulties from 10 schools participated (randomized clinical trial) in a poor area of the city of Sao Paulo to test the results of interventional music education, while assessing reading skills and academic achievement during the school year. Five schools were randomly selected to incorporate music classes (total 114 children), and five served as controls (total 121 children). As mentioned above the research results are optimistic that music training helps with reading skills and educational performance.

Habib, Lardy, Desiles, Commeiras, Chobert and Besson (2016) in a recent study on students with dyslexia studied the effectiveness of a new method of music intervention (Cognitivo-Musical Training CMT), which included musical activities visual, acoustic, kinesthetic and kinetics with special emphasis on rhythmic perception. They observed statistically significant improvements in auditory perception and attention, as well as phonological awareness skills, reading skills and pseudo-word reading. The important thing about this study is that the specific improvements remained in a measurement that was made six weeks after the completion of the program. The same was concluded by Tierney and Kraus (2013) through a review of the literature, emphasizing that music education enhances the reading ability of all students and especially those who face difficulties, such as dyslexia and others. They even say that music is an effective way to teach reading, as it not only enhances the required reading skills, such as phonological awareness, auditory working memory, perception of rhythm and speech, but is a means of pulling the attention of students, providing them with the appropriate motivation to succeed in academic performance. Malak et al (2017) using the Tomatis music intervention method in 78 students, wanted to explore what reading skills can be improved thanks to this intervention. The results showed that there were high correlations with phonological awareness skills, phonological and auditory short-term memory, selective attention, while a small correlation was found in visual perception.

In a study by Schlaug et al., (2005), it is reported that music therapies such as melodic tonic therapy have been used to enhance the connection between the neurons responsible for music and by extension to the reason so as to restore speech problems in aphasic patients, emphasizing the musical characteristics of speech. In particular, music education between the ages of 6 and 12 may accelerate the progressive

development of neuroimmutations in the upper cortical layers (Hannon & Trainor, 2007).

The fact that music can enhance auditory skills such as auditory perception and processing has been the subject of research by many researchers, who have concluded that music education not only has a positive effect on auditory skills, but enhances neuronal processing. of sound, which offers benefits to language skills (Strait & Kraus, 2014; Strait, O'Connell, Parbery-Clark & Kraus, 2014; Tierney, Krizman & Kraus, 2015; Zhao & Kuhl, 2016) while improving phonological awareness skills (Gordon, Fehd & McCandliss, 2015; Habib et al, 2016; Malak, 2017; Moritz et al, 2013). At the same time, there is a lot of research that highlights the beneficial role that music and various musical activities can play in oral and written speech, as one of the factors that strengthen it is the development of vocabulary, as concluded by Bolduc (2009) and Piro and Ortiz (2009), finding that musical interventions significantly improved the students who participated in them compared to the others. At the same time, the literature states that musical activities (singing, learning musical instruments) significantly regulate reactionary behavior (Choi, Lee & Lee, 2010; Roden et al, 2016). Furthermore, the meta-analysis of 100 studies by Gaastra, Groen and Tucha (2016) showed that interventions (including music) reduce the disorganizing behavior of students with ADHD.

The ability to perceive the rhythm and synchronize with it activates not only the kinetic region of the brain but at the same time also the acoustics which in turn enhances the ability of voice learning (Patel and Iversen, 2014). The kinetic function is not only used to play speech and musical sounds, but also to understand speech and music (Chen et al., 2008). These findings show the relationship between kinetic, acoustic and phonological ability. While most researches concern the relationship between musical education and the brain in order to show results in the cognitive lifestyle, Wan and Schlaug (2010) refer to its ability to reduce certain effects of aging in the brain as it may delay the (Parbery-Clark et al., 2012). Considering the brief bibliography, it is easy to understand that there is a close relationship between language and music, which allows us to use music teaching as a means of preventing and restoring language problems.

## 1.12 Conclusions

Indeed, music stimulates a wide range of brain functions, from sound coding to higher cognitive functions. However, there is clear evidence that music education has the potential to cause functional and structural changes in both the auditory and sensory motor systems (Herholz & Zatorre, 2012). Recent data support the view that music education affects speech and language processing.

From the above it can be seen that the use of music education for the rehabilitation of dyslexia and language disorders is based on both theoretical assessments and experimental results. If there are common underlying processes between music and language, especially between the perception of music and the perception of speech, it is reasonable to argue that improving some of the processes involved in the perception of music can simultaneously help improve reading and language skills (Corrigall & Trainor, 2011; Cumming et al., 2015; Lifshitz-Ben-Basat & Fostick, 2019; Frey et al., 2019).

Overall, the above evidence suggests that music education may have a positive causal effect on language skills impaired in children with dyslexia. This seems to be happening, thanks to the improvement of their rhythmic and metric abilities. Education on these topics probably leads to improved auditory processing, phonological awareness, sequencing skills, etc. The findings of the research presented in this survey strongly support the hypothesis of the beneficial effect of music training on reading and phonological skills awareness. They also emphasize the important role of rhythm in phonological perception and production. As rhythm and measure require more precise synchronization, improving reading difficulties in children with music and rhythm dyslexia could enhance their phonological and linguistic development from a point of view that is quite different from most traditional language-based approaches.

In terms of music, reinforcing plasticity has been observed on a functional level as for instance when we are doing music, not only when I play music but also when I listen to prolonged music, that is, there is a reorganization of the wiring to better assemble the specific stimuli we are most exposed to, while at morphological level, new neurons have been born in the cortex but also sub-cortical regions as well as swelling of specific regions according to the members moving the process of learning a musical instrument.

The positive effects of this plasticity are observed both at the brain level with better and more specialized connectivity but also at the behavioral level with better concentration, better coordination and control of movements.

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## 2 Chapter II: Methodology and design

### 2.1 Defining the problem

Music teaching is a broad concept that includes music performance, song, rhythm, composition, improvisation, musical games, listening. Respectively, a broad concept is the dyslexia associated with various difficulties which differ from person to person. In the case of students with dyslexia there are symptoms such as rhythmic instability, inability to learn symbols and distinguish pitch, unstable performance in dynamics and tone, confusion in direction as well as weak, short-term memory (Vamvoukli, 2005).

The elaboration of this doctoral research is considered important since the increase of the percentage of students with dyslexia is one of the most important problems that are observed nowadays not only in Greece but also in the rest of the world. Focusing on the difficulties that dyslexia causes to students, the ultimate goal is to treat as many symptoms as possible.

This research will focus on improving musical perception in students with reading difficulties through interventional teaching methods in order to improve the language disorder caused by dyslexia. In addition, it will be checked whether the curriculum of music studies for the specific age, fourth grade, is suitable not only for the typical population but also not, and more specifically for students with dyslexia and how it can be improved with more specialized activities. In particular, through a thorough review of the history of Greek music from antiquity to the present day, the most appropriate musical educational way is sought, capable of intervening in the language disorder and will be analyzed on the basis of the LAMDA Test.

### 2.2 Objectives

It is generally accepted that by identifying and recognizing a difficulty in any area, distinguishing and understanding it, we move towards resolving it in a more confident and effective way. Teaching music to children with dyslexia is undoubtedly one such case.

The purpose of this research is to improve the rhythmic education of students with dyslexia in music lessons, through invasive teaching methods in order to emphasize the need to design a music curriculum for these children. This research is considered

important since the increase in the percentage of students with dyslexia is one of the most important problems observed today not only in Greece but also in the rest of the world. According to many modern researches, it turns out that the perception of rhythm is important for both speech and music. Therefore, the main goal of the study is to investigate the effectiveness of the existing educational process and to improve as much as possible the students with dyslexia.

### 2.3 Research questions

Important questions that will be answered by this research proposal are:

1. There is a connection between language and music?
2. There is improvement in students with dyslexia who attended the intervention program?
3. There is improvement in students with dyslexia who attended the curriculum?
4. There is improvement in typical students who attended the intervention program?
5. There is improvement in typical students who attended the curriculum?

### 2.4 Method

#### 2.4.1 Research Planning

##### The Epistemological Example of Research

All research has a philosophical background and researchers should be aware of the assumptions that govern it regarding the search and acquisition of knowledge during research. These hypotheses shape both the formulation of the research questions and the conduct of the research itself (Creswell & Clark 2011). According to Crotty (1998) and Creswell (2003), the research design process must answer the following four questions:

Which philosophical example (theoretical background) including the epistemological position governs research by defining the methodology and providing the reference framework for the procedures, logic and criteria adopted (eg positivism and neo-positivism, critical theory, etc.)

To which methodology (research strategy or research design process) is the selection of specific methods subject and their connection with the results (eg experiment, field research, ethnography, etc.)

What methods (specific techniques and procedures) are proposed for the collection and analysis of data related to research questions and research hypotheses.

The research is carried out in the best way when the position of the researcher's intention to carry out the research is clearly stated (ontological position). This ontological position must be connected on the one hand with the content of the phenomenon that can be investigated (epistemological position) and on the other hand with the way in which it will be acquired (the methodological approach). Thus, the impact of the ontological view on individual research decisions can be understood (Grix, 2004).

According to Crotty (1998, p. 3), epistemology is defined as "the theory of knowledge" which is part of a theoretical background and therefore a research method. It is the researcher's perception of how to acquire knowledge. Epistemology concerns the "nature of knowledge, its possibility and its scope" (Hamlyn, 1995; p.242). Maynard (1994, p. 10) explains the relevance of epistemology to research design: "Epistemology provides a philosophical background for identifying the types of knowledge that are feasible and ways to ensure that these types are satisfactory and legitimate."

Ontology is about a subject's view of reality. It is defined as the study of "claims and assumptions made about the nature of social reality, assumptions about what exists, what it looks like, what its components are, and how they interact with each other" (Blaikie, 1993 p. 6). Ontology together with epistemology are a research example (Mack, 2010).

Theoretical background is the way the researcher sees things, the world, and tries to make sense of it. The philosophical example concerns the assumptions about the nature of the knowledge that will be acquired during the research. These hypotheses are often referred to as the worldview of research or as the research paradigm. Thomas Kuhn (1970) formulated the term for the first time, defining it as "the set of generalizations, views, and values that are accepted by the research community." The term example refers to "a vague set of logically connected hypotheses, ideas, and propositions that guide thought and research" (Mack, 2010, p. 6).

Overall, in adopting a philosophical example, researchers make claims about what constitutes knowledge (ontology), how we know it (epistemology), what values govern it (evaluation), how we describe it (rhetoric), and the procedures for studying it. (methodology) (Creswell, 2003). The four basic schools of thought that inspire social research are post positivism, constructivism, advocacy / participatory, and pragmatism.

This doctoral dissertation adopts the philosophical example of neo-positivism. Neo-positivism emerged after a critique of positivism and the axiom according to which the scientific method and the laws of nature can be applied to human behavior (Creswell, 2003). The claims of positivism include the belief that social reality can be explored in the same way as the natural world, that there is a way to study value-free social phenomena, and that causal relationships can be formulated (Mertens, 2005). Positivists claim that Scientific knowledge is completely objective and only scientific knowledge is valid, reliable and accurate" (Crotty, 1998, p. 29).

The term neo-positivism refers to the search after positivism, questioning the traditional doctrine of the absolute truth of knowledge (Phillips & Burbules, 2000). At the same time, it recognizes the impossibility of absolute positivism regarding cognitive claims in the study of human behavior. According to Crotty (1998), neo-positivists make claims for a satisfactory level of objectivity rather than absolute objectivity, seeking to approach truth rather than to capture it as a whole.

The ontological difference between the two schools lies in the fact that positivists believe in the existence of a single reality and therefore the researcher's job is to discover it (naive realism) (Guba & Lincoln, 1994). Neo-positivists claim that reality exists but believe that it can only be discovered free of charge because of limitations stemming from the human nature of the researcher (critical realism) (Maxwell, 2004). Therefore, researchers can discover "reality" through a certain level of probability.

They do not have the ability to "prove" a theory, but they can make a strong assumption by limiting alternative explanations. Neo-positivists continue to argue for the importance of objectivity and generalization but suggest that researchers should modify their claims about the nature of truth based on probability rather than certainty (Mertens, 2005). They believe that various elements of human behavior may not be measurable, but they are still important (for example, thought and emotion). At the

same time, neo-positivist psychologists rejected the positivist narrow-minded view that what can be studied is limited to what can be observed. At the same time, they challenged the ability to generalize laws relating to human behavior.

Neo-positivism is a causal philosophy according to which causes probably determine outcomes. Consequently, the problems studied by neo-positivists reflect the need to identify the causes that cause the results. Reduction is central to the claims of neo-positivism, as the aim is to limit the issues to a small, distinct set of ideas that will be tested by research, such as the relationships between the variables contained in research hypotheses and queries.

The knowledge that emerges through the prism of neo-positivism is based on the careful observation of the objective reality that exists "out there" in the world. Therefore, the creation of quantitative observational measures and the study of individuals' behavior is crucial for the researcher. In addition, neo-positivism advocates that there are laws and rules that define the world, which must be controlled and perfected in order to achieve an understanding of phenomena.

Thus, by adopting the scientific method, the accepted research methodology for neo-positivists, the researcher begins with the theory, collects data that either supports or contradicts the theory, and then makes the necessary revisions to proceed with further tests (Creswell, 2003). According to Phillips & Burbules (2000) the key points of neo-positivism are the following:

Knowledge is conjecture, as the absolute truth cannot be found. Consequently, the evidence obtained during the investigation is always incomplete and subject to error.

Research is the process of formulating axioms and then improving or abandoning some of them for the sake of others that are more convincingly documented.

Data, evidence and rational estimates guide knowledge. In practice, the researcher collects data either through tools containing measurement scales, or through observation captured by the researcher.

The research aims to develop relevant true propositions, which can be used to explain the problem under investigation or to describe the causal relationships that define it. In

quantitative research, researchers promote the relationships that link research variables to their inclusion in research queries or research variables.

Objectivity is a key element of research. Therefore, researchers need to check the methods and conclusions for any bias. For example, compliance with the rules of validity and reliability plays a critical role in quantitative research.

The positions of neo-positivism have come to be identified with the "scientific method" of conducting research (Creswell, 2003). Neo-positivism is governed by the epistemological view of objectivism. Objectivity is the epistemological conception according to which everything exists as a separate entity, regardless of the consciousness and experience of the individual and can contain truth or meaning in its capacity as an object ("objective" truth and meaning). Systematic (scientific) research can reach this truth (Crotty, 1998).

Regarding the evaluation of neo-positivism, according to Mertens (2005) the six evaluation rules of scientific research are:

- The use of a valid research design
- The ability of the researcher to carry out the research process
- Recognizing the consequences of research: Procedures must respect personal data, keep it private, maximize the benefits and minimize the risks.
- The sample selection must be appropriate for the research objectives. The sample must be representative of the population that will benefit from research and satisfactory in size.
- Participants must consent to their participation in the research through a voluntary declaration of consent.
- The researcher must inform the participants in case their participation entails risks for which they will be compensated.

According to Creswell (2003), the type of research problem is the one that largely determines the approach to be chosen. Thus, with the aim of the present research which is to formulate causal relationships between variables and the application of a predetermined theory (the theory of Cognitive Assessment), the research design of the doctoral dissertation is inspired by the theoretical background and claims of neo-

positivism. In particular, the way research variables are related is formulated and controlled through the formulation of clear research questions and research hypotheses. Both in the literature review and in the data analysis, an attempt was made to reduce the variables of interest that significantly affect the dependent variables.

The field research and the approach of the participants was carried out with absolute respect to the evaluative positions of neo-positivism. Finally, in the processing of the results, strictly accepted rules regarding the validity and reliability of the research variables were strictly observed, in order to limit the subjectivity of the researcher. The specific methods and procedures for achieving the above are described in detail in the corresponding sections of this chapter.

#### 2.4.2 Choice of research method

Research methods are divided into qualitative and quantitative method. The quantitative ones analyze the quantity of occurrence of the phenomenon under consideration and the qualitative ones refer to the species, to the specific character of the phenomenon (Kvale, 1996: 67). Both methods enable the researcher to approach a research field and focus on it. Significant elements that characterize qualitative methods are that they have a normal flow and to a large extent are not directed by the researcher. Lincoln and Guba, moreover, wrote in 1985 that qualitative methods are natural (Lincoln & Guba, 1985). The researcher can thus penetrate the personality of the subjects and understand the social influences that the subjects have received (Creswell, 2003).

The researcher who follows a qualitative method observes, interviews, takes notes, describes and interprets the phenomena exactly as they are. When the researcher is working on the field he is studying, he is always active, because the qualitative methods require the use of all those elements that the researcher encounters: comments from those related to the object, something that he observes, even the way where subjects sit or converse (Eisner, 1991: 217). He has to record the facts, but at the same time he is confronted with himself. Undertakes to combine in a logical way data, data and situations in order to reach a conclusion from what he observes. This is done through the way he perceives the presence of things and their importance. The researcher, after collecting the data, will try to interpret it (Eisner, 1991: 36), with the help of the literature or collaboration with fellow scientists, in order to achieve the best possible

result. The awareness of what is important and the context in which it will be researched is subject to the abilities of the researcher. Peshkin (1985) likened the subjective elements of the researcher to a positive "explosion". He is the researcher who will bring to life the essential elements of the research and will decide what to include in the results and what not. However, his subjectivity as a researcher should always be taken into account, despite the efforts for objective research.

Qualitative methods give the researcher the opportunity to aim at what the experience they are talking about means to the subjects, in other words, to deepen. What happens is a "subtle" description (Geertz, 1973) on the part of the researchers. But beyond the detailed analysis, qualitative methods record the "voice" of the subject and his expressions (Eisner, 1991).

However, only the subjects and their narratives in the qualitative methods are not described. Qualitative methods are greatly influenced by the culture of the researcher. The researcher is asked to interpret the collected data and to present the final conclusions, using his observations. The text proves that it is not a machine behind the lines, but a human being and sometimes it may be insincere, hypocritical (Eisner, 1991) that it is covered behind the first plural person or the third singular (eg "we" or "the researcher").

So, what is important in qualitative methods is the judgment of the researcher and those who will read the research (Eisner, 1991). However, the results of a research are always the starting point for a series of qualitative and quantitative methodological efforts, because the issues to be studied and analyzed do not cease to exist and their results pose constant concerns to researchers.

#### 2.4.3 Credibility

"Credibility" in a qualitative research refers to the power of methodological design, the quality of the data collected during it and how this design and specific data lead to true and trustworthy findings, in the sense that they represent reality (Lincoln, 2001). The concept of research reliability within the quality school would correspond to the concept of "internal validity" in the quantitative / positivist school.

The first methodological strategy that was followed in this research and that tried to ensure its reliability was the "triangulation" of methods and data. Triangulation is called

the "application and combination of different research methodologies in the investigation of the same phenomenon" (Denzin, 1994b). In this research, multiple data collection methods, as well as multiple data sources and evidence, were employed in order to triangulate and confirm the findings that emerged during data collection. Each data source was linked to a specific research question, providing confirmatory evidence in relation to the specific research query, which was triangulated with information from other data sources. In this way, the research methods and tools were linked to the research objectives and the coding framework in which the data would be analyzed.

The data of the interviews were triangulated with the data of the questionnaires and the observations, while at the same time the interviews were triangulated with each other - those of the teachers with those of the parents and the children, and vice versa. Thus, each data source updated the final data analysis in such a way that each finding of the research resulted from the confirmation of at least one more data source. This triangulation gave credibility to the research findings and ensured the adequacy and appropriateness of the interpretations that emerged from these findings.

The decision to investigate the specific research questions in primary education was not accidental, but was taken in order to meet the criterion of reliability of prolonged experience and contact (prolonged engagement) with the research field. As the researcher who conducted this research, I had a lot of educational experience both in terms of pedagogy and teaching in the specific educational context as well as in matters related to the area under investigation, school-family relations.

#### 2.4.4 Transferability / generalizability of research

The transferability of the findings of a qualitative study, similar to the term "external validity" used in the quantitative school of educational research, refers to the extent to which the conclusions of the study can be generalized to broader sets of similar cases. from the population from which the sample is derived. It is the validity or legitimacy that the readers themselves can give to the research.

The most important technique for a researcher to meet the criterion of transferability / generalizability is the dense and vivid description of the research data and findings. Denzin (1994a) defines as a dense description "that which gives the context of an experience, states the intentions and meaning that organize the experience, and reveals

the experience as a process" (p. 505). Aiming to meet the transferability criterion, this research attempted to provide a true and consistent dense description of the research findings and to travel its readers to the world of its participants. The readers of the research could thus recognize the experience of the participants and the researcher and compare them with their own experiences and those they had studied through other relevant empirical research in a way that would convince them of the claims and statements of the researcher.

#### 2.4.5 Variables

According to the data used, we have three variables:

- Students: 32 typical students, 32 students with dyslexia
- The curriculum of music studies
- The interventional music program
- The LAMDA test used as a measurement tool before and after the intervention, which consists of 13 different modules.

#### 2.4.6 Sample Description

The selection criteria of the sample will be the determination by the school management and the responsible department teachers who will indicate to us the students diagnosed with Dyslexia from the respective opinions that will be present in each school. The diagnosis of dyslexia was official and had been issued by a certified government agency. Also, the sample of the students was from Greece and more specifically from the area of Chalkis.

Mention that the study was conducted with the consent of the parents. No compensation was given for participation.

Furthermore:

- The data collection will take place during the school lessons of the school's daily schedule, by agreement with the responsible teachers at the school departments and with the Principal. The goal of the researcher is to be able to carry out the research without hindering in the least the teaching process.
- Regarding the management of research data following the legislation on personal data protection that is in force internationally, all the prescribed procedures will follow. If the researcher conducts the research in the context of his / her doctoral dissertation, he

/ she must, after the establishment of the University ethics committee, preserve the data in a place completely safe from third parties. The letter of cooperation to the Directors was adjusted accordingly.

- The school management, maintaining the personal secrecy of the students' identity, will have a telephone communication with the parents in order to get their permission for their children to participate in the research, explaining in detail its content, nature and purpose. The school management knows which students are diagnosed with Dyslexia. Then the researcher's visit to the school will follow she is accepted. In addition, a meeting could be held with parents who have any questions or reservations about the research in order to clarify any questions. Once this process is complete, it will distribute the letter of consent to the parents in order to confirm in writing their willingness for their children to participate in this research. Finally, a letter of cooperation to the Principals will be distributed to each school in order to approve the research process.

## 2.5 Instrument

Within the framework of the Business Program of Education and Initial Vocational Training (BPEIVT) of the Ministry of National Education and Religions, IEL developed software for the automated detection of students with learning difficulties through the general student population. This software was called Learning Skills and Weaknesses Detection Software (LAMDA test) (Skalumbakas & Protopapas, 2005).

As Skaloumbakas and Protopapas (2005) point out, LAMDA examines skills that are indicators of learning potential and not measurements of school performance. The selected indicators are considered internationally reliable dimensions of learning assessment. All indicators constitute a complete criterion for investigating possible learning difficulties in oral and written speech for each age group.

The content of the exercises differs in two classes. There are four levels of content, for the classes (a) 2nd Elementary, (b) 3rd & 4th Elementary, (c) 5th & 6th Elementary, and (d) 1st & 2nd High School. The purpose of LAMDA is to identify potential student weaknesses and whether a child is lagging behind and may need additional support.

The tests selected for the composition of LAMDA contribute to the formation of a complete picture of the student's learning potential, with emphasis on the language field. Evaluate areas of knowledge and use of language and reading processes. They are not limited to accuracy, but also evaluate the ease of processing of linguistic data, utilizing speed measurements during the execution of exercises. In addition, the tools include tests of non-verbal mental ability, to assess students' visual-spatial perception, as a reliable solution for the rough assessment of non-verbal intelligence.

The LAMDA tests directly assess the skills related to the learning potential and the corresponding performance of the student, providing immediately useful information about the areas of possible weaknesses of each student.

The general skill areas assessed in LAMDA and the individual tests of each area are as follows:

1. Stimulus recognition
  - a. Image recognition
  - b. Word recognition
2. Spelling
  - a. Historical spelling
  - b. Grammar spelling
3. Comprehension of texts
  - a. Verbal comprehension
  - b. Written comprehension
  - c. Study of written text
4. Syntactic
  - a. Completion of sentences
  - b. Verbal porpotion
5. Vocabulary
  - a. Image selection
  - b. Definition of words [Only for older children (5th Elementary – 2nd High School)]
6. Working memory (primary memory)
  - a. Letter range
7. Non-verbal mental ability

- a. Visual sequences [Only for younger children (B – D 'Elementary)]
  - b. Pattern completion
8. Perception of music characteristics
- a. Rhythm reproduction [Only for the youngest children (B – D Elementary)]

The purpose of LAMDA is the "automated" detection of learning difficulties in written and spoken language. Automated means that the entire LAMDA process is performed and controlled by the computer automatically. Detection means that a complete clinical assessment or diagnosis of specific learning difficulties is not made, but only an outline of the areas of special weakness of the students, so that they can identify those children who need a more complete assessment and possibly special educational support. The advantages of the test are the following: 1. No specialist intervention is required. 2. No waste of large resources-feasible solution. 3. There is reliability - everyone is tested on the same test. 4. It is administered quickly and in large numbers. 5. There is no stress. 6. Immediate and fast results from PC.

#### 2.5.1 Evaluation indicators

The results of the automated LAMDA detection include the accuracy chart and the speed chart, which provide useful information either individually or in combination. Each diagram is a graphic representation of the student's performance in the LAMDA tests. Each row in the performance profile corresponds to a test. Students' performance is classified into 4 zones, compared to their classmates' performance. The intervals covered by the 4 zones are unequal, reflecting the degree of concern corresponding to each. Specifically, these are the intervals 0-10, 10-25, 25-50 and 50-100 on the scale of percentiles.

The accuracy diagram shows the performance in terms of the number of correct answers given by the student, the number of correct choices in the questions of the respective test. In this diagram, the low performance corresponds to a large number of errors, compared to classmates, regardless of the time or effort required by the student to perform the test. The speed chart shows the performance in terms of the time it took the student to give the correct answers. In this diagram the low performance corresponds to long intervals between the appearance of the alternatives and the student's response.

The performance profile of each student highlights the areas of potential weaknesses, which need further evaluation, and can be, if confirmed by the specialized examination, starting points of a learning intervention program. Any student with a performance that is significantly lower than expected for his / her class in two or more individual tests, or in one or more general areas of skills, should be referred for further investigation.

When evaluating results in an individual profile, the various factors that may have led to that profile should always be considered. For example, a low performance may be due to difficulty in the respective skill area, difficulty in reading (if reading the alternatives required), distraction, fatigue, malaise, etc. Therefore, special care is needed in evaluating and formulating judgments about with an individual profile that includes performance in the red or yellow zone. Of course, it should be borne in mind that the performance in the red zone is comparatively much lower than the performance in the yellow zone. Conversely, a high performance may be due to ease in the respective skill area, moderate ease combined with excellent perseverance and patience, or even (in rare cases) and random selection of the correct answers.

The interpretation of the individual profile can only be indicative and can be done with prejudice. Detailed evaluation by a specialist is absolutely necessary before making diagnostic or other judgments with significant consequences for the academic and possibly social course of any student.

### 2.5.2 Graphics and scenarios

The LAMDA environment should maintain the student's interest. This is achieved through fun events and animations. Despite the fact that the test is like a game, because of the pictures, it does not cease to be adapted to the school environment. Children who fail easily get tired and bored, as well as there is a risk of distraction and children with high performance due to the ease of the exercises.

LAMDA is divided into:

- a) B'-D'- "a walk in the forest"
- b) E'-B 'Gymnasium - "the adventures of the Famous Cyclops".

### 2.5.3 Areas of skills and individual tests

*Stimulus Recognition:* Visual stimulus recognition is the most significant point in the correct student assessment. LAMDA initially includes exercises, which gradually familiarize the student with the interaction framework and ensure his attention and response. LAMDA includes three preliminary exercises, which gradually familiarize the student with the interaction framework and ensure his attention and response.

1. The first step is a simple stimulus response, which does not require stimulus selection or recognition and is not evaluated in the performance profile. It is used to consolidate students' controlled response and prolonged attention. It also works as a short exercise in the use of the mouse.
2. The second exercise ("Image Recognition") is a selection response to a visual stimulus, in which the student must act quickly when a particular image is presented and suppress the reaction to any other image. The pictures are very different, so the only requirement from the student is prolonged attention. Low accuracy in this exercise can mean a lack of concentration and makes the rest of the student's profile misinterpreted. Low speed in this exercise may mean reduced student participation, or that the calculator is too slow and therefore difficult to assess the speed profile. (This possibility should be tested by examining a few more students on the same computer.)
3. The third and most important exercise ("Word Recognition") is a lexical selection test, in which the student must act quickly when a real word appears on the screen and suppress the reaction when a false word appears. Words are easy for ages to consider, so any mistakes are more likely to be related to lack of attention than ignorance of the words. Low speed in this exercise is associated with difficulty in recognizing words and may, in combination with other elements of the profile, occur in cases of reading problems.

*Spelling:* A student's level of spelling depends on his / her general language experience and, in particular, on his / her written experience. As the student's knowledge increases, spelling mistakes are corrected. It has been observed that under time pressure more spelling mistakes are made, as mainly cognitive resources are spent, with the result that the resources for spelling are not sufficient.

*Syntactic processing:* The good grammatical level of the student, allows him to compose the sentences accurately in the meaning and to understand easier and faster what he reads. At LAMDA there are two exercises that explore students' abilities in this field. In the first exercise ("Completing sentences") the correct answer is limited by the phrasal context provided.

1. Thus, the student is asked to complete a sentence with the appropriate word. In some questions, the alternatives differ in morphology and therefore in whether the type of word serves the necessary function within the particular phrase. In other questions the alternatives relate to the syntactic role of specific functional words (for younger children) or to more complex phenomena, such as the passive voice (for older children).
2. In the second exercise ("Proportions") the method of proportion<sup>10</sup> is used to test the student's ability in productive and clitic morphology, without a supporting phrase frame. This exercise requires the explicit morphological manipulation of words without useful consequences so it can be characterized as linguistic:

*Comprehension of oral speech:* Comprehension of spoken language is a prerequisite for linguistic communication orally or in writing. At the same time, oral performance contributes to and influences the high level of written comprehension. A student, as a rule, has a better performance in speaking than in writing. LAMDA is designed to meet the age understanding of children. It is self-evident that in children up to the 5th grade, the vocabulary he uses is simple and is accompanied by virtual representations. LAMDA detects the comprehension of oral speech in the form of narrative text and not the comprehension of the flowing, spontaneous oral speech that we use in our daily oral communication. Thus, the demands of speech processing are increased: On the one hand, their structure is more complex than spontaneous speech and it places additional demands on language processing. On the other hand, the content is not actually supported by the context of the interaction and therefore the comprehension must necessarily be based on the auditory language stimulus.

*Comprehension of written text:* The written comprehension is examined in LAMDA with the presentation of a written text for the student to read. The text is then withdrawn and image choices or multiple-choice questions are given (for younger and older children respectively), as well as in the oral comprehension test.

In general, both the text and the form and content of the questions are similar to the corresponding oral comprehension test, so that the results of the two tests are comparable. Thus, the questions are distinguished according to the processing requirement they ask the student. Memory questions simply require the answer to be revoked as stated at one point in the text. For the correct answer to a memory question it is not necessary to deeply process and understand the meaning of the text, only a superficial processing of the phrases. The wrong choices provided in such questions contain existing but irrelevant elements of the text and are factually acceptable. So, the correct answer cannot be given without reading the text.

*Vocabulary:* Exercise Vocabulary is examined in LAMDA with an "image selection" exercise. It includes 1 virtual speaker, who utters a word, while at the same time 4 im-ages are displayed, of which only one successfully represents the spoken word. The student is asked to choose the right one, e.g. The word "appliance" refers to an ironing board (correct choice), a horn, a hermit crab and a high-pressure cylinder. Poor vocabulary can be an indicator of learning difficulties. On the contrary, vocabulary is important for a child's success in school. Vocabulary is tested in LAMDA with one or two exercises, depending on age.

1. The first exercise ("Image Selection") is given to all ages. Includes a virtual speaker that utters a word. At the same time, 4 images are displayed, of which only one successfully represents the spoken word. The student is asked to choose the correct image. For example, the word 'appliance' refers to: an ironing board (correct choice), a horn, a hermit crab and a high pressure cylinder.
2. In the second exercise ("Definitions"), only for older children, the speaker utters a short definition. At the same time, 4 written words appear, of which only one corresponds exactly to the definition, while the others are phonologically, morphologically or semantically related. For example, in the definition "I set fire and I burn something" the options are "I light", "I set on fire", "I light", "I agree".

*Working memory:* Working memory is considered to be one of the most important factors in supporting language processing and comprehension, and therefore communication and expression. Limitations in working memory give a different character to learning disability from problems limited to areas such as syntactic processing or writ-ten comprehension. Work memory problems are well documented

in children with special learning difficulties, such as dyslexia, as well as in children with language deficits. Lack of working memory has also been linked to Attention Deficit Hyperactivity Disorder (ADHD), which affects 30–40% of children with diagnosed learning disabilities. The working memory is tested by sequence playback. As with other learning disabilities software, LAMDA uses letter sequences rather than numbers, so that the exercise is more difficult for children with insufficient experience in processing written data. Only consonants are used to form the sequences, so that the letter sequences that the student has to memorize do not form words or syllables that make them easier to memorize. Thus, the exercise examines the verbal working memory, which seems to be particularly weak in children with language learning difficulties.

*Perception of music characteristics:* The processes of perception of characteristics of music (rhythm, harmony, melody) are directly connected with corresponding processes of perception of characteristics of oral speech. In children with language development and literacy disorders, the ability to reproduce musical rhythm is associated with language ability.

*Non-verbal mental ability:* In this context, the assessment focuses on the ability to reproduce simple rhythmic patterns, progressively increasing in difficulty, which can be successfully performed by students in the first four grades of primary school without systematic music education. Students listen to rhythmic shapes briefly and then play them with their finger on the computer mouse. This examines the degree of synchronization of auditory, somatosensory, and motor functions, in conjunction with working memory, and quantifies the effectiveness with which the individual processes rapid sequences of sound stimuli and synchronizes them kinetically.

#### 2.5.4 Use and usefulness - Ways of utilizing LAMDA

The test identifies students who need more specialized performance highlighting areas of potential weakness - starting point for a learning intervention program. Mass application of automated detection in one department allows the capture of the learning potential of the whole (taking measures at local and central level). Finally, LAMDA has as its ultimate goal the identification of learning disabilities and not the distinction of students into good / mediocre / bad.

### 2.5.5 Ages examined and age issues

Students in the first grade and the first three months of the second grade are excluded from the test, because many children have not yet sufficiently acquired the ability to read, so that they can be reliably assessed both in reading and in other skills that require reading. Also, the level of cognitive and emotional maturity (endurance, attention, cooperation, discipline) of primary school children is still relatively low, under-mining the reliability and validity of the measurements. Finally, at this age they are not familiar with computers.

### 2.5.6 Who is LAMDA used for?

General and special education teachers, other specialists who staff the diagnostic, evaluation and support centers, speech therapists, psychologists, pediatricians and child psychiatrists if they have attended a relevant training program.

The 90% of the students of all classes complete the LAMDA exercises in about 40'. While less than 5% of students need more than 45'. The child has the opportunity to take a short break between two exercises by simply pressing the "Continue" button. If interruption is necessary, e.g. due to excessive fatigue or illness of the student, the process is interrupted and resumed from where it left off when the student is again able to be examined.

It is important to note that a diagnosis first requires obtaining a history of the person being examined. It also requires a long examination of a wide range of individual skills, with appropriate tools from a specialist. Furthermore, the inclusion of emotional, social, cultural and other factors should not be omitted, nor the exclusion of sensory, neurological and psychiatric problems of the individual. Finally, a clinical observation and evaluation is performed by the specialist.

All of the above, however, cannot be offered by a computer during a school year. Therefore, LAMDA can only give a useful indication of potential areas of weakness and not diagnose of dyslexia or learning difficulties.

The first and most important thing that the teacher-examiner must do after the completion of LAMDA is to discuss this with the students' parents. While the second is its referral for evaluation by KEDDY or other competent bodies.

### 2.5.7 Instructions for displaying the results

The results of the LAMDA automated detection include the accuracy chart and the speed chart that provide information either individually or in combination. The performance chart examines accuracy (performance-the student's correct answers) and speed (student's response-response time).

There are zones in which students' performance and speed are displayed:

- the red (10 percentile)
- the yellow (25 percentile)
- the light green (50° percentile)
- the green (50°-100° percentage)

Red zone performance: Possible weakness of the child in a specific area of skills. If the child has 2 or more performances in the red zone should be referred for detailed evaluation by a specialist. If the child has multiple performances in the yellow zone is a sign of moderate learning disability, so it is recommended to examine the child by a specialist. If the child has a performance in the green zones at the upper 75% (regarding the weighted sample), then it does not inspire concern.

### 2.5.8 Data analysis strategies

Instructions for displaying the results

The results of the LAMDA automated detection include the accuracy chart and the speed chart that provide information either individually or in combination. The performance chart examines accuracy (performance-the student's correct answers) and speed (student's response-response time).

There are zones in which students' performance and speed are displayed:

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specialist. If the child has a performance in the green zones at the upper 75% (regarding the weighted sample), then it does not inspire concern.

## 2.6 Description of the intervention program

The intervention program aims to evaluate the effect of the two different teaching approaches, innovative activities - traditional method of teaching through the instructions of the APS, on the learning performance of the music lesson, on the rhythmic education unit in both students of the typical population as well as in students with dyslexia. In addition, the effect of the two will be investigated the effectiveness of the intervention program in children with dyslexia not only in the improvement of rhythmic education but also in their improvement in the language areas examined by the assessment tool "LAMDA" test.

### 2.6.1 Stage 1

After dividing children with dyslexia into 2 groups:

- Group A (experimental group - group of children who will attend the interventional teaching method)
- Group B (group of children who will follow the teaching through the Curricula) will use the evaluation tool "LAMDA" test to all students before and after the teaching of music, whether it is the intervention or through the Curriculum, by the class teachers under the supervision of the researcher, so that to perform the evaluation both in the rhythmic education and in the other modules of the test.

### 2.6.2 Stage 2

In group A – experimental. The following procedure will be used:

In place of the usual curriculum-based teaching method, innovative activities will be used. Some activities will be compatible with the curriculum but will be presented in a playful form.

More specifically, this interventional method will last 12 lessons, where each lesson corresponds to 20 minutes. Two groups will be divided with 32 children of D ' Elementary School each, of which 16 will have an official diagnosis of Dyslexia from a certified while the remaining 16 will belong to the typical student population.

### 2.6.3 Stage 3rd

In group B (group of children who will follow the teaching through the Curricula), which will consist of 16 children who will have a formal diagnosis of Dyslexia from a certified state body and 16 children who will belong to the typical student population will be granted the assessment tool before and after the classical teaching by the class teacher who will follow the Curriculum.

Students from different schools and districts / prefectures are very likely to coexist in these groups. The division of children into these groups will be random.

### 2.7 Intervention program- activities

One of the key features of inclusive teaching is the different way it is offered to students, including innovative teaching methods suitable for each student individually with any difficulty, as well as that of dyslexia. The teacher's goal should be the varied way of teaching in order to find the best and most effective for each student in order to ensure learning with the most enjoyable and fun lesson. More specifically, in students with dyslexia the teaching should be structured and thorough with many repetitions. Different ways of teaching can be used such as multi-student teaching which uses different methods to deepen the effect of stimuli. Learning becomes more stable with the mutual support of as many senses as possible during the learning process.

According to Chrysostomou (Chrysostomou, 2003) the main methods of teaching music are as follows:

- **THE DALCROZE METHOD**

This method was invented at the beginning of the 20th century and is the most complete system for rhythmic training and movement. Jacques Dalcroze, born in Vienna in 1865-1950, created this method. He had studied music, theater, piano and composition. In 1892 he was hired as a professor of music writing in Geneva where he began to develop this method. In the early 20th century, he observed that the existing teaching method did not help his students discover the elements of music and express themselves through music.

He watched the students who played music without understanding it, and consequently without emotion. He therefore considered that the solution to this problem would be to be able to control the contraction and the relaxation of the muscles according to the speed, the duration and the dynamics (nuances) of the sound. He also believed that rhythm and height could develop a system that connected the ear with the brain and the body. Finally, his system is based on three different elements: eurythmy, that is to say, the movement used to express emotions, hearing ability and improvisation. Dalcroze argued that teaching Rhythmic Solfeze using rhythm-based can bring positive results to pupils with reading problems. He created about 100 melodies and 450 rhythmical solo exercises, and gave great importance to the teaching of space mussels.

- THE KODALY METHOD

Kodaly, born in 1882 in a village a few kilometers from Budapest, began his musical training at an early age, learning piano, cello, and violin. His great interest in music led him to publish books on music training, but also helped him to devise a systematic method appropriate for school curricula from kindergarten to high school, emphasizing rhythm, singing and learning musical instruments.

This method emphasizes the importance of learning musical notation, once the teacher considers that children are ready to learn, write and read music, that is, when the child begins to learn, read and write the alphabet.

The learning of the sounds is done in a special way, since each episode corresponds to a gesture according to the method of Curven Ms Glover.

He also felt that learning music should begin at an early age and take place on a daily basis as well as hold an important place in the curriculum of the school by including songs with hand movements so that children have better school performance Carder et al., 1972). In addition, in order to achieve the goal of learning how to read and write music independently of learning difficulties, he created a system of rhythmic syllables where each syllable corresponded to a rhythmic value based on Emile Joseph Cheve's rhythmic learning system (Wheeler, 1985).

He also teaches two-beat rhythmic patterns first, then continues with three-beat rhythms. It also highlights the importance of the minor third interval. He also teaches

kinaesthetic learning using gestures made to understand pitch, as well as hearing skills that focus on listening to recognize rhythmic and melodic patterns. These elements formed the core of his method. Finally, improvisation, that is, the child's ability to create melodic phrases and to imitate, played an important role in his method of teaching. Kodaly believed that music education should be based on the musical tradition of each culture.

- **THE ORFF METHOD**

Creator of the method is the German Carl ORFF. Being influenced by ancient Greece, he approaches the teaching of music by combining melody, movement and speech, a unit that has also called it elementary music. Having studied piano, he discourages his students from learning to play the piano, because he thinks that the use of percussion can create a need for students, a need to create their own music, their own melodies.

This method is characterized by a combination of speech and rhythm, because he considered that the recitation could be combined with the beatings of the rhythmic hands, with fingers in hand - feet on the floor. Also, the movement that accompanies the rhythm, but also the improvisation on rhythmic or melodic motives on the percussions were essential elements of its method of teaching. He felt that the relationship of the student with the teacher is based on interaction and is variable. He believed that creative play could develop the personality of the child and his contact with art to cultivate free music expression, improvisation. He believed that all children were able to acquire the musicality and it was enough for them to participate in musical activities corresponding to their level.

- **THE SUZUKI METHOD**

Suzuki, a Japanese musician and educator, invented the so-called talent education method for teaching string instruments to small children. The main elements of the method are listening to music, developing techniques and encouragement. He believes that every child can achieve a very high musical sensitivity

The development of the capacity of the musical memory through listening, observation and imitation is a key element of the method. he Suzuki method is also referred to as

the mother tongue method since its main purpose is to learn music in a straightforward way that one learns the mother tongue. In addition, he believes that audible skills can be exercised before learning musical notation and that the child can play a musical instrument without knowing how to read music while the notation is inserted when the child plays several pieces on the musical instrument he is learning. The musical pieces used by students in the world include carefully selected musical pieces and not craftsmanship exercises to support hearing learning. Yet another key element of Suzuki's learning music is the emphasis on acoustic imitation and the enhancement of acoustic memory.

He believes that acoustic ability is very important to musicians and cannot be cultivated in the same way when the student is attached to the score. (Kendall, 1985). A basic prerequisite for the success of this music teaching is a well-trained music instructor who will encourage his student and help him feel safe and accepting, encouraging him to make the most of his skills (Collier-Slone, 1991).

In summary, the Suzuki method is useful for students as it offers:

- Structured and systematic learning
- Acoustic, visual and kinesthetic activities
- Amplification of auditory stimulation through learning a musical instrument with an ear tool.

The activities that were proposed to complete the music curriculum to improve and make music teaching easier and more enjoyable for both students with dyslexia and typical. The structure of each course is almost the same and the aim of these courses is to improve as many skills as possible through rhythmic games.

In the first lesson the activities that took place were the following:

- The first lesson started with an introductory song in which the child was asked to participate by repeating it rhythmically.
- The next activity is an activity aimed at developing cooperation and trust. The children were asked to become couples. One student created a rhythmic pattern either with their voice or with their body which in turn the other student had to imitate. The activity is constantly alternating.

- The next game is a memory game in which each student has in front of him 32 cards in total with quarters and eighths, which each have a different color. has placed them upside down so that the rhythmic value is not visible and tries to match them by finding the same.
- Finally, the lesson closes with a greeting song.

The second lesson was not much different from the first since it is another adaptation lesson for both the teacher and the children. So, the activities are as follows:

- The lesson begins with the same introductory song in which the child was asked to participate by repeating the rhythmic quarters by striking a percussion instrument.
- The next activity is an activity aimed at developing cooperation and trust. The children were asked to become pairs and to imitate in order the rhythmic forms which are performed with a percussion instrument.
- The next game is a memory game in which each student has in front of him 32 cards in total with quarters and eighths as well as halves, which each have a different color. Initially he has placed them upside down so that the rhythmic value is not visible and he tries to turn them to match them by finding the same ones.
- Finally, the lesson closes with a greeting song in which he is asked to clap rhythmically.

The third lesson had the following activities:

- The child was asked to create a simple song in 4/4 rhythm in order to start the lesson.
- The children were asked to become pairs and imitate the rhythmic patterns in order. The student taps the other child's back on a simple rhythmic pattern and is asked to repeat exactly the same with claps.
- The next game is a game of perception of space in relation to the body of each child. Each child was asked to create a value, whichever he chooses, whole, quarter and pause on the floor using his body.
- Finally, the lesson closes with a greeting song in which he is asked to beat rhythmically on a percussion instrument

The fourth lesson included the following activities:

- The child was asked to create a simple song in 3/4 rhythm this time in order to start the lesson.
- The children were asked to become pairs and imitate the rhythmic patterns in order. The student taps the other child's back on a simple rhythmic pattern and is asked to repeat exactly the same on a percussion instrument.
- Creating rhythmic values on the floor in small and large dimensions using cardboard
- Finally, the lesson closes with a greeting song in which he is asked to beat rhythmically on a percussion instrument.

The fifth lesson included the following activities:

- Using words from the vocabulary they are about to learn or from what they already know, picture cards were created that represented each word. Each child chose a card and tried to say it orally by clapping each syllable.
- Having created a path using large cards with musical values quarters and eighths, the children are asked to walk on it and at the same time to hit on a percussion instrument what is written on each card.
- Creating rhythmic values on the floor in small and large dimensions using cardboard
- Finally, the lesson closes with a greeting song in which he is asked to beat rhythmically on a percussion instrument.

The sixth lesson included the following activities:

- Using words from the vocabulary they are about to learn or from what they already know, picture cards were created that represented each word. Each child chose a card and tried to say it orally by clapping two syllables on each syllable.
- Having created a path using large cards with musical values quarters and eighths, the children are asked to walk on it and at the same time to hit on a percussion instrument what is written on each card.
- Creating rhythmic values on the floor in small and large dimensions using cardboard

- Finally, the lesson closes with a greeting song in which he is asked to beat rhythmically on a percussion instrument.

The seventh lesson included the following activities:

- using words from the vocabulary they are about to learn or from what they already know but now also false words, each child tried to say it orally by clapping two syllables on each syllable.
- Having created a path using large cards with musical values quarters and eighths, the children are asked to walk on it and at the same time to hit on a percussion instrument what is written on each card.
- The teacher strikes a rhythmic pattern and asks the children to repeat it on a musical instrument
- Finally, the lesson closes with a song created by the children containing familiar words for them and false words.

The eighth lesson included the following activities:

- The teacher strikes a rhythmic pattern and asks the children to repeat it on a musical instrument
- Having created a path using large cards with musical values quarters and eighths, the children are asked to walk on it and at the same time to hit on a percussion instrument what is written on each card.
- Using the metronome, which we have hidden in the classroom while it is in operation, the children are asked to find it following its rhythm by clapping.
- Finally, the lesson closes with a song created by the children containing familiar words for them but also false words by clapping rhythmically.

The ninth lesson included the following activities:

- Having created a path using large cards with musical values quarters and eighths, the children are asked to walk on it and at the same time to hit on a percussion instrument what is written on each card.

- Creating rhythmic values using children's bodies upright or on the floor. Extra objects such as a ball or even the activity in pairs can be used in order to achieve a better representation.
- Using the metronome, which we have hidden in the classroom while it is in operation, the children are asked to find it following its rhythm by clapping.
- Finally, the lesson closes with a song created by the children containing familiar words for them but also false words by rhythmically striking a musical instrument.

The tenth lesson included the following activities:

- The teacher keeps the tempo of one piece steady and asks the children to beat the drum accurately to the beat. The song can be in 4/4  $\frac{3}{4}$ .
- The teacher asks the children to sit in pairs and create false syllables two syllables and three syllables. Then, after reading one of their own to the other, they are asked to say them aloud, clapping each syllable.
- The teacher keeps the tempo of a steady song and asks each child individually to walk in rhythm by rhythmically hitting a ball on the floor.

The eleventh lesson included the following activities:

- The teacher keeps the tempo of one piece steady and asks the children to beat the drum accurately to the beat. The song can be in 4/4  $\frac{3}{4}$ .
- The teacher asks the children to sit in pairs and create false syllables two syllables and three syllables. Then, after reading one of their own to the other, they are asked to say them aloud, two clapping each syllable.
- The teacher keeps the tempo of a steady song and asks each child individually to walk in rhythm by rhythmically hitting a ball on the floor while at the time he hits the floor they try to clap.

Lesson 12 included the following activities:

- the child chooses one of the previous songs that have been created and repeats it with the educator.

- Musical bowling, using pins with rhythmic values painted on them. Each student rolls the dice and tries to roll the girl to the value of his dice.
- The teacher keeps the tempo of a song steady and asks each child individually to walk in rhythm by rhythmically hitting a ball on the floor while at the time he hits the floor they try to clap.
- Finally, the lesson closes with a greeting song, with each child participating as they wish, either with vocal accompaniment or body percussion, or by beating a musical instrument rhythmically.

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### 3 Chapter III: Results

#### 3.1 Results of the pre-test on students with dyslexia

The results of all the students who took part in the research are presented in detail in Figure 1. Below are the 32 students with dyslexia who responded to the LAMDA test they received before the intervention and before attending the syllabus. Analytically, the results of the pre-test on students with dyslexia showed that 26 had more mistakes than 90% of their classmates, thus receiving a result of 0 -10% in the first exercise regarding image recognition. The other 6 seem to have done better and received a 10-25% result.

In the second section, word recognition, 28 of the 32 received from 0-10% while 4 of the 32 made more mistakes than 75% of their classmates and received 10-25%.

In the third exercise, historical spelling, 4 of the 32 had more mistakes than 90% of their classmates, thus receiving a result of 0 -10%, 17 of the 32 students made more mistakes than 75% of their classmates and thus received 10-25%, while the remaining 11 made more mistakes than 50% of their classmates and thus received 25-50 %.

In the fourth exercise, grammar spelling, 5 of the 32 had more mistakes than 90% of their classmates, thus receiving a result of 0 -10%, 19 of the 32 students made more mistakes than 75% of their classmates and thus received 10-25%, while the remaining 8 made more mistakes than 50% of their classmates and thus received 25-50 %.

In verbal comprehension, 23 students had a 0-10% result, 4 of the 32 made more mistakes than 75% of their classmates with a score of 10-25%, 3 of the 32 had 25-50%.

In the written comprehension 8 out of 32 received 0-10% while 23 out of 32 received only 10-25% while the remaining 1 made more mistakes than 50% of their classmates and thus received 25-50 %.

In the completion of sentences 11 out of 32 received 0-10% while 19 out of 32 received only 10-25% while the remaining 2 made more mistakes than 50% of their classmates and thus received 25-50 %.

In the eighth exercise related to verbal proportion, students seem to have done better with 13 out of 32 responding with less than 75% of their classmates receiving 10-25% while 18 of 32 received 25-50% and only 1 student received 0-10%.

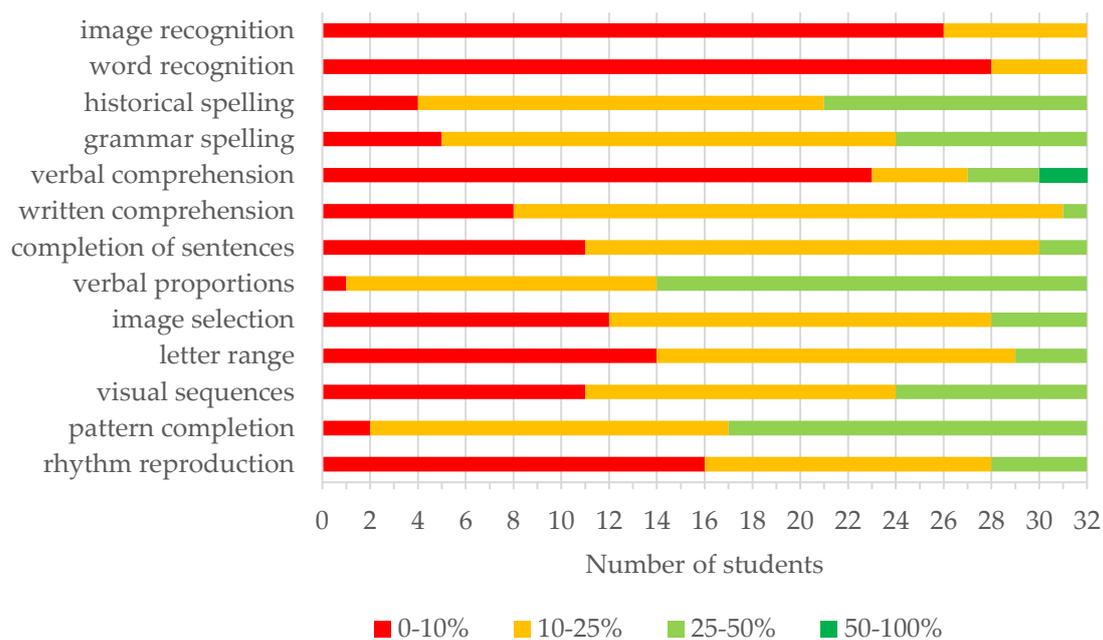
In the ninth exercise concerning image selection 12 out of 32 students do not seem to have a good performance with a result of 0-10%, 16 of the 32 also do not seem to have done so well with 10-25% while only 4 seems to have moderate with a result of 25-50%.

In the tenth concerning letter range 14 out of 32 received 0-10% while 15 out of 32 received only 10-25% while the remaining 3 made more mistakes than 50% of their classmates and thus received 25-50 %.

In the eleventh exercise, visual sequences, 11 out of 32 did not perform well with 0-10%, 13 out of 32 made more mistakes than 75% of their classmates taking 10-25% while only 8 did relatively well with 25-50% result.

In the twelfth exercise, which concerns the pattern completion, it seems that they did better with only 2 student having more mistakes than 90% of his classmates, 15 out of 32 got a result of 10-25% while 15 out of 32 seem to have done relatively well with a result of 25-50%.

In the last exercise, rhythm reproduction, and quite important since the intervention program is shaped by rhythmic activities, it seems that 16 out of 32 students had a hard time getting 0-10%, 12 out of 32 got 10-25% while only 4 seems to have gone relatively well with a result of 25-50%.



*Figure 1: Results of the pre-test on students with dyslexia*

### 3.2 Results of the post-test on students with dyslexia who followed the intervention program

The results of the post-test in the students with dyslexia who followed the intervention program Figure 2, specially adapted to the needs of these children, showed that in the first section 9 of the 16 had more mistakes than 75% of their classmates, thus obtaining a score of 10-25 %, 7 of the 16 answered with less correct answers than 50% of their classmates.

In the second section, word recognition 5 of the 16 students made more mistakes than 75% of their classmates and thus received 10-25%, 10 out of 16 received 25-50% while the remaining 1 did very well with a result of 50- 100%.

In the third exercise, historical spelling, 2 of the 16 students made more mistakes than 75% of their classmates and thus received 10-25%, 4 out of 16 received 25-50% while the remaining 10 did very well with a result of 50- 100%.

In the fourth exercise, grammar spelling, 4 of the 16 students had a result of 10-25%, 8 of the 16 received 25-50% and the other 4 seem to have done very well with 50-100%.

In the fifth exercise concerning verbal comprehension, 11 of the 16 received 0-10%, 2 of the 16 students had a result of 10-25%, 1 of the 16 received 25-50% while only 2 answered very well receiving a result of 50- 100%.

In the written comprehension 4 in 16 received 0-10% while 11 in 16 received only 10-25% while only 1 student did relatively well with 25-50%.

In completion of sentences, 4 out of 16 did not seem to have a good performance with 0-10%, while 10 out of 16 respectively with a result of 10-25% while only two did relatively well with 25-50%.

In the eighth exercise concerning verbal proportions, the students seem to have done better with 4 of the 16 receiving 10-25%, while 9 of the 16 received 25-50% and the other 3 had a 50-100% result.

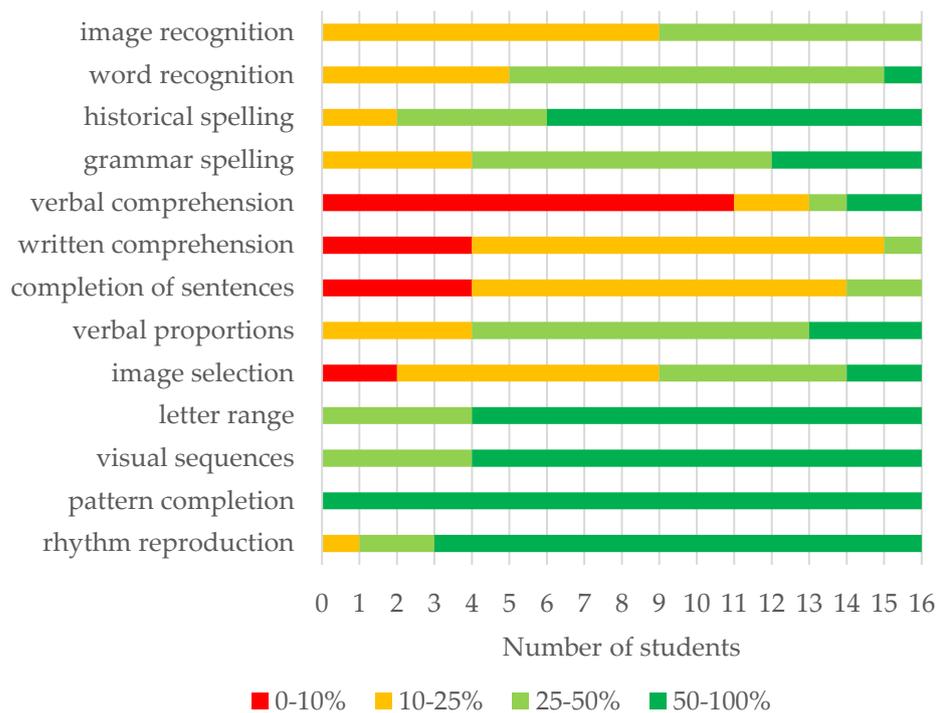
In the ninth exercise concerning image selection 2 in 16 students do not seem to have a good performance with a result of 0-10%, 7 of the 16 also do not seem to have done so well with 10-25%, 5 seem to have done well moderate with a result of 25-50% while 2 of them had very good results taking 50-100%.

In the tenth exercise concerning letter range, 4 out of 16 students seem to have done poorly with a result of 25-50% while 12 of them had very good results taking 50-100%.

In the eleventh exercise, visual sequences, 4 out of 16 did relatively well with a 25-50% result and 12 with a 50-100% result.

In the twelfth exercise concerning pattern completion all the students 16 out of 16 seem to have done well with a result of 50-100.

In the last exercise, rhythm reproduction, and quite important since the intervention program is shaped by rhythmic activities it seems 1 out of 16 received 10-25%, 2 out of 16 received 25 -50% while 13 seems to have done well with a result of 50-100%.



*Figure 2: Results of the post-test on students with dyslexia who followed the intervention program*

### 3.3 Results of the post-test in students with dyslexia who followed the school curriculum

The results of the post-test in students with dyslexia who followed the school curriculum, Figure 3, showed that all 3 of the 16 had more errors than 90% of their classmates, thus obtaining a score of 0 -10%, 2 of them 16 answered with less correct answers than 75% of their classmates, 9 did relatively well taking 25-50% while 2 seem to have done very well with 50-100%.

In the second section, word recognition 3 of the 16 received again from 0-10% while 5 of the 16 made more mistakes than 75% of their classmates and received 10-25% while only 8 seem to have done relatively well taking 25 -50%.

In the third exercise, historical spelling, 1 in 16 had a yield of 0-10%, 6 of the 16 students made more mistakes than 75% of their classmates and thus received 10-25%, 6 out of 16 received 25-50% while the other 3 did very well with a result of 50-100%.

In the fourth exercise, grammar, 3 of the 16 received 0-10%, 7 of the 16 students had a result of 10-25%, one of the 16 received 25-50% and the other 5 seem to have done very well with 50-100%.

In the fifth exercise concerning verbal comprehension, 11 of the 16 received 0-10%, 2 of the 16 students had a result of 10-25% while 2 of the 16 received 25-50%.

In the written comprehension 3 out of 16 received 0-10% while 11 out of 16 received only 10-25% while only one student did relatively well with 25-50%.

In the completion of sentence, 6 out of 16 seem to have not had a good performance with 0-10%, while 8 out of 16 respectively with a result of 10-25% while only one did relatively well with 25-50%.

In the eighth exercise on verbal proportion, students seem to have done better with 1 out of 16 responding with fewer correct answers than 90% of their classmates taking, 9 out of 16 receiving 10-25% while 5 out of 16 received 25-50%.

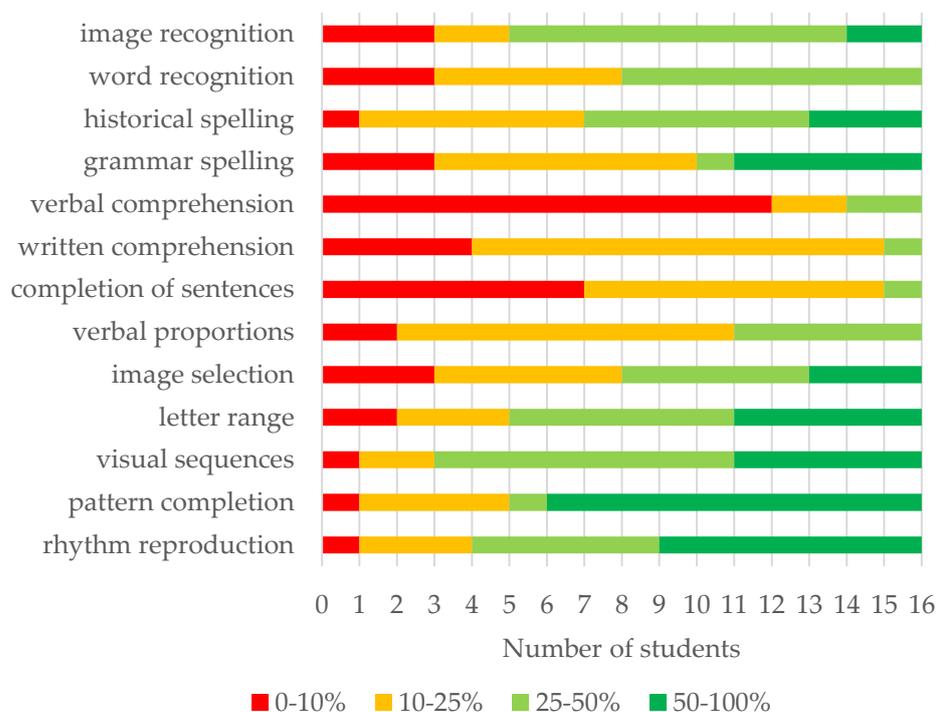
In the ninth exercise concerning image selection 3 in 16 students do not seem to have a good performance with a result of 0-10%, 5 of the 16 also do not seem to have done so well with 10-25%, 5 seem to have done moderate with a result of 25-50% while 3 of them had very good results taking 50-100%.

In the tenth exercise, 2 in 16 students do not seem to have a good performance with a result of 0-10%, 3 of the 16 also do not seem to have done so well with 10-25%, 6 seem to have done poorly with a result of 25-50% while 5 of them had very good results taking 50-100%.

In the eleventh exercise, visual sequences, 1 in 16 did not perform well with 0-10%, 2 in 16 made more mistakes than 75% of their classmates taking 10-25%, only 8 did relatively well with 25-50% result and 5 with a result of 50-100%.

In the twelfth exercise, which concerns the pattern completion, it seems that they did better with 1 in 16 having more mistakes than 90% of his classmates, 4 in 16 got a result of 10-25%, only one with a result of 25-50% while 10 out of 16 seem to have done well with a result of 50-100%.

In the last exercise, rhythm reproduction, and quite important since the intervention program is configured with rhythmic activities it seems that 1 in 16 students had a hard time receiving 0-10%, 3 of 16 received 10-25%, 5 of 16 received 25 -50% while 7 seems to have done well with a result of 50-100%.



*Figure 3: Results of the post-test in students with dyslexia who followed the school curriculum*

### 3.4 Overall improvement of the students with dyslexia

The findings regarding the overall improvement (or lack thereof) in the performance of the dyslexic students comprising the experimental group are summarized in Figure 4.

For each LAMDA-test criterion, the number of students with improved performance is represented by the horizontal bar next to it. Since the results of the LAMDA test classify the students into four performance intervals, i.e., 0-10%, 10-25%, 25-50%, 50-100%, the amount of improvement is denoted by different colors within each bar, based on the number of intervals by which this improvement occurred, e.g., for a student performing within the 0-10% range in the pre-test, and within the 50-100% range in the post-test, an improvement by three intervals is reported.

The findings show that the intervention improved the performance of all 16 students in rhythm reproduction (for 11 of them by three intervals, for three of them by two intervals and for two of them by one interval), as well as in letter range (for nine of them by three intervals, for five of them by two intervals and for two of them by one interval), in visual sequences (for two of them by three intervals, for 11 of them by two intervals and for three of them by one interval), in word recognition (for ten of them by two intervals and for six of them by one interval), in image recognition (for seven of them by two intervals and for nine of them by one interval), and in pattern completion (for seven of them by two intervals and for nine of them by one interval). In addition, 14 out of the 16 students exhibited an improvement in historical spelling (five of them by two intervals and nine of them by one interval), and in image selection (all 14 by one interval).

Moreover, 12 out of 16 students showed an improvement in grammar spelling (one of them by two intervals and 11 of them by one interval). A total of three students performed better in verbal proportions (all three of them by one interval) and only two students appeared to have improved in written comprehension and completion of sentences (all by one interval). Finally, improvement was observed by none of the students regarding verbal comprehension. In **Error! Reference source not found.**, the overall performance differences are presented this time based on the sex of the participating students. The overall improvement appears to be similar between male and female students, Figure 5.

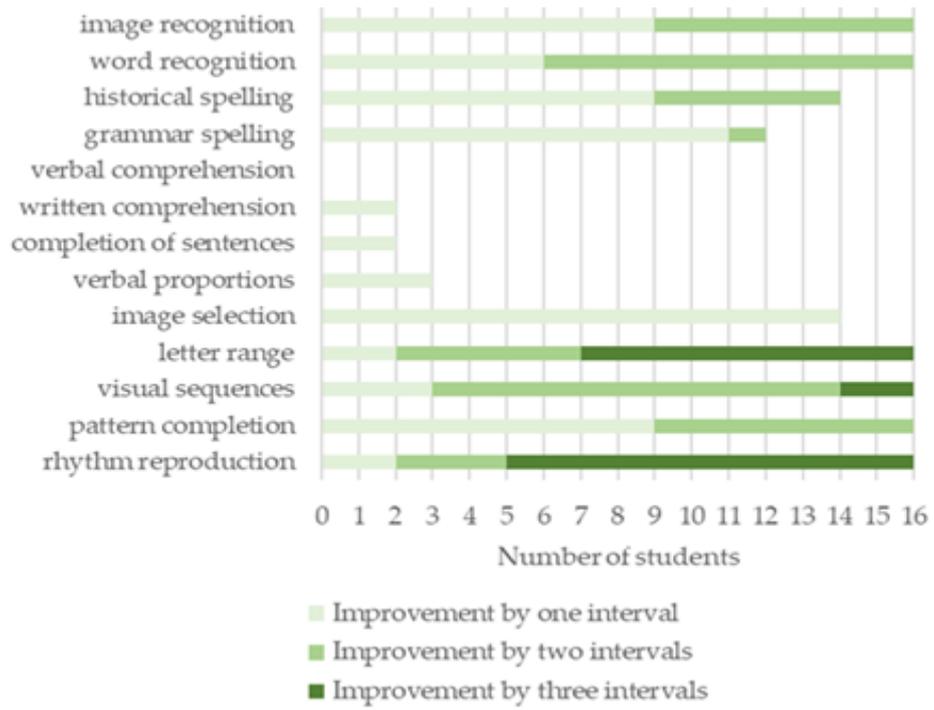


Figure 4: Number of students of the experimental group that improved in each LAMDA-test category.

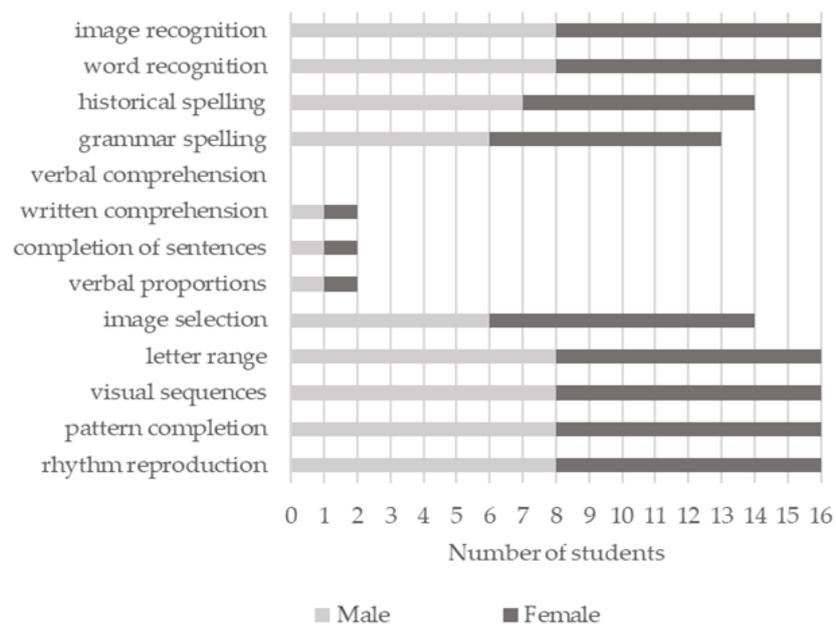


Figure 5: Number of male and female students of the experimental group that improved in each LAMDA-test category.

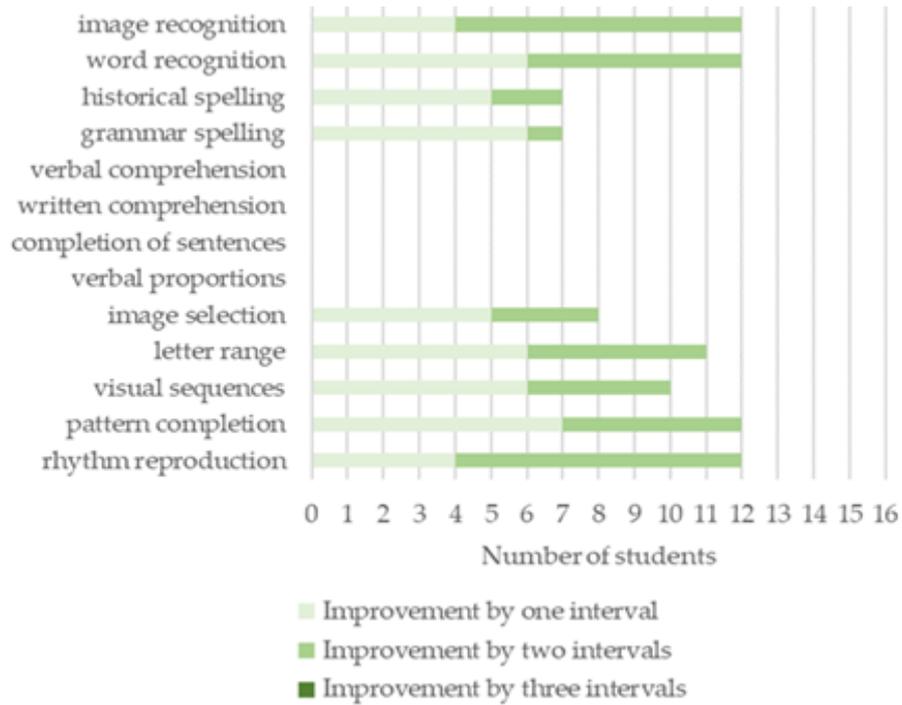
Figure 6 presents the findings regarding the overall performance improvement of dyslexic students belonging to the control group. Similarly, to **Error! Reference source not found.**, the different colors represent the number of intervals by which the improvement took place.

The findings show that the conventional music lessons of the typical curriculum had a positive effect on 12 out of 16 students in image recognition (8 of them by two intervals and 4 of them by one interval), rhythm reproduction (8 of them by two intervals and 4 of them by one interval), word recognition (six of them by two intervals and six of them by one interval) and pattern completion (5 of them by two intervals and 7 of them by one interval).

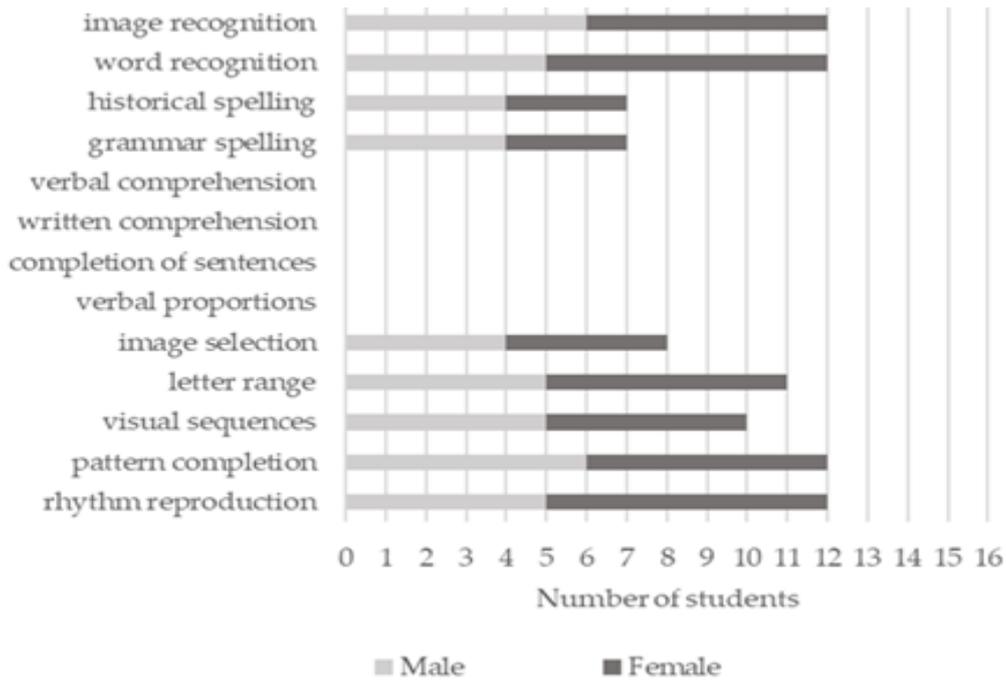
It also improved the performance of 11 students in letter range (5 of them by two intervals and 6 of them by one interval). For 10 students an improvement appeared with respect to visual sequences (4 of them by two intervals and 6 of them by one interval). Eight students performed better in image selection (3 of them by two intervals and 5 of them by one interval), while, for seven students, enhanced performance was exhibited

in historical spelling (2 of them by two intervals and 5 of them by one interval) and grammar spelling (1 of them by two intervals and 6 of them by one interval).

No improvement was observed for any of the students of the control group in verbal comprehension, written comprehension, completion of sentences and verbal proportions. Finally, as can be observed in Figure 7, there are no significant differences in performance improvement between male and female students of the control group.



*Figure 6: Number of students of the control group that improved in each LAMDA-test category.*



*Figure 7: Number of male and female students of the control group that improved in each LAMDA-test category.*

In Figure 8, the number of students that improved in each LAMDA-test category is presented for both the experimental and the control group, for comparison purposes. Compared to the music courses of the typical curriculum, the interventional music-training program appears to be considerably more beneficial with respect to rhythm-related skills, and consequently to all pertinent LAMDA-test criteria, namely image recognition, word recognition, historical spelling, grammar spelling, image selection, letter range, visual sequences, pattern completion and rhythm reproduction. On the other hand, the difference between the two groups is less profound regarding written comprehension, completion of sentences, verbal proportions and verbal comprehension. However, with the exception of the latter, even in those skills some improvement was observed in the case of the experimental group whereas none was detected in the case of the control group.

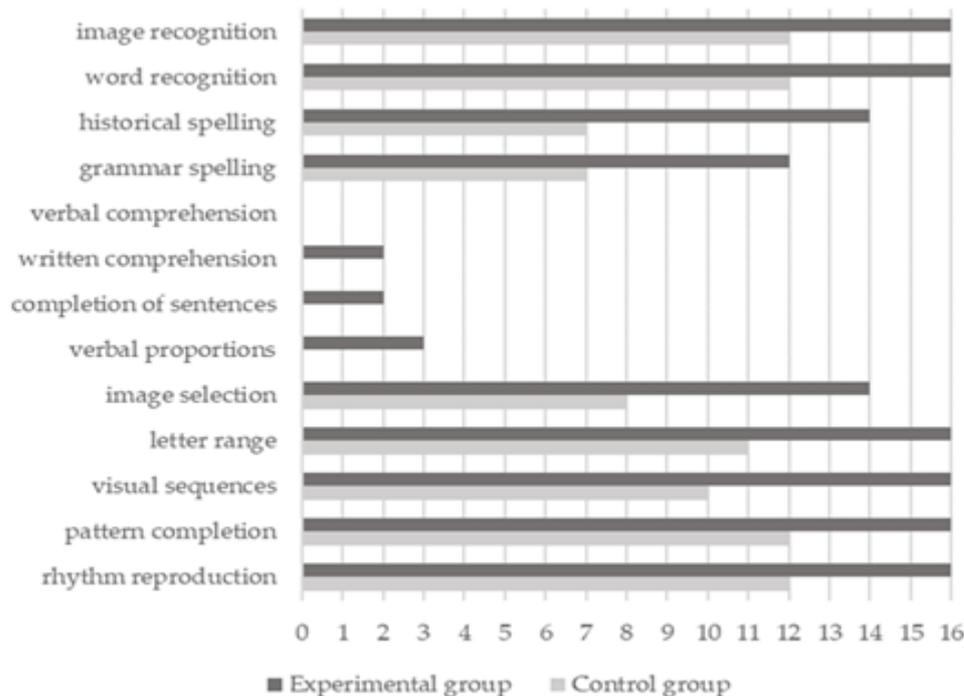


Figure 8: Comparison between the experimental and the control group with respect to the number of students that improved in each test category.

### 3.5 Results for of typical development students before intervention

In Figure 9, presents the findings of the analysis regarding the performance of students with typical development before intervention. The findings showed that all students had increased performance in all areas of the LAMDA test. More specifically, the results of the pre-test on students with typical development showed that all 20 of 32 had a performance that ranked in the 25% to 50% of the performance in image recognition while the rest had a performance that ranked in the to 50-100%.

In the second section, word recognition 12 of the 32 received again from 25-50% while 20 of the 32 made received 50-100%.

In the third exercise, historical spelling, 16 of the 32 students made more mistakes than 50% of their classmates while the remaining 16 received 50-100%.

In the fourth exercise, grammar spelling, the 15 students had a 25-50% result while 17 received 50-100%.

In verbal comprehension, 4 students had a result 25-50% while 28 of the 32 seem to they had a good performance with 50-100%.

In the written comprehension 23 out of 32 received 25-50% while 9 out of 32 received only 50-100%.

In the completion of sentences 8 of the 32 students had a result 25-50% while 24 of the 32 seem to they had a good performance with 50-100%.

In the eighth exercise related to verbal proportion, 21 of the 32 students had a result 25-50% while 11 of the 32 seem to they had a good performance with 50-100%.

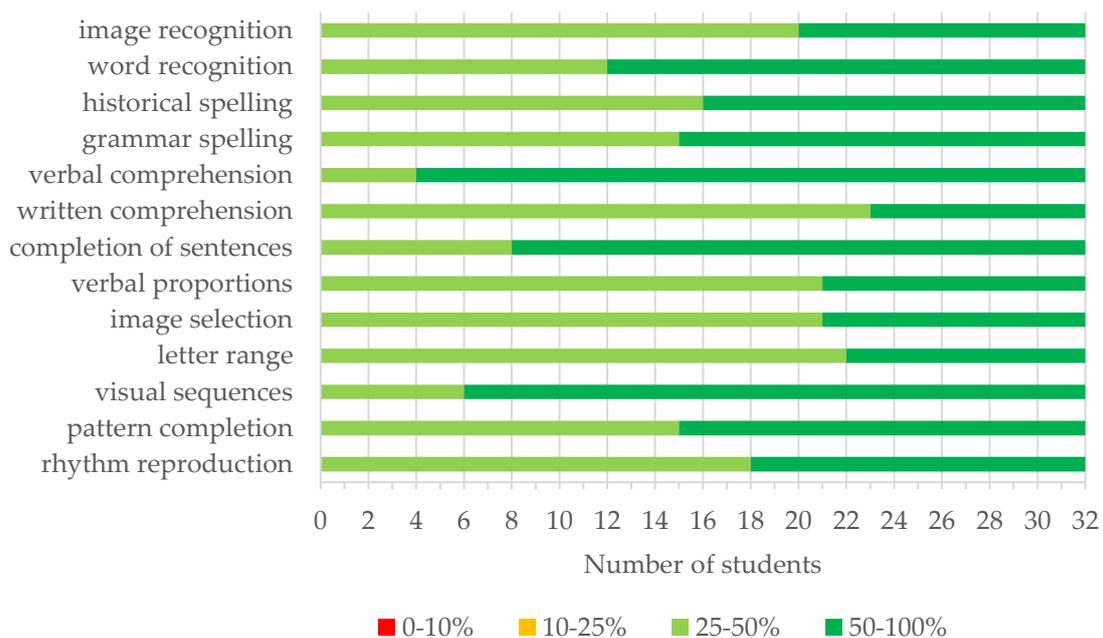
In the ninth exercise concerning image selection 21 out of 32 received a result 25-50% while the rest did very well with a result of 50-100%.

In latter range 22 out of 32 received a result 25-50%, 10 out of 32 did very well with a result of 50-100%.

In the eleventh exercise, visual sequences, 6 out of 32 receives a result 25-50% while the rest did very well with a result of 50-100%.

In the twelfth exercise, which concerns the pattern completion, 15 out of 32 seem to have done relatively well with a result of 25-50% while the rest did very well with a result of 50-100%.

In the last exercise, rhythm reproduction, 18 of 32 students had a result of 25-50% while the rest played very well with a result of 50-100%.



*Figure 9: Results for of typical development students before intervention*

### 3.6 Results for typical students who followed the intervention program

The results for the sixteen typical development students who followed the intervention program, Figure 10, showed that all the students improved by one level from 25-50% went to 50-100% in the first, image recognition, in the second exercise word recognition and in the third exercise historical spelling.

In the fourth exercise grammar spelling and in the fifth verbal comprehension, only one student had a 25-50% result while 15 received 50-100%.

In the written comprehension 9 out of 16 received 25-50% while 7 out of 16 received only 50-100%.

In the completion of sentences 4 of the 16 students had a result 25-50% while 12 of the 32 seem to they had a good performance with 50-100%.

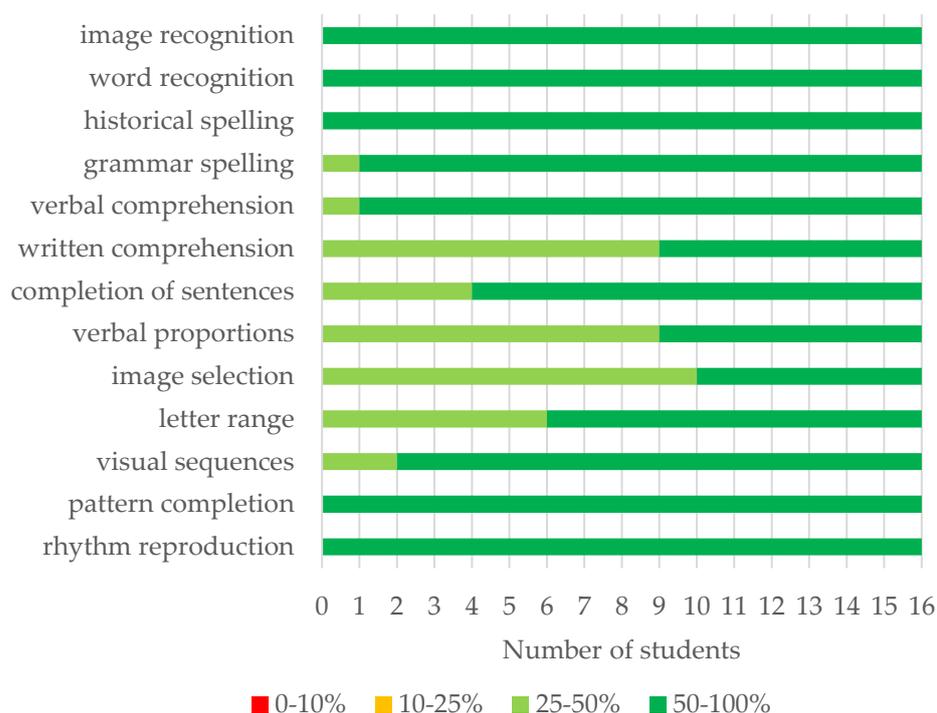
In the eighth exercise related to verbal proportion, 9 of the 16 students had a result 25-50% while 7 of the 16 seem to they had a good performance with 50-100%.

In the ninth exercise concerning image selection 10 out of 16 received a result 25-50% while the rest did very well with a result of 50-100%.

In latter range 6 out of 16 received a result 25-50%, 10 out of 16 did very well with a result of 50-100%.

In the eleventh exercise, visual sequences, 2 out of 16 receives a result 25-50% while the rest did very well with a result of 50-100%.

In the pattern completion and the last exercise rhythm reproduction all the students improved by one level from 25-50% went to 50-100% in the first, image recognition, in the second exercise word recognition and in the third exercise historical spelling.



*Figure 10: Results for typical students who followed the intervention program*

### 3.7 Results for the typical students who followed the curriculum

The results for the sixteen typical development students who followed the curriculum program, Figure 11, showed that all the students received 50-100% in the first, image recognition, in the second exercise word recognition, in the third exercise historical spelling and In the fourth exercise grammar spelling.

In the fifth verbal comprehension, only one student had a 25-50% result while 15 received 50-100%.

In the written comprehension 13 out of 16 received 25-50% while 3 out of 16 received only 50-100%.

In the completion of sentences 5 of the 16 students had a result 25-50% while 11 of the 32 seem to they had a good performance with 50-100%.

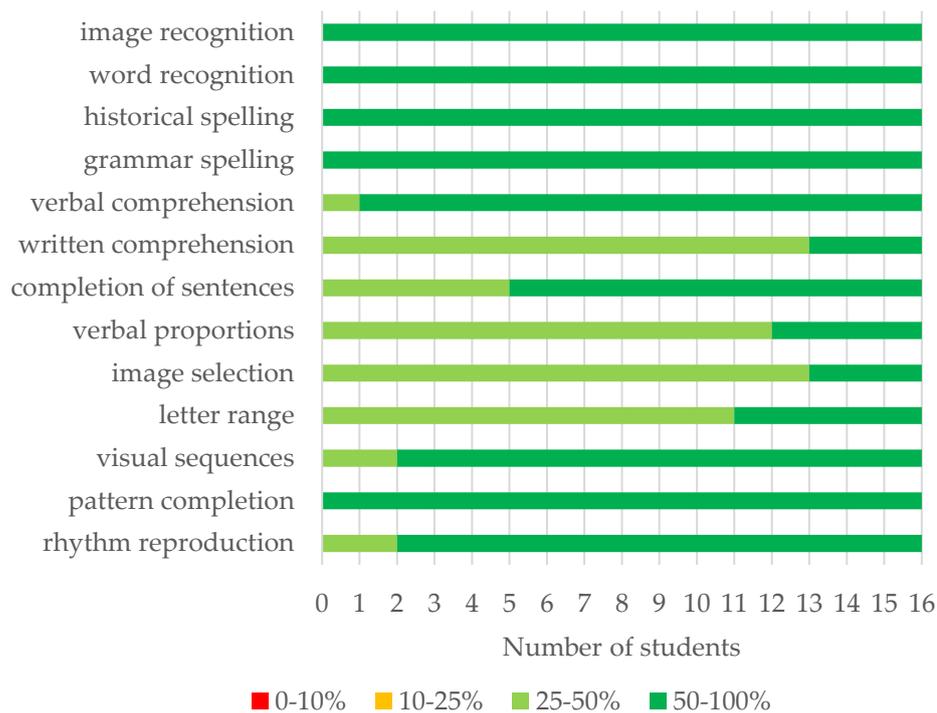
In the eighth exercise related to verbal proportion, 12 of the 16 students had a result 25-50% while 4 of the 16 seem to they had a good performance with 50-100%.

In the ninth exercise concerning image selection 13 out of 16 received a result 25-50% while the rest did very well with a result of 50-100%.

In latter range 11 out of 16 received a result 25-50%, 5 out of 16 did very well with a result of 50-100%.

In the eleventh exercise, visual sequences, 2 out of 16 receives a result 25-50% while the rest did very well with a result of 50-100%.

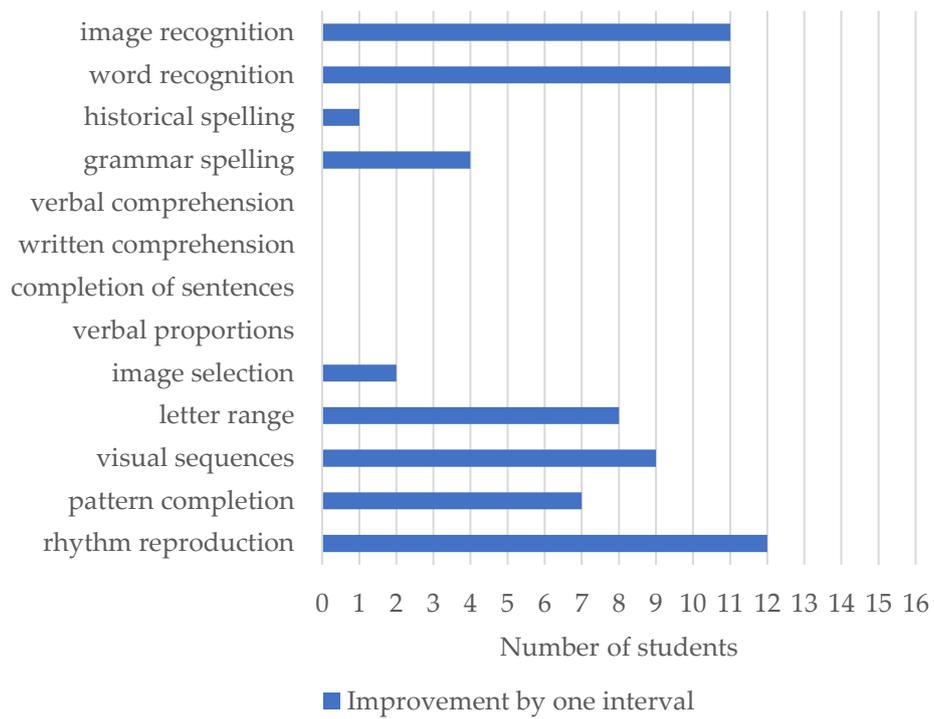
In the pattern completion all the students received 50-100% and in the last excersice rhythm reproduction 2 out of 16 receives a result 25-50% while the rest did very well with a result of 50-100%.



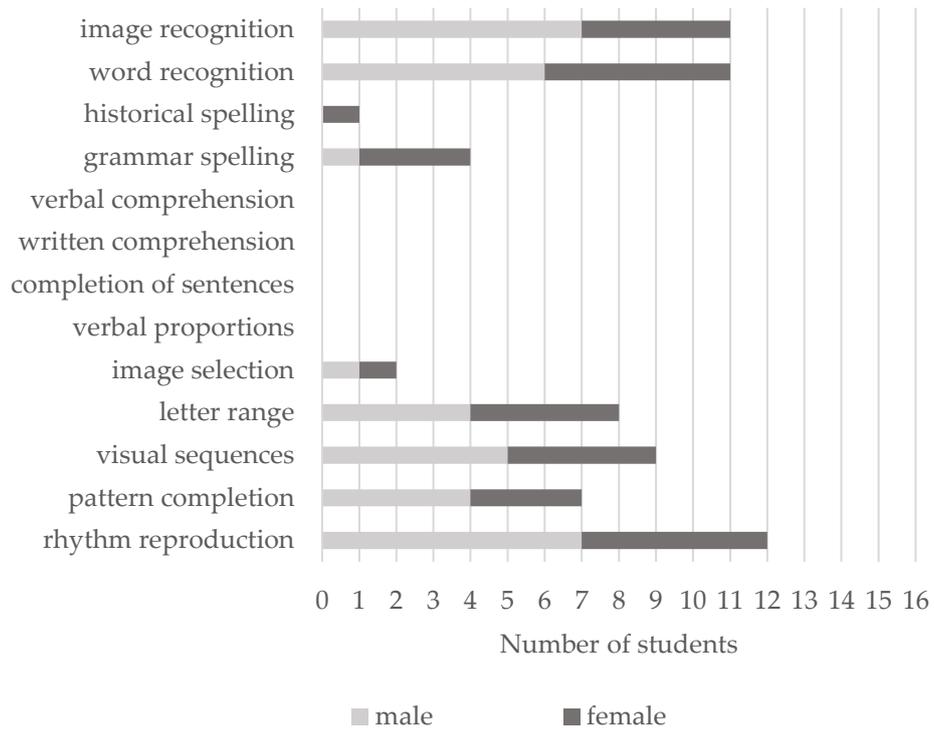
*Figure 11: Results for the typical students who followed the curriculum*

### 3.8 Overall improvement of typical development student

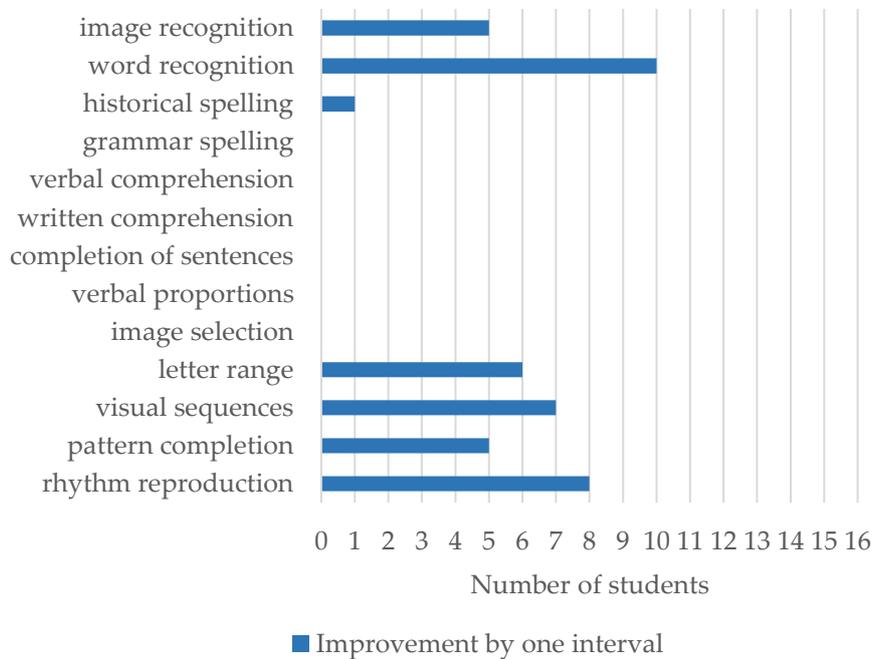
The comparative results regarding the typical students as according to the LAMDA test do not show that there is a special development in both groups. Regarding the group of students who attended the intervention music program, they seem to have improved in the following areas of the LAMDA test as shown in the following diagram Figure 12 without any significant difference between the gender of the children, Figure 13. Fewer boys than girls performed better in the following two areas of the LAMDA test, in rhythmic activity but also in image recognition. Regarding the children who attended the school curriculum, a smaller number of children is observed to have evolved as shown in Figure 14, while there seems to be no significant difference between the gender of the children Figure 15.



*Figure 12: Number of students of the experimental group that improved in each LAMDA-test category*



*Figure 13: Number of male and female students of the experimental group that improved in each LAMDA-test category*



*Figure 14: Number of students of the control group that improved in each LAMDA-test category*

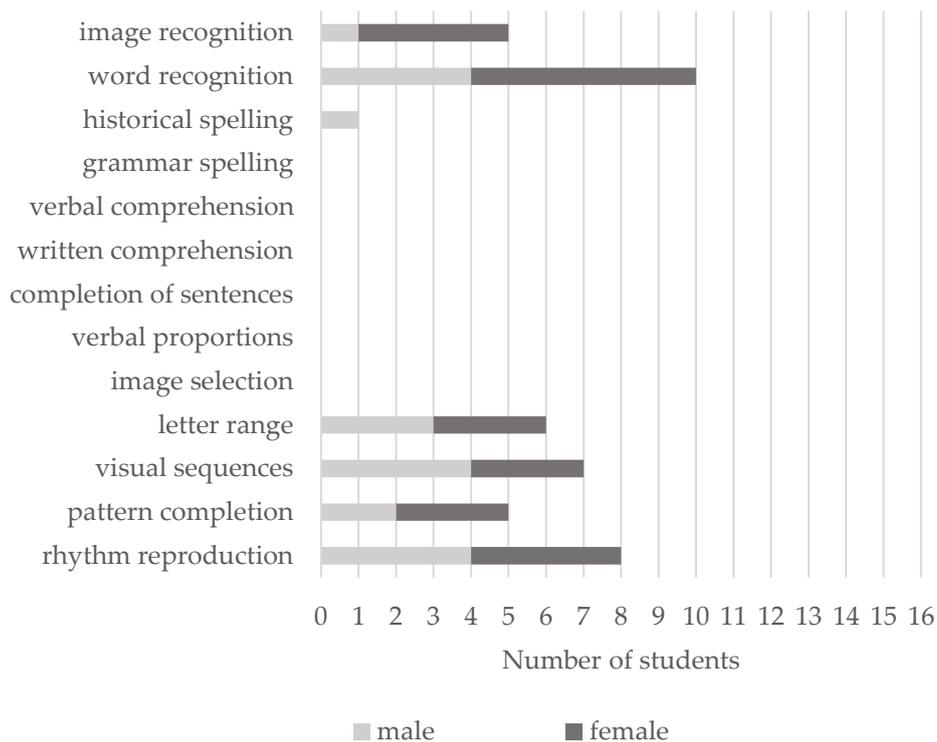


Figure 15: Number of male and female students of the control group that improved in each LAMDA-test category

### 3.9 Comparisons between the two groups of children

Regarding the children of formal development, there was no significant improvement in either category, neither in those who attended the school curriculum nor in those who attended the intervention. More specifically, in Table 2 seems to be a small difference in the improvement of the specific sections of the LAMDA test, image recognition, word recognition, historical spelling, grammar spelling, image selection, image selection, letter range, visual sequences, pattern completion, rhythm reproduction in relation to children who attended the intervention music program.

Table 2: Comparison between two groups of children

Dimensions				
	Ex_d	Con_d	Exp_t	Con_t
image recognition	15	12	11	6
word recognition	16	12	11	8

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historical spelling	14	7	1	No
grammar spelling	12	7	4	1
verbal comprehension	No	No	No	No
written comprehension	2	No	No	No
completion of sentences	2	No	No	No
verbal proportions	3	No	No	No
image selection	14	8	2	No
letter range	16	11	8	7
visual sequences	16	10	9	7
pattern completion	15	12	7	5
rhythm reproduction	16	12	13	8

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## 4 Chapter IV: Research questions

Dyslexia is a form of learning disorder due to the lack of ability of individuals to decode words and this lack is usually reflected in the ability to process sounds. This ability to decode is not directly related to elements such as intelligence, age, sensory abilities, other cognitive abilities, or general developmental disorders (Adlof & Hogan, 2018; Blackburn, 2018). The manifestation of dyslexia occurs with the appearance of difficulties in accurate word recognition and poor performance in reading and writing. It is one of the most common neurodevelopmental disorders in children (Adlof & Hogan, 2018. Wagner, et al., 2020). About 5-10% of school-age children suffer from dyslexia, which is more common in boys (Ahmad, Ali & Salehuddin, 2018).

The aim of this research paper is to study the effect of an intervention program on students who have been diagnosed with dyslexia based on music teaching.

Based on the purpose of the research the research questions and research hypotheses are posed as follows:

### 4.1 First Research request

Is there a positive effect of the intervention program on students who have been diagnosed with dyslexia based on music teaching?

As can be seen in the results of the research, there does not seem to be a positive effect of the intervention program on students who have been diagnosed with dyslexia based on the syllabus. On the contrary, students who were diagnosed with dyslexia and at the same time attended the intervention music program seem to have more interest in the lesson, greater desire to participate in activities, greater confidence in the process of activities, as they were all adapted to the needs of these children. The results show the positive effect of this intervention program and in particular and the music seems to affect quite a few language skills according to the Lambda test.

Regarding the bibliography the relationship between music and language and the similarities in their learning are confirmed by various neurophysiological and other research (Ludke & Weinmann, 2012; Gooding, 2011; Hallam, 2010; Ritblatt, Longstreth, Hokoda, Cannon & Weston, 2013) which showed that infants are more

likely to learn music and language through their familiarity with the sound environment in which they live. The basic mechanisms for the development of music and language ability are created already from the first months of human life and even during the last months of pregnancy (Chiang et al., 2018).

Due to this parallel interacting development, a child's early vocal formations contain both linguistic and musical characteristics and it is often difficult to identify a purely promotional or pre-linguistic vocal formation (Miendlarzewska & Trost, 2014). A completely different view of the relationship between language and music is held by Brandt, Gebrian and Slevc (2012), who believe that spoken language is taken by children as a vocal representation and that children first pay attention to the musical characteristics of language. They believe that without the ability to listen to music, it would be impossible to learn to speak and that language is a special kind of music and not music a universal language. Music offers every child an opportunity for fun, but at the same time it can serve various educational purposes.

In many genres such as Homeric epics, lyric poetry and ancient drama there is a connection between music and speech, demonstrating that this match has existed since antiquity. As far as teaching is concerned, it is the nature and the content of these two courses that make them interconnected. In the context of the experiential teaching of music, its communicative goal and aesthetic experience, language emerges as a code of communication and as a representative feature of every people, culture and historical period. Both the communicative character and the cognitive content aim at the development of psychomotor skills, the cultivation of emotions, attitudes and values and vigor. encouraging all students to actively participate in the school and wider society, while developing their creativity. Skleida (2011) comparing the main objectives of the two courses, observes many common points, such as the use of the senses for the communication development of students, the understanding of sound stimuli and their awareness of them, the use and utilization of written speech, the value of literature, especially melodic poetry and songs, the development of vocabulary, grammar and syntax, as formal and structural elements of speech and the management of information, the use of new technologies and their utilization for the achievement of teachers purposes.

In the following references record its positive effect on students' development, both enhancing their self-esteem and self-confidence, and significantly improving their learning skills, thus contributing to the development of their academic, social and linguistic level. Music is a language that, despite its diversity, reduces language barriers and individual peculiarities, allowing for experimentation and interaction (Sammler & Elmer, 2020). Studies focusing on reading difficulties in children with dyslexia correlate children's ability to read with their ability to accurately distinguish tone (Magne Schön&Besson, 2006; Loui et al., 2011), supporting the existence of a strong relationship between basic auditory perception and reading skills. According to one of the initial studies that took place on the issue under consideration, (Anvari et al., 2002) significant correlations were found between the musical skills, phonological awareness and reading ability of children aged four and five years.

Musical education has a useful consequence on higher intellectual purposes, but questions ascend whether relations between music lessons and cognitive abilities are specific to an area or general. Hille, Gust, Bitz and Kammer (2011) tested 194 boys in Grade 3 by measuring reading and spelling performance, non verbal intelligence and asked parents about musical activities since preschool. Questionnaire data presented that 53% of the boys had learned to play a musical instrument. Intelligence was higher for boys playing an instrument ( $p < .001$ ). To control for general effects we excluded families without instruments. The effect on intelligence remained ( $p < .05$ ). Furthermore, boys playing an instrument showed better performance in spelling compared to the boys who were not playing, despite family members with instruments ( $p < .01$ ). This effect was observed independently of IQ. Our results propose an association between music education and general cognitive ability as well as a specific language link.

The purpose of this study was to investigate whether the use of a music intervention program in the music lesson can have a positive effect on the learning and music skill of students with dyslexia. Regarding the final evaluation through the Lambda test, a direct relationship was observed between the ability to perceive music and some difficulties that dyslexia causes in this student population, as mentioned in similar research such as Cumming et al., (2015), Tierney, Krizman and Kraus (2015), Zhao

and Kuhl (2016), Roden et al, (2016), Lifshitz-Ben-Basat and Fostick (2019), Frey et al. (2019).

#### 4.2 Second Research request

Is there a relationship between music teaching and improving dyslexia?

The sense of rhythm is a musical parameter that very often afflicts dyslexic children. What is immediately noticeable is their frequent rhythmic instability while performing pieces, but this result stems from other problems, such as inability to coordinate hand-eye, noticeable difficulty playing with other performers, and keeping the rhythm steady on their own. part, confusion regarding bilaterality, right-left arm or leg, and direction up-down and up-down on the instrument. It is also possible to have purely kinesiological difficulties involving the fine movements of the limbs, which can be a significant obstacle to the performance of piece, what sounds often resembles a line of the seismograph due to abrupt movements, without continuous flow. Height is another potential difficulty. "In general, dyslexic children need more time to stabilize an inner sense of pitch than other children. *"These children often have a reduced perception of space and a confusion with directions, while those children, dyslexic and not, who have a good relationship with space, tend to be able to sing accurately."* (Beaumont, 1992, p.13)

What we can observe is the result of their inability to 'internalize' the sense of pitch, according to the Western model, and to understand the meanings of 'high' and 'low'. In short, it can be confusing as to the distinction of the heights themselves but also as to their name, which appears in a strict order, in general, symbols and names in a row are an area-'moving sand' for the dyslexics.

Another parameter of their possible unstable performance is the dynamics and the hue. In other words, they often find it difficult to distinguish with certainty and accurately detect changes in volume, while the task of distinguishing and recognizing different tones can prove to be completely incomprehensible and inaccessible or - at least - confusing. The most controversial area that is usually presented as the most serious obstacle for dyslexic children is that of written symbols, and in particular for music, Western notation. In addition to the difficulty of learning it, there are problems with the

symbols written in 5 different lines, up and down, which is confusing, in black and white, and with the requirement to be decoded at a steady pace to be an evolution of the music. Weak short-term memory and problems with concentration and attention, characteristic of most dyslexic children, make the above process even more difficult (Rolka & Silverman, 2015; Eren, 2017).

Music therapy can be applied to children with learning disabilities. The sessions are either individual or group. You do not need to know music or have the talent to participate in a music therapy program. The form of treatment is adapted and individualized according to the needs of the individual, and thus can take the form of play in preschool or school children. People with learning disabilities, due to biological or other factors have suffered some mental deprivation, which makes it difficult for their "normal" physical, mental, emotional and general development. For this reason, they may acquire mechanisms of defense against pain to realize their diversity (Habib, et al., 2016).

Music therapy, because it offers a non-verbal means of communication, can reach these people more easily. By treating each person as a separate entity, with different needs and abilities, the music therapist tries to help him better know these needs and abilities, and to highlight them (Papadopoulos, 2000). More specifically, music therapy can help to develop communication and social skills, to develop the ability to concentrate, to encourage interaction and self-expression, and to develop speech and language. It also helps to develop self-awareness and self-confidence, to express and process different emotions, to develop important skills such as listening, shifting and the child's ability to share. Finally, it helps to develop gross and fine motor skills, to strengthen and enhance the use of the voice and the development of speech, to expand the skills of coordination of the movement and to the emotional support (Hadjieftychiou, 2011)

The intervention program used to improve the ability to perceive the rhythm of music seems to have helped students with dyslexia. More specifically, the improvement of rhythmic ability in children with dyslexia seems to be directly related to the recognition of stimuli which includes the recognition of words and pseudowords, the comprehension of texts which includes oral comprehension, working memory and non-verbal reasoning in which includes evaluation of optical sequences and pattern

completion. On the contrary, no improvement was observed in the comprehension and study of written texts, in the syntax, in the vocabulary, in the spelling as well as in the completion of sentences.

Students seem to enjoy the activities in the first four lessons and respond relatively well to the needs of the lesson. Nevertheless, it is very common, even in normally developing children, for the adaptation time to be two to three lessons. The students showed interest in the lesson and it was not noticed that they had enough difficulty in performing the activities. After the fifth lesson, the students seem to do moderately in all the activities and thus show more enthusiasm for the lesson since it becomes an easier process. From the seventh lesson it is observed that some students cope adequately and more specifically in the activity with the song that contains false words while some go perfectly in all the activities and show improvement in the visual-psoriatic ability, in the ability of coordination, memory, attention. It was observed by some students to enjoy the activity of hitting a ball as they move forward, listening to the rhythm of the music, while they seem to be doing satisfactorily in the musical game-bowling but also in a more difficult version of the activity hitting the ball from the previous lesson.

The comparison of the results before and after the intervention program used shows that the students who managed to improve to a greater degree, ie by two or even three levels of the Lambda test are also those who managed to adequately perform in the activities of the last courses while it seems to they do quite well after the seventh lesson and respond relatively adequately to most of the activities given to them.

#### 4.3 Third Research request

Is there a relationship between music teaching and the improvement of the individual skills examined by the LAMDA test (stimulus recognition, spelling, grammatical processing, oral comprehension, written comprehension, working memory, non-verbal mental ability, vocabulary, vocabulary) perception?

Proper coding of voices and speech is also considered vital to phonological awareness, which is the precursor to reading and writing. The ability of a child to accurately distinguish vowels or sounds that are heard differently affects the ability to reproduce sound orally. Hallam's review of music intervention studies (2010) highlights the

correlations between early musical skills, phonological awareness and early reading skills (Anvari, Trainor, Woodside & Levy, 2003), tonal memory and reading age (Barwick, Valentine, West & Nicholson, 1972, as cited in Hallam, 2010), as well as music education and standard reading skills (Butzlaff, 2000).

Other studies show that music education can enhance auditory skills that support vocal perception (Meyer, Elmer & Jäncke, 2012) by allowing musicians to demonstrate better speech coding (Patel & Iverson, 2007; Tallal & Graab, 2006). This became apparent in eight-year-olds with no previous musical experience after an eight-week period of music education (Moreno & Besson, 2006). Musicians are also more sensitive to the different components involved in acoustic function as a result of their training, such as tonality (Magne, Schön & Besson, 2006; Schön, Magne & Besson, 2004) and melody. with advanced working audio memory and superior attention skills. A two-year study comparing children receiving 45 minutes of weekly music training with children participating in a painting program isolated the effect of music education as a reason why the music group surpassed the painting group in its ability to extract words from a flow of syllables (François, Chobert, Besson & Schön, 2013).

The aforementioned studies used music pedagogical approaches that are multi-sensory in nature and encourage the development of visual, auditory and motor skills. Although the quality of sensory coding appears to be enhanced as the duration of music training increases (Wong, Skoe, Russo, Dees & Kraus, 2007), these intervention studies and others (Anvari, Trainor, Woodside & Levy, 2003; Gromko, 2005) ) suggest that the observed broader effects of music education are not limited to professional musicians, but are achievable in shorter time periods compatible with the school calendar year.

The development of reading skills depends not only on the acquisition of fluency in audio coding but also on language comprehension. Linguistic comprehension in turn depends on perception and the ability to deduce meaning from contextual information, which cannot be achieved by a phoneme-based approach alone, so a combined approach is required. Children who have difficulty extracting meaning from language may use different interventions regarding phonological difficulties. A student's ability to remember the text is based on recognition, recollection and familiarity. Memory is stronger when combined with a strong "memory" experience and enhanced when

semantic processing of information takes place (Mirandola, DelPrete, Ghetti & Cornoldi, 2011). Training in mental representations (images) can help to address the difficulties of verbal memory. Music offers important opportunities for children to concretize (conceptualize) abstract concepts and to make sense through active and meaningful explorations of sounds and related emotions, which support the development of mental representations and auditory function (Kraus & Hornickel, 2012).

Two trials are investigated in the work of Leloup et al., (2021) to evaluate the effectiveness of a novel intervention program known as repeated reading with vocal music masking for the improvement of reading skills in children with dyslexia (RVM). Breznitz's initial study prompted the recommended corrective strategy. The studies compare a 5-week intensive RVM training program to an 8-month typical remediation program in a pre-post-test clinical paradigm as well as a longitudinal paradigm (SRP). Both investigations back up the effectiveness of the newly proposed RVM approach. Specifically, in the longitudinal study, children's reading speed, as well as related phonological, visuo-attentional, and cognitive skills, and attitudes toward reading, were measured regularly.

Following RVM training, there were significant increases in reading efficiency and related skills, as well as a stronger desire to read. The data was modeled to show that executive and processing speed abilities were involved in RVM training, implying that RVM could aid in rebalancing the phonological and orthographic coding techniques required for efficient reading. RVM training is a realistic and appealing intervention for clinical practice since it is brief, intensive, and concentrated. RVM training may show to be a useful tool for therapists to use in the treatment of reading fluency issues, especially when typical programs fail.

Gaboury, et al. (2020) conducted a quasi-experimental study to evaluate the impact of a music and writing program on lexical spelling in Grade 2 elementary school students. An experimental group (n = 24) of Grade 2 students in a French-language elementary school in Québec devised and tested a music and writing curriculum (Canada). A control group (n = 23) was formed from another Grade 2 class at the same school. In January and May, both groups were tested for lexical spelling. When comparing the

experimental and control groups' post-test results on performance and improvement in lexical spelling, the experimental group scored significantly higher than the control group.

#### 4.4 Fourth Research request

Are there any differences between students with dyslexia who followed the traditional school curriculum and students with dyslexia who followed the intervention program?

Regarding the fourth hypothesis, regarding the relation of the music curriculum to the students with dyslexia, it was observed that they found it difficult to attend the curriculum. Although the activities are not as complicated and difficult, the students did not show the same enthusiasm and interest as those in the intervention program. The students were not so focused and often in activities such as singing they did not want to participate. Although the results showed improvement in the following skills of the lambda test image recognition, rhythm reproduction, word recognition, pattern completion, letter range, visual sequences, image selection, historical spelling, grammar spelling, the number of students who improved was smaller. Respectively, the levels of improvement were lower, the students showed at most two levels of improvement in contrast to those who followed the curriculum and had three levels of improvement.

Teaching music to dyslexic children is undeniably such a case. Especially for them, since their specific difficulties are recognized in time and the fact that the traditional teaching methods do not suit their 'idiosyncratic' way of learning, then they can confidently avoid their first unfortunate encounters with music and themselves. to make sure that their difficulties are not due to lack of intelligence or effort and study. Thus, alternative teaching methods can be fully justified in their case.

The aim is to approach in alternative ways and methods that do not give the main emphasis on learning musical notation, while leaving much room for the development of musical memory, creativity and imagination as well as familiarity with the 'vocabulary' of musical language. Below will be briefly presented the reflection on one of the deeply entrenched conceptions of music teaching and a relatively concise presentation of alternative paths and methods particularly suitable for dyslexic children

will be attempted. First of all, music is about listening. Also, the musical act is primarily kinesthetic (except for music produced exclusively by technological means).

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In other words, two of the basic parameters of any music activity have to do with purely practical engagement, at least in the early stages in order to lay a solid musical foundation. That is, there is no reason to consider and deal with music as something inextricably linked to musical notation. The score can often help music teachers by providing clear evaluation criteria, which is not to be condemned on its own, as long as it does not act as the sole mediator between music and performer-student, that is, it does not monopolize the attention of teaching and learning. evaluation. And especially in the case of dyslexic children, the attachment to the score and the approach to music exclusively through written symbols is often far from meeting the abilities of the children and reflecting their level and musicality, while at the same time highlighting their weaknesses.

At this point, the basic rationale and philosophy that is vital to be adopted in the case of dyslexic children must be re-emphasized: the experiential, multi-sensory approach that addresses as many senses as possible (Mina et al., 2021). The musical repertoire is approached much more directly and with less delay, without the mediation of a long period of symbol expression, which in the case of dyslexics can easily lead to their resignation from the whole effort. In the same way, concepts such as 'high' and 'low', which are confusing to many dyslexics and both as a distinction of height and as a correspondence of a concept with a corresponding area of the respective instrument, can - beyond the experiential approach already mentioned - be represented by using their colors and shades. Muscular memory, although not recognized by some as a distinct type of memory, sometimes makes all the difference for a dyslexic child as the basic mnemonic trick he uses (Habib et al., 2016).

For example, when performing the drum, what can be imprinted in the memory is for some children the pure movement of the hands, acting as a memory of the body, without being aware of the rhythmic motifs that play in the form of graphic representation. In similar, multi-sensory ways (multi-sensory) other concepts can be approached, such as loud and soft, sharp and extended, etc. In general, the teaching especially for the case of dyslexic children definitely needs to be built gradually, step by step, assigning small tasks that ensure the success of anyone to a degree, and in fact success that children can feel immediately and not look forward to the distant future (Kelly & Phillips, 2016). Only one new concept must be introduced at a time, as well as a meticulous recording of each lesson. Similarly, one hint at a time and pausing to follow the processing time, along with clear, concise and simple instructions (using pictures and diagrams) make the lesson much more comfortable, providing a sense of security and adapted to the pace of comprehension and children's response (Kelly & Phillips, 2016).

In the modern educational reality, the percentage occupied by students with learning difficulties is getting bigger and bigger and concerns teachers and parents. The fact that it tends to be synonymous in many cases of school failure triggers reactions of anxiety and worry in parents, discourages students and raises questions among teachers about the appropriate behavior they should show towards these children, about them. ways to improve the daily school routine and simplify the procedures, so that the lesson is not only a privilege of the average and typical student, but of the whole school class. In this climate, the role of the teacher is protagonist and complex as it includes both the diagnosis and the development of a program of intervention and assistance to the student with learning disabilities. In order to be effective and to cope with his already demanding mission, he is called to be vigilant, to constantly expand his knowledge, not only in the context of his subject matter, but also in the context of the principles of the new pedagogical and counseling , with the aim of addressing learning problems, building a relationship of mutual trust with students who present with such problems as well as their parents, while enhancing their mental health.

More recently, Cogo-Moreira and his research team (2012, 2013) argued that music training had a positive effect on reading skills and educational performance in children and adolescents with dyslexia. At the same time, research by Weiss et al. (2014) found that adult musicians with dyslexia performed better than typical non-music readers.

These performances related to various tasks of distinguishing tonality, rhythmic beats of speech and noise perception tasks.

Similarly, the research of Flaunacco et al. (2014) revealed that between rhythm production and perception tests, the level of performance in a metric perception project specifically predicted both speed and reading accuracy, as well as phonological processing in individuals with dyslexia. The authors conclude that their results strongly encourage the use of music education in the restoration of dyslexia, and in particular they themselves recommended focusing more on rhythm than on tone accuracy, as is often the case in classical music pedagogy. This recommendation is in line with another study (Slater et al., 2013), which examined the phenomenon of one-year music training based on the perception of tonality, rhythm and improvisation. The level of performance of 8-year-olds who were considered "at risk" for the presence of learning disabilities who received this music education was significantly higher than the corresponding controls in the synchronization tests.

Going one step further, Przybylski et al. (2013) examined the effect of rhythm perception on editorial processing. They presented children with reading difficulties with a rhythmic test, followed by an oral phrase that was syntactically correct or incorrect. The results showed a clear superiority over normal and irregular rhythmic patterns in children's performance in editorial work. Based on these results, the authors proposed to use rhythmic stimulation in rehabilitation protocols designed for children with reading and writing disorders.

#### 4.5 Fifth Research request

Are the intervention program and the curriculum effective for students without a diagnosis of dyslexia, students of typical development? Regarding the fifth hypothesis and the effectiveness of the intervention program in the typical students, it was observed that it positively affected their own development in the respective fields of the Lambda test. The improvement is clearly not great since the children already had very good results, however during the lesson the students seem to have a lot of fun and rejoice in every alternation of activities. Especially in the activities where one student was beating a rhythm on the back of the other and he had to repeat exactly the same on a musical instrument, the students showed special attention and concentration. Respectively, they

were observed to be excited about activities such as music bowling and the one where they had to hit the ball on the floor to the beat of the music. In general, the children showed great enthusiasm as the lesson was turned into a game and learning was done through teaching.

Compared to the international literature, similar research shows that improving rhythmic ability can benefit not only students with reading difficulties but also the general population if Corrigan and Trainor (2011) seems to improve attention span. Although in some studies there seems to be a similar correlation between music education and language Li Wenhui, Suo Changqing, Danfei and Zhou Tingting (2016), Franziska Degé and Gudrun Schwarzer (2017) do not seem to support the same from the research of Kempert et al. (2016), Swaminathan and Schellenberg (2017) in which no correlation is presented.

At the research level, the results converge on the view that there is a link between the functions that accompany musical listening and sound management skills and the corresponding phonological processing skills. It was also found that the participation of children with or without special educational needs in music intervention programs resulted in the strengthening and improvement of specific phonological awareness skills such as: distinguishing similar and dissimilar phonemes and separating words into syllables. It is emphasized that the enhancement of auditory functions through music education, leads to the improvement of the auditory function that is activated and required during phonological processing (Forgeard et al., 2008).

A study of five-year-olds examined the hypothesis that imitating rhythm and accentuation in speech is associated with increased sensitivity to tone and rhythm in musical environments as well as phonological processing skills. Therefore, there is talk of connecting the acoustic function with the mechanisms based on phonological and music processing processes. Research has concluded that sensitivity to metric stress is associated with accentuation in spoken words and therefore phonological awareness which is a critical stage in the acquisition of reading ability (Cardillo, 2008).

From the above it can be seen that the use of music education for the rehabilitation of dyslexia and language disorders is based on both theoretical assessments and

experimental results. If there are common underlying processes between music and language, especially between the perception of music and the perception of speech, it is reasonable to argue that improving some of the processes involved in the perception of music can simultaneously help improve reading and language skills (Corrigall & Trainor, 2011; Cumming et al., 2015; Lifshitz-Ben-Basat & Fostick, 2019; Frey et al., 2019).

Overall, the above evidence suggests that music education may have a positive causal effect on language skills impaired in children with dyslexia (vocabulary, syntactic, spelling and written comprehension). This seems to be happening, thanks to the improvement of their rhythmic and metric abilities. Education on these topics probably leads to improved auditory processing, phonological awareness, sequencing skills, etc. The findings of the research presented in this survey strongly support the hypothesis of the beneficial effect of music training on reading and phonological skills awareness. They also emphasize the important role of rhythm in phonological perception and production. As rhythm and measure require more precise synchronization, improving reading difficulties in children with music and rhythm dyslexia could enhance their phonological and linguistic development from a point of view that is quite different from most traditional language-based approaches.

Regarding the fifth hypothesis and the effectiveness of the curriculum in typical students, we observe that there is a slight improvement compared to the children who attended the interventional curriculum. In addition, although they do not seem to be doing very well in all activities, they do not seem to have much difficulty in them. It is observed that they are not sufficiently concentrated during the execution of the activities and that they are not so interested.

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## 5 Chapter V: Conclusions

### 5.1 Conclusions

The results of the research are the result of 64 students in total, 32 students with dyslexia, of which 16 girls and 16 we bought dyslexia and 32 typical students of the opposite sex, in the fourth grade of primary school. Half of them participated in the interventional music program while the rest followed the school curriculum.

The results of the research showed that the students with dyslexia, who attended the intervention program had a significant improvement in the following areas of the lambda test namely image recognition, word recognition, historical spelling, grammar spelling, image selection, letter range, visual sequences, pattern completion and rhythm reproduction, but it does not appear that gender can differentiate these effects and there has been some noticeable change due to this. This fact leaves no room for further research in different age groups of the opposite sex.

In addition, there is a significant improvement in children with dyslexia and no, in rhythmic reproduction, the last section of the Lambda test, which reveals the positive results of an interventional rhythmic lesson adapted to the needs of children. The specialized activities, the pleasant nature of the lesson but also the alternative way of learning seem to affect the performance of the students and not only in the field of music. Besides, the music and specifically the musical activities that included the improvement of the auditory-visual memory, the attention, the concentration but also the improvement of the verbal ability seems to have positively affected the results of the children in the respective areas of the Lambda test.

### 5.2 Limitation and prospective of the study

This chapter will discuss the limitations and prospects of this research intervention in the Greek school community to spark possible proposals for change to educational policy as well as to propose different extensions for further study and research effort.

First, it is very important to mention that in a society with constant changes and developments, in which each of us evolves and changes, so it would be right to happen in the educational process. Teaching methods need to be differentiated according to the

student population and its possible difficulties. For this reason, the teacher should be constantly vigilant and trying to meet the needs that arise. It is important that in order to conduct a research, research questions should be used continuously, tools in order to stimulate the students' interest, and to spend the time of the lesson pleasantly enjoying different activities.

More specifically, in the present research, which concerned the implementation of an interventional curriculum teaching of the musk rhythm in order to improve as many difficulties as possible of students with dyslexia and not with the LAMDA test assessment tool, it was observed that the teacher and the way of teaching through the syllabus was almost unsuitable for students with dyslexia. In addition, it was observed that the use of this program and the non-choice of other activities is not a familiar process for teachers but seems to need constant mobilization and an urgent need to improve existing teaching.

In addition, it was found that the change in the traditional way of teaching, which is not characterized by specialized activities for the learning population with dyslexia and meeting the needs, was the main reason for this involvement in exploring new activities. Every research is able to offer not only to the researcher himself but is able to contribute to the realization of better ways of teaching and better schools.

#### 5.2.1 Research restrictions

At this point it is important to refer to the limitations of the research efforts that have been presented both to the researcher himself and to a future one who will want to conduct similar research. Clarifying the limitations can give an overview of the research and the difficulties that have arisen.

One of the main limitations that arises is the very nature of the research. Characteristic of qualitative research is the reduced ability to generalize the results, therefore the results in this case concern the specific school unit, therefore it could not be presented to represent the entire Greek school community.

Constituting a specific type of qualitative research, that of action-intervention research, it is advisable to mention that time was limited as according to the IEP researchers cannot attend more than 2 hours in the school. So, the test was performed with the help of the teachers of each class and the intervention was performed over a period of 8

weeks, dividing these 2 hours into about 15 minutes each time depending on the activities and the time-manner of their execution. This by extension did not help to establish close relationships with the children since they sometimes needed us to get to know each other and the intervention process to run smoothly. It makes perfect sense to have a more comprehensive picture of the intervention and the outcome over a longer period of time

A third limitation was the researcher's difficulty with her multiple roles. Active observation, organization and coordination of the order for the conduct of the research required constant attention and concentration as well as the maintenance of the element of neutrality so that the observation becomes as objective as possible.

### 5.2.2 Research perspectives

Concluding the intervention music program and having noticed the positive effect of music on children with dyslexia, it is useful to mention that the suggestions that would be useful for further research and for global coverage of the topic concern:

1. The effectiveness of the intervention program even one year after the intervention
2. The use of music education as a tool for the treatment of dyslexia
3. Creating a music program based on the specific activities that will be included in the existing program.

Raising the awareness of teachers to recognize and address this difficulty is extremely important because their contribution can help this student population and on the other hand because each teacher individually can expand this intervention program.

### 5.2.3 Final consideration

The review of the literature findings highlights the direct relationship of music and language since both involve the cooperation of similar neural mechanisms. The fact that music can enhance auditory skills such as auditory perception and processing has been the subject of research by many researchers, who have concluded that music education not only has a positive effect on auditory skills but enhances neuronal processing of sound, which offers benefits to language skills while improving phonological awareness skills. At the same time, there is a lot of research that highlights the beneficial role that music and various musical activities can play in oral and written

speech, as one of the factors that strengthen it is the development of vocabulary. The results of the present study show that the improvement of rhythmic perception has positive results and improvement in children with dyslexia in their language skills (vocabulary, syntactic, spelling and written comprehension). Further research is needed on the use of music as a therapeutic tool through innovative educational programs designed specifically for people with language disorders.

## 6 Extended Spanish Summary

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## 1 Dislexia

### 1.1 Revisión de la literatura sobre la dyslexia

La dislexia es una discapacidad de aprendizaje debido a la falta de capacidad para decodificar palabras y generalmente se refleja en la capacidad de procesar sonidos. Esta capacidad de decodificación no está directamente relacionada con elementos como la inteligencia, la edad, las capacidades sensoriales, otras capacidades cognitivas o los trastornos generales del desarrollo (Adlof & Hogan, 2018; Blackburn, 2018). Los investigadores han descubierto que la dislexia en los niños puede estar relacionada con problemas genéticos, daño cerebral, displasia cerebral, desnutrición, etc. (Rüsseler, et al., 2018). Los niños con dislexia van a la zaga de los niños con un desarrollo normal y muestran una baja motivación de aprendizaje (Cardillo, et al., 2018; Snowling, Hulme & Nation, 2020). La dislexia es una discapacidad específica del aprendizaje de origen neurobiológico, como señalan Sümer Dodur y Altındağ Kumaş (2020), caracterizada por dificultades con el reconocimiento preciso y / o impecable de las palabras y deficientes habilidades de ortografía y expresión, y ocurre en uno de cada cinco niños.

Se distinguen dos categorías principales, distinguiendo primero la dislexia de una adquirida y evolutiva. Conocer se trata de personas que han adquirido el mecanismo de leer, escribir y deletrear, pero tienen dificultad o incapacidad para escribir la palabra debido a un daño cerebral. Las lesiones cerebrales pueden ser causadas por lesiones cerebrales en el estado lateral-temporal del hemisferio izquierdo, por enfermedades e infecciones (Stasinos, 2020).

Las personas con dislexia acústica tienen dificultad para analizar palabras en sílabas, sílabas en palabras con contenido y en la distinción de detalles acústicos y en la reproducción de conjuntos sonoros (Stasinos, 2020). Un niño con dislexia acústica tiene un rendimiento más bajo en escritura y ortografía que en lectura. Esto se debe a que no puede reconocer pequeñas diferencias entre sonidos que corresponden a vocales o acordes. No se pueden asociar los sonidos especiales con sus correspondientes símbolos escritos. Podemos encontrar esto cuando le pedimos a un niño que escriba un texto dictado. Las personas con dislexia acústica no escuchan correctamente las palabras o frases de un texto. Entonces, sienten la necesidad y piden la repetición del dictado

continuamente. De manera indicativa, un niño con dislexia acústica necesita, en el mejor de los casos, de tres a cinco minutos para escribir una oración simple en dictado (Stasinos, 2020).

Se distinguen dos categorías principales, distinguiendo primero la dislexia de una adquirida y evolutiva. Conocer se trata de personas que han adquirido el mecanismo de leer, escribir y deletrear, pero tienen dificultad o incapacidad para escribir la palabra debido a un daño cerebral. Las lesiones cerebrales pueden ser causadas por lesiones cerebrales en el estado lateral-temporal del hemisferio izquierdo, por enfermedades e infecciones (Stasinos, 2020).

La dislexia es un trastorno del aprendizaje, como confirma Marshall (2021), que afecta la capacidad de una persona para comprender las relaciones entre letras y sonidos, lo que a su vez afecta su capacidad para decodificar palabras.

En cuanto al tratamiento de la dislexia, éste puede incluir enseñanza terapéutica (logopedia), programas psicomotores y grafocinéticos y psicoterapia. A nivel docente, que es un núcleo de interés, son importantes los factores motivadores y el clima positivo-emocional. Los principios básicos son evitar enseñar letras paralelas que sean confusas, acompañar imágenes, leer en voz alta, entender lo que se lee en lugar de reproducirlo mecánicamente y utilizar juegos como escribir en la arena (Daloiso, 2017; Stuart & Yates, 2018).

## 1.2 Educación musical en Grecia

Según la última ley 3699 (Gaceta del Gobierno A, 199 / 2-10-2008) sobre educación especial, Grecia adopta un nuevo sistema educativo para personas con dificultades adaptado al sistema europeo. En concreto, se afirma que “Educación y Formación Especial (EAE) es el conjunto de servicios educativos que se prestan a los alumnos con discapacidad y necesidades educativas especiales identificadas o al alumnado con necesidades educativas especiales.

La formación de estos especialistas se puede realizar en las Escuelas de Educación y Formación Especial (SEDAE) así como mediante la educación inclusiva en las escuelas generales mediante la implementación de programas educativos especialmente adaptados a las necesidades de los estudiantes. En 2008, el instituto pedagógico y, en

particular, el departamento de educación especial completaron los planes de estudio para las dificultades de aprendizaje. Expertos y educadores especiales adaptaron los planes de estudio de lengua, matemáticas y ciencias naturales con la modificación adecuada de los módulos de enseñanza por asignatura con el fin de diversificar la enseñanza de los estudiantes con discapacidades de aprendizaje. En la lección de música, actualmente no existe una propuesta para modificar el plan de estudios por dificultades de aprendizaje, pero existen programas de música personalizados para niños con retraso mental moderado y leve y autismo.

Durante el proceso educativo de la música en niños con dislexia existen varias dificultades:

- acústico,
- leyendo,
- habilidades mecánicas,
- en percepción visual,
- habilidades de sincronización,
- en la puntuación de juego,
- en kinesiología,
- dinámica
- en el tinte,
- sentido del ritmo,
- distinción de tono tonal

Aunque las dificultades de los niños con dislexia en las lecciones de música son obvias, aún no existe un programa de estudio de música especializado para estos estudiantes en la población educativa. el resultado mostró que los estudiantes que siguen el programa de música del plan de estudios no se divierten tanto y no ofrecen tantos aspectos positivos que cada niño podría recibir de él.

### 1.3 Relación de la música y la dislexia

La música ofrece a los niños la oportunidad de divertirse, pero al mismo tiempo puede servir para varios propósitos educativos. Numerosos estudios destacan su efecto positivo en el desarrollo de los estudiantes, mejorando tanto su autoestima como la confianza en sí mismos, y mejorando significativamente sus habilidades de aprendizaje,

contribuyendo así al desarrollo de sus habilidades académicas, sociales y lingüísticas. La música es un lenguaje que, a pesar de su diversidad, reduce las barreras lingüísticas y las peculiaridades individuales, permitiendo la experimentación y la interacción (Sammler & Elmer, 2020).

La relación entre la música y las discapacidades del aprendizaje es ahora ampliamente aceptada por la comunidad científica. Es una herramienta útil para terapeutas ocupacionales, logopedas y educadores, razón por la cual la música atrae cada vez a más investigadores para realizar investigaciones en el campo de la musicoterapia (Bonacina, Lanzi, Lorusso y Antonietti, 2015). Frey y col. (2019), teniendo en cuenta los resultados de investigaciones previas sobre el efecto positivo de la música en las habilidades del lenguaje, compararon los programas de intervención de música y pintura y sus beneficios para los estudiantes con dislexia del desarrollo. Los resultados mostraron que la educación musical, en comparación con la pintura, tuvo un efecto positivo en los niños con dislexia. Además, la investigación muestra un efecto positivo de la música en la precisión de la lectura, en la capacidad de leer pseudopalabras, en la velocidad de lectura, así como una mejora significativa en la reproducción del ritmo de la música (Goswami, Huss, Mead, Fosker y Verney, 2013; Huss, Verney, Fosker, Mead y Goswami, 2011). Habib y col. (2016) en su estudio sobre estudiantes con dislexia, investigaron la efectividad de un nuevo método de intervención musical (“Entrenamiento Cognitivo-Musical, CMT”), que incluía actividades musicales con especial énfasis en la percepción rítmica. Observaron mejoras estadísticamente significativas en la percepción auditiva y la atención, así como en las habilidades de conciencia fonológica, lectura y lectura de pseudopalabras. Un aspecto particularmente importante de este estudio fue que las mejoras mencionadas se mantuvieron seis semanas después de la finalización del programa. Malak y col. (2017), utilizando el método de intervención musical “Tomatis”, exploró qué habilidades lectoras pueden mejorarse. Los resultados mostraron que el entrenamiento musical estaba altamente correlacionado con las habilidades de conciencia fonológica, la memoria fonológica y auditiva a corto plazo y la atención selectiva, mientras que se encontró una pequeña correlación con respecto a la percepción visual.

De lo anterior, se puede ver que el uso de la educación musical para la rehabilitación de niños con dislexia y trastornos del lenguaje se basa tanto en evaluaciones teóricas

como en resultados experimentales. Si existen procesos subyacentes comunes entre la música y el lenguaje, especialmente entre la percepción de la música y la percepción del habla, es razonable argumentar que mejorar algunos de los procesos involucrados en la percepción de la música puede ayudar simultáneamente a mejorar las habilidades de lectura y lenguaje (Corrigall Y Trainor, 2011; Cumming, Wilson, Leong, Colling y Goswami, 2015; Frey et al., 2019; Lifshitz-Ben-Basat y Fostick, 2019).

La relación entre la música y las discapacidades del aprendizaje es ahora comúnmente aceptada por la comunidad científica. Es un material útil para terapeutas ocupacionales, logopedas y educadores, razón por la cual la música atrae cada vez a más investigadores para realizar investigaciones sobre el tema central de la musicoterapia (Bonacina et al., 2015). Estudios neuropsicológicos recientes confirman que la música puede mejorar una amplia gama de funciones cognitivas como la percepción auditiva, la atención, el aprendizaje, la memoria (incluido el razonamiento, la resolución de problemas y la toma de decisiones).

Los beneficios que pueden resultar de la musicoterapia para niños con dislexia son:

- Estimulación del cerebro (Schlaug, 2005).
- Mejorar el recuerdo de la memoria (Parbery-Clark et al., 2009; Janata, 2009).
- Activar el movimiento a un ritmo, lo que ayuda a la coordinación (Corriveau y Goswami, 2009; Slater et al., 2013).
- Mejorar las habilidades auditivas (Putkinen, 2013; Frey et al., 2019).
- La contribución de escuchar y participar en actividades musicales para mejorar la capacidad de los niños para dividir palabras, un proceso particularmente difícil para los disléxicos (Tierney & Kraus, 2013).
- Atraer la atención (Tierney & Kraus, 2013).
- Ayuda y beneficios en el procesamiento del habla (Patel, 2014; Lifshitz-Ben-Basat & Fostick, 2019).
- Mayor atención (Dewi et al., 2015; Putkinen et al., 2013).
- Probablemente un aumento en el rendimiento escolar (Slater, 2013)
- Producción de sustancias químicas (dopamina) en el cerebro que provocan emociones felices (Salimpoor et al., 2013).
- Fomentar las habilidades sociales (Gerry et al., 2012).

## 2 Metodología y diseño

La elaboración de esta investigación doctoral se considera importante ya que el aumento del porcentaje de estudiantes con dislexia es uno de los problemas más importantes que se observan en la actualidad no solo en Grecia sino también en el resto del mundo. Centrándose en las dificultades que causa la dislexia a los estudiantes, el objetivo final es tratar tantos síntomas como sea posible.

Esta investigación se enfocará en mejorar la percepción musical en estudiantes con dificultades lectoras a través de métodos de enseñanza intervencionistas con el fin de mejorar el trastorno del lenguaje causado por la dislexia. Además, se comprobará si el plan de estudios de los estudios musicales para la edad concreta, cuarto curso, es adecuado no solo para la población típica sino también no, y más concretamente para estudiantes con dislexia y cómo se puede mejorar con actividades más especializadas. En particular, a través de una revisión exhaustiva de la historia de la música griega desde la antigüedad hasta nuestros días, se busca la vía educativa musical más adecuada, capaz de intervenir en el trastorno del lenguaje y será analizada en base al Test Lamda.

### 2.1 Objetivos

En general, se acepta que al identificar y reconocer una dificultad en cualquier área, distinguirla y comprenderla, avanzamos hacia su resolución de una manera más segura y eficaz. Enseñar música a niños con dislexia es sin duda uno de esos casos.

El propósito de esta investigación es mejorar la educación rítmica de los estudiantes con dislexia en las lecciones de música, a través de métodos de enseñanza invasivos con el fin de enfatizar la necesidad de diseñar un currículo musical para estos niños. Esta investigación se considera importante ya que el aumento en el porcentaje de estudiantes con dislexia es uno de los problemas más importantes que se observan en la actualidad no solo en Grecia sino también en el resto del mundo. Según muchas

investigaciones modernas, resulta que la percepción del ritmo es importante tanto para el habla como para la música. Por tanto, el objetivo principal del estudio es investigar la efectividad del proceso educativo existente y mejorar al máximo a los estudiantes con dislexia.

## 2.2 Elección del método de investigación y credibilidad

Esta investigación es una combinación de investigación cualitativa y cuantitativa. El investigador utiliza una prueba de evaluación ponderada antes y después de la intervención, así como un programa de intervención, adecuadamente adaptado a las necesidades de los estudiantes con dislexia. La observación y el descubrimiento y las respuestas a las preguntas de investigación que se formularon, así como los resultados de la prueba, permitieron una investigación segura y confiable.

El investigador que sigue un método cualitativo observa, entrevista, toma notas, describe e interpreta los fenómenos exactamente como son. Cuando el investigador está trabajando en el campo que está estudiando, siempre está activo, porque los métodos cualitativos requieren el uso de todos esos elementos que el investigador encuentra: comentarios de aquellos relacionados con el objeto, algo que observa, incluso la forma en que los sujetos se sientan o viceversa (Eisner, 1991: 217). Se compromete a combinar lógicamente datos, datos y situaciones para llegar a una conclusión a partir de lo que observa. Esto se hace a través de la forma en que percibe la presencia de las cosas y su significado. El investigador, luego de recolectar los datos, intentará interpretarlos (Eisner, 1991: 36), con la ayuda de la literatura o en colaboración con compañeros científicos, con el fin de lograr el mejor resultado posible. La conciencia de lo que es importante y el contexto en el que se explorará depende de las habilidades del investigador. Peshkin (1985) comparó los elementos subjetivos del investigador con una "explosión" positiva. Es el investigador quien dará vida a lo esencial de la investigación y decidirá qué incluir en los resultados y qué no. Sin embargo, siempre se debe tener en cuenta su subjetividad como investigador, a pesar de los esfuerzos por realizar una investigación objetiva.

Lo importante en los métodos cualitativos es el juicio del investigador y de quienes leerán la investigación (Eisner, 1991). Sin embargo, los resultados de una investigación son siempre el punto de partida de una serie de esfuerzos metodológicos cualitativos y

cuantitativos, porque los temas a estudiar y analizar no dejan de existir y sus resultados son una constante preocupación para los investigadores.

La "credibilidad" en una investigación cualitativa se refiere al poder del diseño metodológico, la calidad de los datos recolectados durante la misma y cómo este diseño y datos específicos conducen a hallazgos verdaderos y confiables, en el sentido de que representan la realidad (Lincoln, 2001). El concepto de confiabilidad de la investigación dentro de la escuela de calidad correspondería al concepto de "validez interna" en la escuela cuantitativa / positivista.

La primera estrategia metodológica que se siguió en esta investigación y que intentó asegurar su confiabilidad fue la "triangulación" de métodos y datos. La triangulación se denomina "aplicación y combinación de diferentes metodologías de investigación en la investigación de un mismo fenómeno" (Denzin, 1994b). En esta investigación, se emplearon múltiples métodos de recopilación de datos, así como múltiples fuentes de datos y evidencia, para triangular y confirmar los hallazgos que surgieron durante la recopilación de datos.

Cada fuente de datos se vinculó a una pregunta de investigación específica, proporcionando evidencia confirmatoria en relación con la consulta de investigación específica, que se trianguló con información de otras fuentes de datos. De esta manera, los métodos y herramientas de investigación se vincularon a los objetivos de la investigación y al marco de codificación en el que se analizarían los datos.

Por lo tanto, cada fuente de datos actualizó el análisis de datos final de tal manera que cada hallazgo de la investigación resultó de la confirmación de al menos una fuente de datos más. Esta triangulación dio credibilidad a los resultados de la investigación y aseguró la idoneidad y pertinencia de las interpretaciones que surgieron de estos resultados.

La decisión de investigar las preguntas específicas de investigación en la educación primaria no fue accidental, sino que se tomó para cumplir con el criterio de confiabilidad de la experiencia prolongada y el contacto (compromiso prolongado) con el campo de investigación. Como investigador que realizó esta investigación, tuve mucha experiencia educativa tanto en términos de pedagogía y docencia en el contexto educativo específico como en materias relacionadas con el área bajo investigación.

### 2.3 Preguntas de investigación

Las preguntas importantes que serán respondidas por esta propuesta de investigación son:

- Existe una conexión entre el idioma y la música?
- Hay una mejora en los estudiantes con dislexia que asistieron al programa de intervención?
- Hay una mejora en los estudiantes con dislexia que asistieron al plan de estudios?
- Hay una mejora en los estudiantes típicos que asistieron al programa de intervención?
- Hay una mejora en los estudiantes típicos que asistieron al plan de estudios?

### 2.4 Variables

Según los datos utilizados, tenemos tres variables:

- Estudiantes: 32 estudiantes típicos, 32 estudiantes con dislexia
- El plan de estudios de estudios musicales
- El programa de música intervencionista
- La prueba LAMDA utilizada como herramienta de medición antes y después de la intervención, que consta de 13 módulos diferentes.

### 2.5 Descripción de la muestra

El criterio de selección de la muestra será la determinación por parte de la dirección del colegio y los profesores del departamento responsables quienes nos indicarán los alumnos diagnosticados con Dislexia a partir de las respectivas opiniones que estarán presentes en cada colegio. El diagnóstico de dislexia era oficial y había sido emitido por una agencia gubernamental certificada. Además, la muestra de los estudiantes era de Grecia y más concretamente de la zona de Chalkis.

Mencione que el estudio se realizó con el consentimiento de los padres. No se dio ninguna compensación por la participación.

Es más:

- La recolección de datos se llevará a cabo durante las lecciones escolares del horario diario de la escuela, de acuerdo con los maestros responsables de los departamentos escolares y con el Director. El objetivo del investigador es poder realizar la investigación sin obstaculizar en lo más mínimo el proceso de enseñanza.
- En cuanto a la gestión de los datos de investigación siguiendo la legislación sobre protección de datos personales vigente a nivel internacional, se seguirán todos los procedimientos prescritos. Si el investigador realiza la investigación en el contexto de su tesis doctoral, deberá, luego de la constitución del comité de ética de la Universidad, conservar los datos en un lugar completamente a salvo de terceros. La carta de cooperación a los Directores se ajustó en consecuencia.
- La dirección del colegio, manteniendo el secreto personal de la identidad de los alumnos, dispondrá de comunicación telefónica con los padres a fin de obtener su permiso para que sus hijos participen en la investigación, explicando en detalle su contenido, naturaleza y finalidad. La dirección de la escuela sabe qué estudiantes son diagnosticados con dislexia. Luego seguirá la visita de la investigadora a la escuela. Ella es aceptada. Además, se podría realizar una reunión con los padres que tengan preguntas o reservas sobre la investigación para aclarar cualquier duda. Una vez finalizado este proceso, distribuirá la carta de consentimiento a los padres con el fin de confirmar por escrito su voluntad de que sus hijos participen en esta investigación. Finalmente, se distribuirá una carta de cooperación a los directores a cada escuela para aprobar el proceso de investigación.

## 2.6 Prueba de evaluación

Para evaluar las habilidades de aprendizaje de los estudiantes se utilizó la prueba LAMDA (Protopapas & Skaloumbakas, 2008). La prueba de Software de Detección de Debilidades y Habilidades de Aprendizaje (LAMDA) fue desarrollada en el marco del Programa Empresarial de Educación y Formación Profesional Inicial (EPEAEK) del Ministerio de Educación Nacional y Religiones por el Instituto IEL de Procesamiento del Habla y es un software para la detección de dificultades de aprendizaje dentro de la población estudiantil general que asiste a las clases: (a) 2da. Primaria, (b) 3ª y 4ª Primaria, (c) 5ª y 6ª Primaria, y (d) 1ª y 2ª Escuela Secundaria. Este software detecta posibles dificultades de aprendizaje específicas. Como señalan Protopapas y

Skaloumbakas (2008), LAMDA examina las habilidades que son indicadores del potencial de aprendizaje y no medidas del desempeño escolar. Los indicadores seleccionados se consideran dimensiones internacionalmente fiables de la evaluación del aprendizaje. Todos los indicadores constituyen un criterio completo para investigar posibles dificultades de aprendizaje en el habla oral y escrita para cada grupo de edad.

Las pruebas LAMDA evalúan directamente las habilidades relacionadas con el potencial de aprendizaje y el correspondiente desempeño del alumno, proporcionando información de utilidad inmediata sobre las áreas de posibles debilidades de cada alumno. Las áreas de habilidades generales evaluadas en LAMDA y las pruebas individuales de cada área son las siguientes: reconocimiento de estímulos (reconocimiento de imágenes y reconocimiento de palabras), ortografía (ortografía histórica y ortografía gramatical), comprensión de textos (comprensión oral, comprensión escrita, estudio de escritos texto), sintáctico (finalización de propuestas, proporciones), vocabulario (selección de imágenes y definición de palabras), memoria de trabajo (rango de letras), capacidad mental no verbal (secuencias visuales y finalización de formas) y percepción de las características musicales (ritmo reproducción).

Los resultados de la detección automática de LAMDA incluyen la tabla de precisión y la tabla de velocidad, que brindan información útil, ya sea individualmente o en combinación. Cada diagrama es una representación gráfica del desempeño del estudiante en las pruebas LAMDA. Cada fila del perfil de rendimiento corresponde a una prueba. El desempeño de los estudiantes se clasifica en 4 zonas, en comparación con el desempeño de sus compañeros. Los intervalos cubiertos por las 4 zonas son desiguales, lo que refleja el grado de preocupación que corresponde a cada una. Específicamente, estos son los intervalos 0-10, 10-25, 25-50 y 50-100 en la escala de percentiles. El perfil de desempeño de cada estudiante destaca las áreas de posibles debilidades, que necesitan una evaluación más profunda y pueden ser, si se confirma mediante un examen especializado, puntos de partida de un programa de intervención de aprendizaje. Cualquier estudiante con un rendimiento significativamente más bajo de lo esperado para su clase en dos o más pruebas individuales, o en una o más áreas generales de habilidades, debe ser referido para una mayor investigación.

Los criterios de evaluación de la prueba LAMDA se describen a continuación:

Reconocimiento de imágenes: Se refiere a una respuesta de selección a un estímulo visual, en la que el alumno debe actuar con rapidez cuando se presenta una imagen en particular y suprimir la reacción a cualquier otra imagen. Las imágenes son muy diferentes, por lo que el único requisito del alumno es una atención prolongada. La baja precisión en este ejercicio puede significar falta de concentración.

Reconocimiento de palabras: Es una prueba de selección léxica, en la que el alumno debe actuar con rapidez cuando aparece una palabra real en la pantalla y suprimir la reacción cuando aparece una palabra falsa.

Ortografía (histórica y gramatical): el nivel de ortografía de un estudiante depende de su experiencia general en el lenguaje y, en particular, de su experiencia en la escritura. A medida que aumenta el conocimiento del estudiante, se reducen los errores ortográficos. Se ha observado que bajo la presión del tiempo se cometen más errores ortográficos.

Comprensión (escrita y oral): La comprensión del lenguaje hablado es un requisito previo para la comunicación lingüística oral o escrita. Al mismo tiempo, la interpretación oral contribuye e influye en el nivel de comprensión escrita. Un estudiante, por regla general, tiene un mejor desempeño al hablar que al escribir. LAMDA detecta la comprensión del habla oral en forma de texto narrativo y no la comprensión del habla oral fluida y espontánea que usamos en nuestra comunicación oral diaria. Por tanto, aumentan las demandas del procesamiento del habla. Su estructura se vuelve más compleja que el habla espontánea e impone exigencias adicionales al procesamiento del lenguaje. La comprensión escrita se examina en LAMDA con la presentación de un texto escrito para que el alumno lo lea. A continuación, se retira el texto y se dan opciones de imágenes o preguntas de opción múltiple, como en la prueba de comprensión oral.

Compleción de oraciones y proporciones verbales: son indicadores de la capacidad de procesamiento sintáctico. Al completar oraciones, la respuesta correcta está limitada por el contexto de frase proporcionado. Por lo tanto, se le pide al estudiante que complete una oración con la palabra adecuada. En algunas preguntas, las alternativas difieren en morfología y por lo tanto se trata de averiguar si el tipo de palabra cumple la función necesaria dentro de la frase en particular. El método de proporciones verbales

se utiliza para probar la capacidad del estudiante en morfología productiva y clítica, sin un marco de frase de apoyo. Este ejercicio requiere la manipulación morfológica explícita de palabras sin consecuencias útiles para que se pueda caracterizar como lingüístico.

Selección de imágenes: Incluye un locutor virtual, que pronuncia una palabra, mientras que al mismo tiempo se muestran cuatro imágenes, de las cuales solo una representa con éxito la palabra hablada. Se le pide al estudiante que elija el correcto, por ejemplo, la palabra "aparato" se refiere a una tabla de planchar (elección correcta), un cuerno, un cangrejo ermitaño y un cilindro de alta presión. Un vocabulario deficiente puede ser un indicador de dificultades de aprendizaje. Por el contrario, un vocabulario relativamente rico es importante para el éxito de un niño en la escuela.

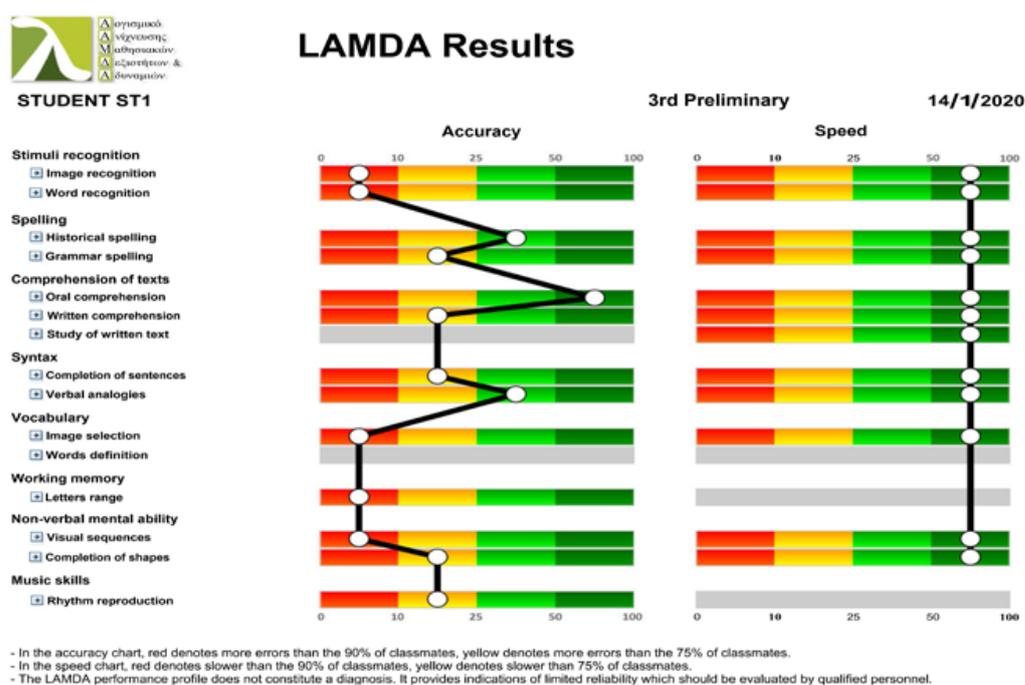


Figure 16: Prueba de evaluación aleatoria (captura de pantalla de la prueba LAMDA, tentativamente traducida al inglés por los autores).

Rango de letras, secuencias visuales y finalización de patrones: se refiere a la evaluación de la memoria de trabajo mediante la reproducción de secuencias. Al igual que con otros programas de software para discapacidades de aprendizaje, LAMDA utiliza secuencias de letras en lugar de números, por lo que el ejercicio es más difícil para los estudiantes con experiencia insuficiente en el procesamiento de datos escritos.

Solo se utilizan consonantes para formar las secuencias, de modo que las secuencias de letras que el alumno tiene que memorizar no formen palabras ni sílabas, lo que las hace más fáciles de memorizar. Así, los ejercicios examinan la memoria de trabajo verbal, que parece ser particularmente débil en estudiantes con dificultades de aprendizaje del idioma. La finalización de patrones se refiere a completar las partes que faltan de una forma determinada.

Percepción de las características de la música: los procesos de percepción de las características de la música (ritmo, armonía, melodía) están directamente relacionados con los correspondientes procesos de percepción de las características del habla oral. En los estudiantes con trastornos del desarrollo del aprendizaje y de la alfabetización, la capacidad de reproducir el ritmo musical está asociada con la capacidad de aprendizaje.

## 2.7 Descripción del programa de intervención

El programa de intervención tiene como objetivo evaluar el efecto de los dos enfoques de enseñanza diferentes, actividades innovadoras - método tradicional de enseñanza a través de las instrucciones de la APS, sobre el desempeño de aprendizaje de la lección de música, sobre la unidad de educación rítmica en ambos estudiantes de la población típica así como en estudiantes con dislexia. Además, se investigará el efecto de los dos en la efectividad del programa de intervención en niños con dislexia no solo en la mejora de la educación rítmica sino también en su mejora en las áreas del lenguaje examinadas por la herramienta de evaluación test "LAMDA".

### Nivel 1

Después de dividir a los niños con dislexia en 2 grupos:

- Grupo A (grupo experimental - grupo de niños que asistirán al método de enseñanza intervencionista)
- Grupo B (grupo de niños que seguirán la enseñanza a través de los Currículos)

Utilizará la herramienta de evaluación "LAMDA" test a todos los alumnos antes y después de la enseñanza de la música, ya sea la intervención o mediante el Currículo, por parte de los profesores de la clase bajo la supervisión del investigador, de manera

que para realizar la evaluación tanto en el educación rítmica y en los demás módulos de la prueba.

## Etapa 2

En el grupo A - experimental. Se utilizará el siguiente procedimiento:

En lugar del método de enseñanza habitual basado en el plan de estudios, se utilizarán actividades innovadoras. Algunas actividades serán compatibles con el plan de estudios, pero se presentarán de forma lúdica.

Más concretamente, este método intervencionista tendrá una duración de 12 lecciones, donde cada lección corresponde a 20 minutos. Se dividirán dos grupos con 32 niños de la Escuela Primaria D 'cada uno, de los cuales 16 tendrán un diagnóstico oficial de Dislexia por parte de un certificado mientras que los 16 restantes pertenecerán a la población estudiantil típica.

## Tercera etapa

En el grupo B (grupo de niños que seguirán la enseñanza a través del Currículo), que estará conformado por 16 niños que tendrán un diagnóstico formal de Dislexia por parte de un organismo estatal certificado y se otorgará a 16 niños que pertenecerán a la población estudiantil típica la herramienta de evaluación antes y después de la enseñanza clásica por parte del profesor de clase que seguirá el Currículum.

Es muy probable que los estudiantes de diferentes escuelas y distritos / prefecturas coexistan en estos grupos. La división de los niños en estos grupos será aleatoria.

## 2.8 Descripción de las actividades

Una de las características clave de la enseñanza inclusiva es la forma diferente en que se ofrece a los estudiantes, incluyendo métodos de enseñanza innovadores adecuados para cada estudiante de forma individual con cualquier dificultad, así como la dislexia. El objetivo del profesor debe ser la forma variada de enseñar con el fin de encontrar lo mejor y más efectivo para cada alumno con el fin de asegurar el aprendizaje con la lección más amena y divertida. Más específicamente, en los estudiantes con dislexia la enseñanza debe ser estructurada y completa con muchas repeticiones. Se pueden utilizar diferentes formas de enseñanza, como la enseñanza con varios estudiantes, que utiliza

diferentes métodos para profundizar el efecto de los estímulos. El aprendizaje se vuelve más estable con el apoyo mutuo de tantos sentidos como sea posible durante el proceso de aprendizaje.

Los principales métodos utilizados para crear el programa de música de intervención son:

- EL MÉTODO DALCROZE

Este método fue inventado a principios del siglo XX y es el sistema más completo de entrenamiento y movimiento rítmico. Observó a los estudiantes que tocaban música sin entenderla y, en consecuencia, sin emoción. Por tanto, consideró que la solución a este problema sería poder controlar la contracción y la relajación de los músculos según la velocidad, la duración y la dinámica (matices) del sonido.

- EL MÉTODO KODALY

Kodaly, nacido en 1882 en un pueblo a pocos kilómetros de Budapest, inició su formación musical a temprana edad, aprendiendo piano, violonchelo y violín. Este método enfatiza la importancia de aprender la notación musical, una vez que el maestro considera que los niños están listos para aprender, escribir y leer música, es decir, cuando el niño comienza a aprender, leer y escribir el alfabeto.

- EL MÉTODO ORFF

El creador del método es el alemán Carl ORFF. Este método se caracteriza por una combinación de habla y ritmo, porque consideró que la recitación podría combinarse con los golpes de las manos rítmicas, con los dedos en la mano y los pies en el suelo. Asimismo, el movimiento que acompaña al ritmo, pero también la improvisación sobre motivos rítmicos o melódicos sobre las percusiones fueron elementos esenciales de su método de enseñanza. Consideró que la relación del alumno con el profesor se basa en la interacción y es variable. Creía que el juego creativo podía desarrollar la personalidad del niño y su contacto con el arte para cultivar la expresión musical libre, la improvisación. Creía que todos los niños podían adquirir la musicalidad y les bastaba con participar en las actividades musicales correspondientes a su nivel.

- EL MÉTODO SUZUKI

Suzuki, un músico y educador japonés, inventó el llamado método de educación del talento para enseñar instrumentos de cuerda a niños pequeños. El desarrollo de la capacidad de la memoria musical a través de la escucha, la observación y la imitación es un elemento clave del método. El método Suzuki también se conoce como el método de la lengua materna, ya que su objetivo principal es aprender música de una manera sencilla que uno aprende la lengua materna. Además, cree que las habilidades audibles se pueden ejercitar antes de aprender la notación musical y que el niño puede tocar un instrumento musical sin saber leer música mientras se inserta la notación cuando el niño toca varias piezas en el instrumento musical que está aprendiendo. Las piezas musicales utilizadas por los estudiantes en el mundo incluyen piezas musicales cuidadosamente seleccionadas y no ejercicios de artesanía para apoyar el aprendizaje de la audición.

La duración de cada lección fue de 40 minutos y las actividades se dividieron en unidades temáticas de diez minutos, con el objetivo de verificar la capacidad motora, acústica, visoespacial. Más específicamente, se utilizaron actividades adaptadas de habla, movimiento, tacto, audición y detección del pulso para percibir el ritmo de la música. A título indicativo, algunos de ellos se mencionan a continuación:

- El maestro mantiene estable el tempo de una canción y le pide a cada estudiante individualmente que camine al ritmo mientras rebota rítmicamente una pelota en el piso.
- El profesor esconde un metrónomo en el aula y se pide a los alumnos que lo encuentren por su sonido, mientras aplauden al ritmo.
- El profesor crea un camino utilizando tarjetas grandes con valores musicales dibujados en ellas, a saber, cuartos y octavos. Se pide a los alumnos que caminen sobre él y al mismo tiempo toquen un instrumento de percusión según el valor que se dibuje en cada tarjeta.
- Los alumnos imitan las formas de los valores rítmicos con el cuerpo, de pie o en el suelo.

### 3 Resultados

#### 3.1 Mejora general del alumno con dislexia

Los hallazgos con respecto a la mejora general (o falta de ella) en el desempeño de los estudiantes disléxicos que componen el grupo experimental se resumen en la Figura 2. Para cada criterio de la prueba LAMDA, el número de estudiantes con un desempeño mejorado está representado por la barra horizontal junto a eso. Dado que los resultados de la prueba LAMDA clasifican a los estudiantes en cuatro intervalos de desempeño, es decir, 0-10%, 11-25%, 26-50%, 51-100%, la cantidad de mejora se indica mediante diferentes colores dentro de cada barra, basado en el número de intervalos en los que se produjo esta mejora, por ejemplo, para un estudiante que se desempeñó dentro del rango de 0-10% en la prueba previa, y dentro del rango de 51-100% en la prueba posterior, una mejora en tres intervalos esta reportado.

Los hallazgos muestran que la intervención mejoró el desempeño de los 16 estudiantes en la reproducción del ritmo (para 11 de ellos en tres intervalos, para tres de ellos en dos intervalos y para dos de ellos en un intervalo), así como en el rango de letras (para nueve de ellos por tres intervalos, cinco de ellos por dos intervalos y dos de ellos por un intervalo), en secuencias visuales (para dos de ellos por tres intervalos, para 11 de ellos por dos intervalos y para tres de ellos por uno intervalo), en el reconocimiento de palabras (para diez de ellas por dos intervalos y para seis de ellas por un intervalo), en el reconocimiento de imágenes (para siete de ellas por dos intervalos y para nueve de ellas por un intervalo), y en la finalización de patrones ( para siete de ellos por dos intervalos y para nueve de ellos por un intervalo).

Además, 14 de los 16 estudiantes mostraron una mejora en la ortografía histórica (cinco de ellos en dos intervalos y nueve de ellos en un intervalo) y en la selección de imágenes (los 14 en un intervalo). Además, 12 de los 16 estudiantes mostraron una mejora en la ortografía gramatical (uno de ellos en dos intervalos y 11 de ellos en un intervalo). Un total de tres estudiantes obtuvieron mejores resultados en proporciones verbales (los tres en un intervalo) y solo dos estudiantes parecieron haber mejorado en la comprensión escrita y la terminación de oraciones (todos en un intervalo).

Finalmente, ninguno de los estudiantes observó mejoría en la comprensión verbal. En la Figura 3, las diferencias generales de desempeño se presentan de manera similar a la Figura 1, esta vez en función del género de los estudiantes participantes. La mejora general parece ser similar entre estudiantes hombres y mujeres.

La Figura 4 presenta los hallazgos con respecto a la mejora general del rendimiento de los estudiantes disléxicos que pertenecen al grupo de control. Al igual que en la Figura 2, los diferentes colores representan el número de intervalos en los que se produjo la mejora. Los hallazgos muestran que las lecciones de música convencional del currículo típico tuvieron un efecto positivo en 12 de 16 estudiantes en reconocimiento de imagen (8 de ellos por dos intervalos y 4 de ellos por un intervalo), reproducción de ritmo (8 de ellos por dos intervalos y 4 de ellos por un intervalo), reconocimiento de palabras (seis de ellos por dos intervalos y seis de ellos por un intervalo) y finalización de patrones (5 de ellos por dos intervalos y 7 de ellos por un intervalo).

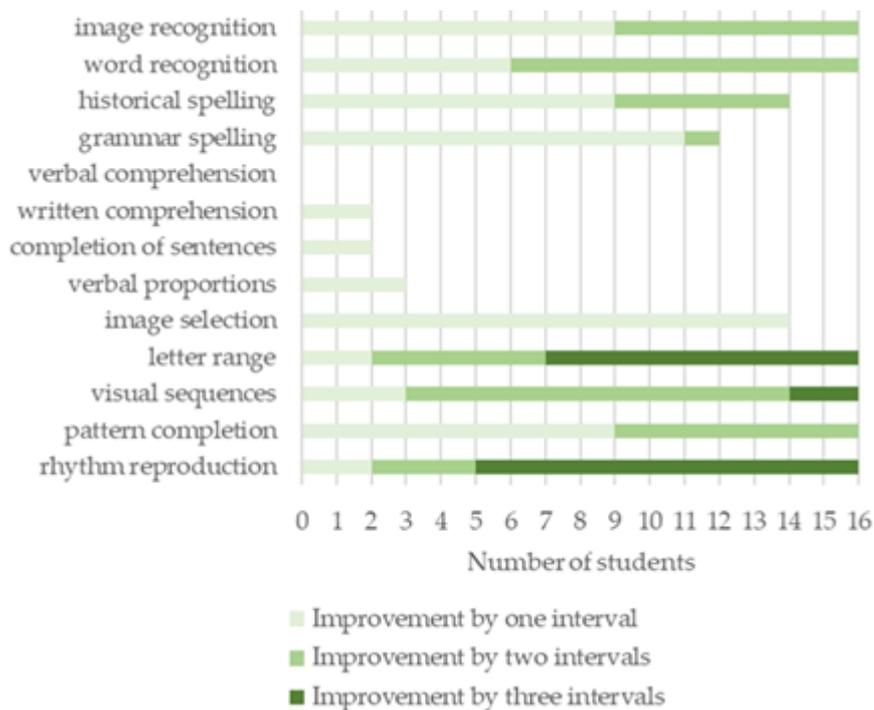


Figure 17 :Número de estudiantes del grupo experimental que mejoraron en cada categoría de la prueba LAMDA.

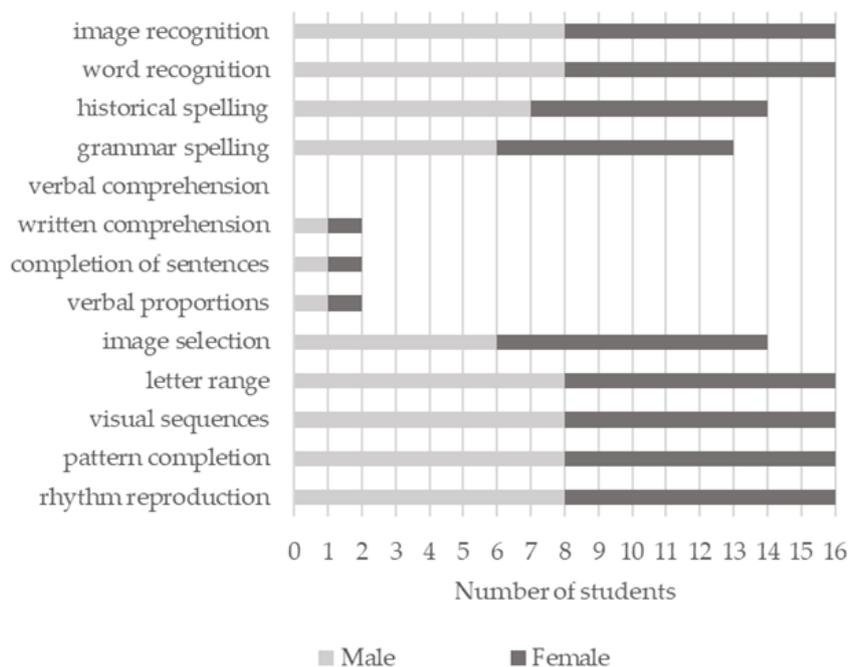


Figure 18: Número de alumnos y alumnas del grupo experimental que mejoraron en cada categoría de la prueba LAMDA.

También mejoró el desempeño de 11 estudiantes en rango de letras (5 de ellos en dos intervalos y 6 de ellos en un intervalo). Para 10 estudiantes apareció una mejora con respecto a las secuencias visuales (4 de ellos por dos intervalos y 6 de ellos por un intervalo). Ocho estudiantes obtuvieron mejores resultados en la selección de imágenes (3 de ellos en dos intervalos y 5 de ellos en un intervalo), mientras que, para siete estudiantes, el desempeño mejorado se mostró en la ortografía histórica (2 de ellos en dos intervalos y 5 de ellos en un intervalo ) y ortografía gramatical (1 de ellos por dos intervalos y 6 de ellos por un intervalo).

No se observó mejoría para ninguno de los estudiantes del grupo de control en comprensión verbal, comprensión escrita, terminación de oraciones y proporciones verbales. Finalmente, como se puede observar en la Figura 5, no existen diferencias significativas en la mejora del desempeño entre los estudiantes hombres y mujeres del grupo de control.

En la Figura 6, el número de estudiantes que mejoraron en cada categoría de la prueba LAMDA se presenta tanto para el grupo experimental como para el de control, con fines comparativos. En comparación con los cursos de música del plan de estudios típico, el programa de formación musical intervencionista parece ser considerablemente más beneficioso con respecto a las habilidades relacionadas con el ritmo y, en consecuencia, a todos los criterios pertinentes de la prueba LAMDA, a saber, reconocimiento de imágenes, reconocimiento de palabras, ortografía histórica, etc. ortografía gramatical, selección de imágenes, rango de letras, secuencias visuales, finalización de patrones y reproducción de ritmos. Por otro lado, la diferencia entre los dos grupos es menos profunda en cuanto a comprensión escrita, finalización de oraciones, proporciones verbales y comprensión verbal. Sin embargo, a excepción de este último, incluso en esas habilidades se observó alguna mejora en el caso del grupo experimental mientras que no se detectó ninguna en el caso del grupo control.

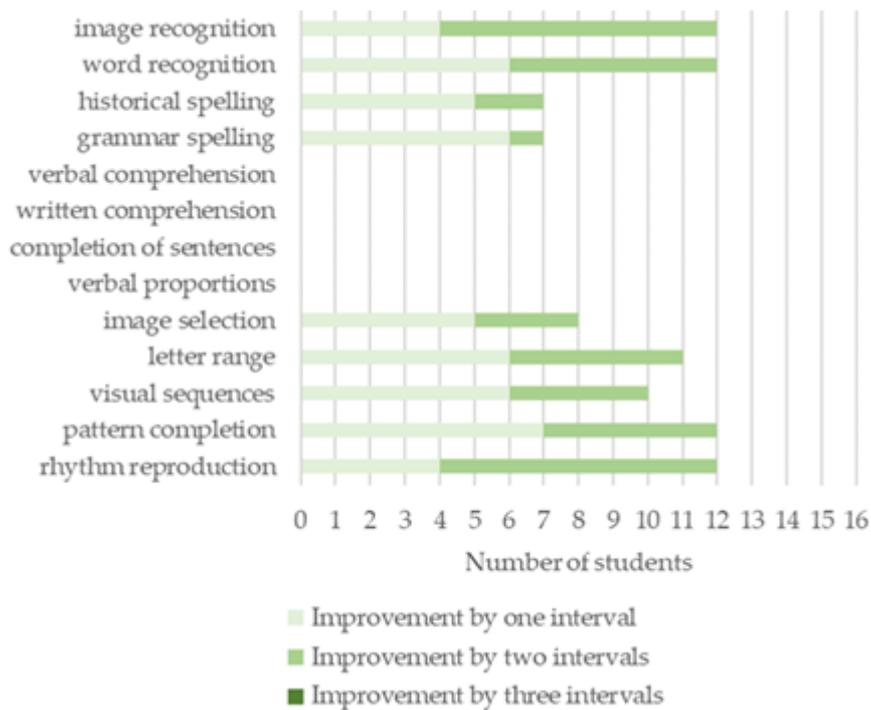


Figure 19: Número de estudiantes del grupo de control que mejoraron en cada categoría de la prueba LAMDA.

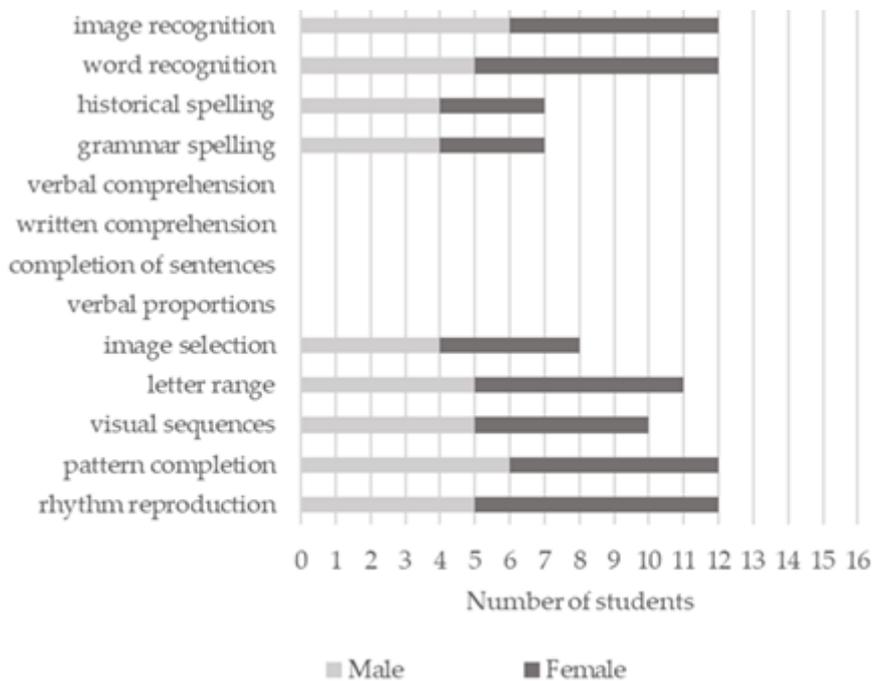


Figure 20: Número de alumnos y alumnas del grupo de control que mejoraron en cada categoría de la prueba LAMDA.

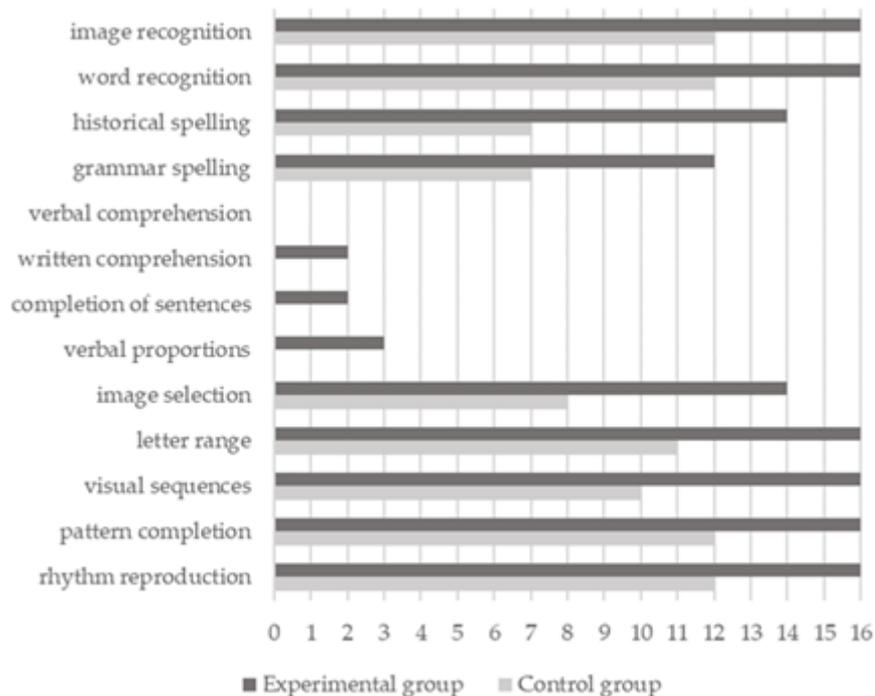
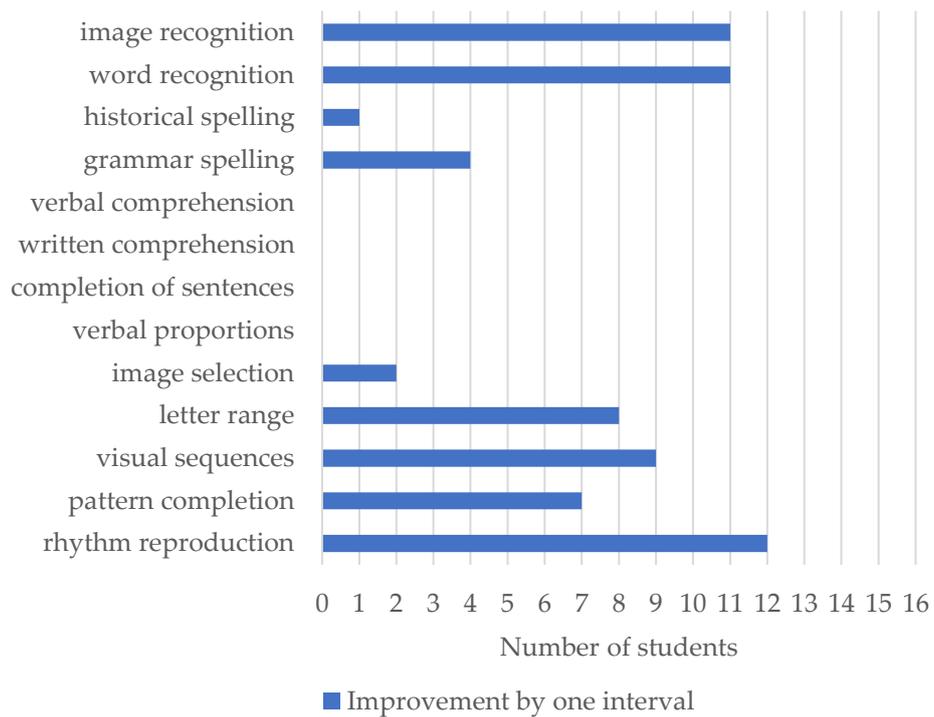


Figure 21: Comparación entre el grupo experimental y el de control con respecto al número de estudiantes que mejoraron en cada categoría de prueba.

### 3.2 Mejora general del estudiante de desarrollo típico

Los resultados comparativos con respecto a los estudiantes típicos según la prueba LAMDA no muestran que haya un desarrollo especial en ambos grupos. En cuanto al grupo de estudiantes que asistieron al programa de intervención musical, parecen haber mejorado en las siguientes áreas de la prueba LAMDA como se muestra en el siguiente diagrama Figura 7 sin diferencia significativa entre el género de los niños, Figura 8. Menos niños que las niñas obtuvieron mejores resultados en las dos áreas siguientes de la prueba LAMDA, en actividad rítmica pero también en reconocimiento de imágenes. En cuanto a los niños que asistieron al currículo escolar, se observa que ha evolucionado un número menor de niños como se muestra en la Figura 9, mientras que parece no haber diferencia significativa entre el género de los niños Figura 10.



*Figure 22: Number of students of the experimental group that improved in each LAMDA-test category*

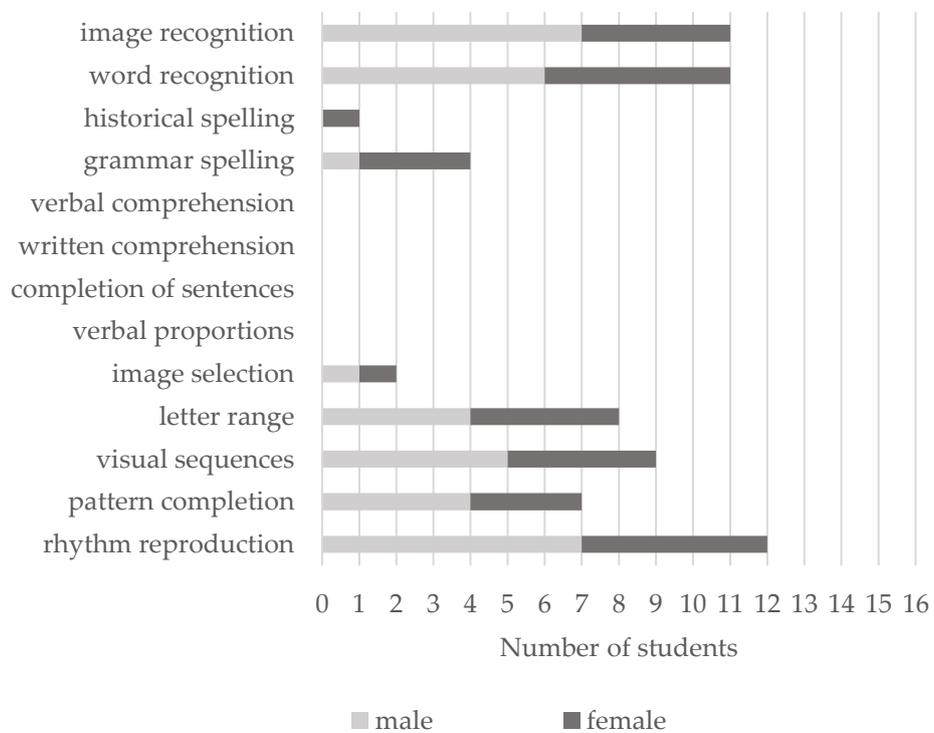


Figure 23: Number of male and female students of the experimental group that improved in each LAMDA-test category

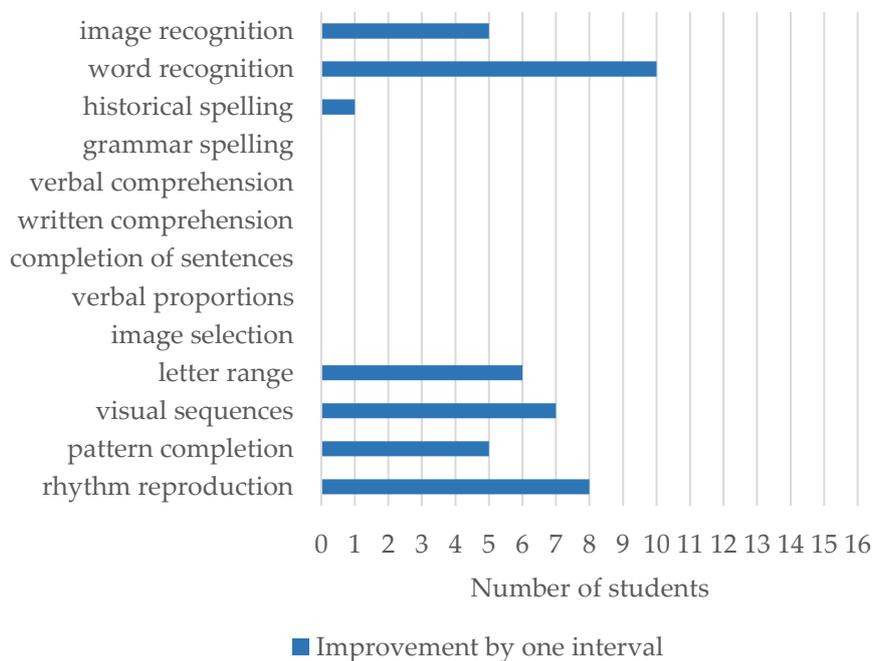


Figure 24: Number of students of the control group that improved in each LAMDA-test category

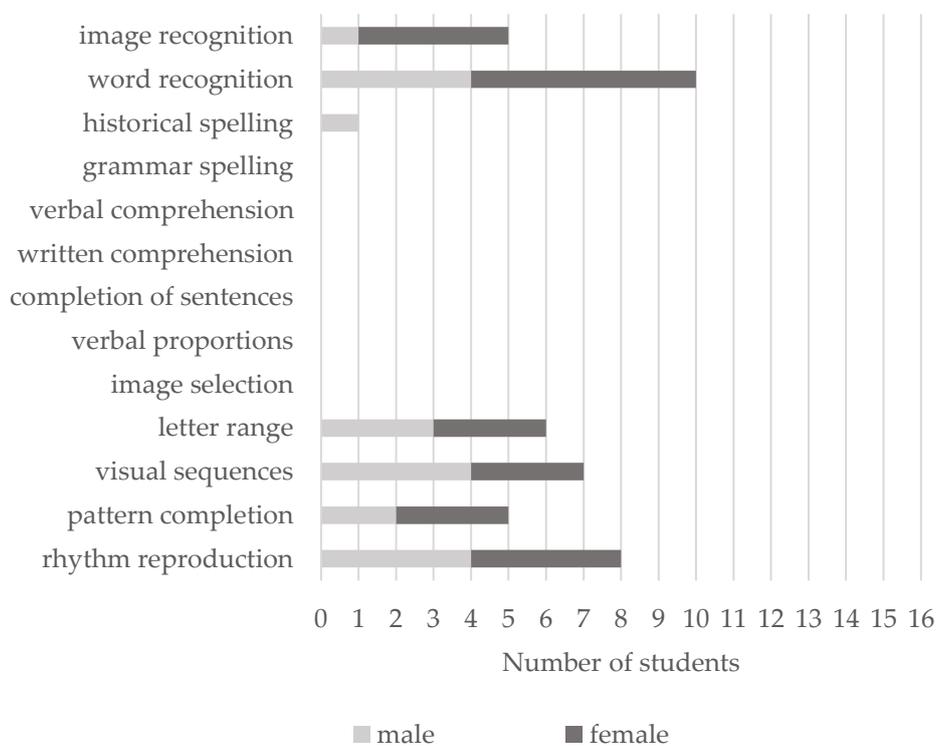


Figure 25: Number of male and female students of the control group that improved in each LAMDA-test category

### 3.3 Comparaciones entre los dos grupos de niños

En cuanto a los niños en desarrollo formal, no hubo mejoría significativa en ninguna categoría, ni en los que asistieron al currículo escolar ni en los que asistieron a la intervención. Más específicamente, en la Tabla 1 parece haber una pequeña diferencia en la mejora de las secciones específicas de la prueba LAMDA, reconocimiento de imágenes, reconocimiento de palabras, ortografía histórica, ortografía gramatical, selección de imágenes, selección de imágenes, rango de letras, secuencias visuales, finalización de patrones. , reproducción del ritmo en relación a los niños que asistieron al programa de intervención musical.

Table 3: Comparaciones entre los dos grupos de niños

Dimensions				
	Ex_d	Con_d	Exp_t	Con_t
image recognition	15	12	11	6
word recognition	16	12	11	8
historical spelling	14	7	1	No
grammar spelling	12	7	4	1
verbal comprehension	No	No	No	No
written comprehension	2	No	No	No
completion of sentences	2	No	No	No
verbal proportions	3	No	No	No
image selection	14	8	2	No
letter range	16	11	8	7
visual sequences	16	10	9	7
pattern completion	15	12	7	5
rhythm reproduction	16	12	13	8

## 4 Preguntas de investigación

### 4.1 Primera solicitud de investigación

Existe un efecto positivo del programa de intervención en los estudiantes que han sido diagnosticados con dislexia debido a la enseñanza de la música?

Los estudiantes que fueron diagnosticados con dislexia y al mismo tiempo asistieron al programa de intervención de música parecen tener más interés en la lección, mayor deseo de participar en las actividades, mayor confianza en el proceso de las actividades, ya que todos se adaptaron a las necesidades de estos niños. Los resultados muestran el efecto positivo de este programa de intervención y, en particular, la música parece afectar a bastantes habilidades lingüísticas según la prueba Lambda. Por el contrario, como se puede ver en los resultados de la investigación, no parece haber un efecto

positivo del programa curricular en los estudiantes que han sido diagnosticados con dislexia según el plan de estudios.

En cuanto a la bibliografía, la relación entre música y lenguaje y las similitudes en su aprendizaje son confirmadas por diversas investigaciones neurofisiológicas y de otro tipo (Ludke & Weinmann, 2012; Gooding, 2011; Hallam, 2010; Ritblatt, Longstreth, Hokoda, Cannon & Weston, 2013) que mostró que los bebés tienen más probabilidades de aprender música y lenguaje a través de su familiaridad con el entorno sonoro en el que viven. Los mecanismos básicos para el desarrollo de la música y la capacidad lingüística se crean ya desde los primeros meses de vida humana e incluso durante los últimos meses de embarazo (Chiang et al., 2018).

En las siguientes referencias se registra su efecto positivo en el desarrollo de los estudiantes, tanto mejorando su autoestima y confianza en sí mismos, como mejorando significativamente sus habilidades de aprendizaje, contribuyendo así al desarrollo de su nivel académico, social y lingüístico. La música es un lenguaje que, a pesar de su diversidad, reduce las barreras lingüísticas y las peculiaridades individuales, permitiendo la experimentación y la interacción (Sammler & Elmer, 2020). Los estudios que se centran en las dificultades de lectura en niños con dislexia correlacionan la capacidad de los niños para leer con su capacidad para distinguir con precisión el tono (Magne Schön y Besson, 2006;), lo que respalda la existencia de una fuerte relación entre la percepción auditiva básica y las habilidades de lectura.

El propósito de este estudio fue investigar si el uso de un programa de intervención musical en la lección de música puede tener un efecto positivo en el aprendizaje y la habilidad musical de los estudiantes con dislexia. En cuanto a la evaluación final a través de la prueba Lambda, se observó una relación directa entre la capacidad para percibir la música y algunas dificultades que la dislexia provoca en esta población estudiantil, como se menciona en investigaciones similares como Cumming et al., (2015), Roden et al, (2016), Lifshitz-Ben-Basat y Fostick (2019), Frey et al. (2019).

#### 4.2 Segunda solicitud de investigación

Existen diferencias entre los estudiantes con dislexia que siguieron el plan de estudios escolar tradicional y los estudiantes con dislexia que siguieron el programa de intervención?

En cuanto a la relación del currículo de música con los estudiantes con dislexia, se observó que les resultaba difícil asistir al currículo. Aunque las actividades no son tan complicadas y difíciles, los estudiantes no mostraron el mismo entusiasmo e interés que los del programa de intervención. Los estudiantes no estaban tan concentrados y, a menudo, en actividades como cantar, no querían participar. Aunque los resultados mostraron una mejora en las siguientes habilidades de reconocimiento de imágenes de la prueba lambda, reproducción de ritmo, reconocimiento de palabras, finalización de patrones, rango de letras, secuencias visuales, selección de imágenes, ortografía histórica, ortografía gramatical, el número de estudiantes que mejoraron fue menor. Respectivamente, los niveles de mejora fueron menores, los estudiantes mostraron como máximo dos niveles de mejora en contraste con los que siguieron el plan de estudios y tuvieron tres niveles de mejora.

Enseñar música a niños disléxicos es sin duda uno de esos casos. Especialmente para ellos, dado que sus dificultades específicas se reconocen a tiempo y el hecho de que los métodos de enseñanza tradicionales no se adaptan a su forma 'idiosincrásica' de aprendizaje, pueden evitar con seguridad sus primeros encuentros desafortunados con la música y con ellos mismos. Para asegurarse de que sus dificultades no se deban a falta de inteligencia o de esfuerzo y estudio. Por tanto, los métodos de enseñanza alternativos pueden estar plenamente justificados en su caso.

El objetivo es abordar de maneras y métodos alternativos que no presten mayor atención al aprendizaje de la notación musical, dejando mucho espacio para el desarrollo de la memoria musical, la creatividad y la imaginación, así como la familiaridad con el "vocabulario" del lenguaje musical. A continuación se presentará brevemente la reflexión sobre una de las concepciones profundamente arraigadas de la enseñanza de la música y se intentará una presentación relativamente concisa de caminos y métodos alternativos particularmente adecuados para niños disléxicos. En primer lugar, la música se trata de escuchar. Además, el acto musical es principalmente cinestésico.

En este punto, se debe volver a enfatizar la razón fundamental y la filosofía que es vital adoptar en el caso de los niños disléxicos: el enfoque experiencial y multisensorial que aborda tantos sentidos como sea posible (Mina et al., 2021). El repertorio musical se aborda de forma mucho más directa y con menos demora, sin la mediación de un largo período de expresión simbólica, que en el caso de los disléxicos puede llevar fácilmente

a su renuncia a todo el esfuerzo. De la misma manera, conceptos como 'alto' y 'bajo', que confunden a muchos disléxicos y tanto como una distinción de altura como una correspondencia de un concepto con un área correspondiente del instrumento respectivo, pueden - más allá de lo experiencial enfoque ya mencionado - sea representado usando sus colores y matices. La memoria muscular, aunque algunos no la reconocen como un tipo distinto de memoria, a veces marca la diferencia para un niño disléxico como el truco mnemónico básico que usa (Habib et al., 2016).

Del mismo modo, la investigación de Flaunacco et al. (2014) revelaron que entre la producción de ritmo y las pruebas de percepción, el nivel de desempeño en un proyecto de percepción métrica predijo específicamente tanto la velocidad como la precisión de la lectura, así como el procesamiento fonológico en los individuos con dislexia.

#### 4.3 Tercera solicitud de investigación

Existe una relación entre la enseñanza de la música y la mejora de las habilidades individuales examinadas por la prueba de percepción LAMDA (reconocimiento de estímulos, ortografía, procesamiento gramatical, comprensión oral, comprensión escrita, memoria de trabajo, capacidad mental no verbal, vocabulario, vocabulario)?

Un programa de música intrusivo, especialmente diseñado para niños con dislexia, parece tener un efecto positivo en la prueba lambda de sus diversas habilidades lingüísticas. El uso del ritmo como método para mejorar las dificultades del lenguaje parece producir resultados positivos. Después de todo, la música en sí misma puede ser una herramienta importante para reducir los síntomas de la dislexia porque es una ciencia multifacética, ya que puede combinarse y enseñarse con muchas otras ciencias, haciendo que el curso sea más agradable y divertido. Por supuesto, esto no significa que simplemente lidiar con él tenga los mismos efectos positivos tanto en los estudiantes disléxicos como en los formales. Los resultados del presente estudio muestran que la mejora de la percepción rítmica tiene resultados positivos y mejora en los niños con dislexia en sus habilidades lingüísticas y más específicamente en las siguientes áreas de la prueba Lamda de vocabulario, sintáctica, ortografía y comprensión escrita.

La codificación adecuada de las voces y el habla también se considera vital para la conciencia fonológica, que es la precursora de la lectura y la escritura. La capacidad de

un niño para distinguir con precisión las vocales o los sonidos que se escuchan de manera diferente afecta la capacidad de reproducir el sonido oralmente. La revisión de Hallam de los estudios de intervención musical (2010) destaca las correlaciones entre las habilidades musicales tempranas, la conciencia fonológica y las habilidades lectoras tempranas (Anvari, Trainor, Woodside & Levy, 2003). Otros estudios muestran que la educación musical puede mejorar las habilidades auditivas que apoyan la percepción vocal (Meyer, Elmer & Jäncke, 2012). Cuarta solicitud de investigación

#### 4.4 Cuarta solicitud de investigación

El programa de intervención o el currículo son efectivos para los estudiantes de desarrollo típicos?

En cuanto a la quinta hipótesis y la efectividad del programa de intervención en los estudiantes típicos, se observó que afectó positivamente su propio desarrollo en los respectivos campos de la prueba Lambda. La mejora claramente no es grande ya que los niños ya tuvieron muy buenos resultados, sin embargo durante la lección los estudiantes parecen divertirse mucho y regocijarse en cada alternancia de actividades. Especialmente en las actividades en las que un alumno tocaba un ritmo en la espalda del otro y tenía que repetir exactamente lo mismo en un instrumento musical, los alumnos mostraron especial atención y concentración. Respectivamente, se observó que estaban entusiasmados con actividades como los bolos musicales y aquella en la que tenían que golpear la pelota en el suelo al ritmo de la música. En general, los niños mostraron gran entusiasmo ya que la lección se convirtió en un juego y el aprendizaje se hizo a través de la enseñanza.

En comparación con la literatura internacional, una investigación similar muestra que mejorar la capacidad rítmica puede beneficiar no solo a los estudiantes con dificultades de lectura sino también a la población en general si Corrigall y Trainor (2011) parecen mejorar la capacidad de atención. Aunque en algunos estudios parece existir una correlación similar entre la educación musical y el lenguaje Li Wenhui, Suo Changqing, Danfei y Zhou Tingting (2016), Swaminathan y Schellenberg (2017) en los que no se presenta correlación.

En cuanto a la cuarta hipótesis y la efectividad del currículo en estudiantes típicos, observamos que existe una leve mejoría en comparación con los niños que asistieron al

currículo intervencionista. Además, aunque no parece que les vaya muy bien en todas las actividades, no parece que tengan mucha dificultad en ellas. Se observa que no están lo suficientemente concentrados durante la ejecución de las actividades y que no están tan interesados.

## 5 Conclusiones

Los resultados de la investigación mostraron que los estudiantes con dislexia que asistieron al programa de intervención tuvieron una mejora significativa en las siguientes áreas de la prueba lambda, a saber, reconocimiento de imágenes, reconocimiento de palabras, ortografía histórica, ortografía gramatical, selección de imágenes, rango de letras, secuencias visuales. , finalización del patrón y reproducción del ritmo, pero no parece que el género pueda diferenciar estos efectos y ha habido algunos cambios notables debido a esto.

Además, hay una mejora significativa en los niños con dislexia y no, en la reproducción rítmica, el último tramo de la prueba Lambda, que revela los resultados positivos de una lección rítmica intervencionista adaptada a las necesidades de los niños. Las actividades especializadas, el carácter agradable de la lección pero también la forma

alternativa de aprendizaje parecen afectar el desempeño de los estudiantes y no solo en el campo de la música. Además, la música y específicamente las actividades musicales que incluían la mejora de la memoria auditivo-visual, la atención, la concentración pero también la mejora de la capacidad verbal parece haber afectado positivamente los resultados de los niños en las respectivas áreas de la Lambda. prueba.

### 5.1 Limitación y prospectiva del estudio

La revisión de los hallazgos de la literatura destaca la relación directa de la música y el lenguaje, ya que ambos involucran la cooperación de mecanismos neuronales similares. El hecho de que la música pueda mejorar las habilidades auditivas, como la percepción y el procesamiento auditivos, ha sido objeto de investigación por parte de muchos investigadores, quienes han concluido que la educación musical no solo tiene un efecto positivo en las habilidades auditivas, sino que también mejora el procesamiento neuronal del sonido, lo que ofrece beneficios a las personas. habilidades lingüísticas mientras se mejoran las habilidades de conciencia fonológica. Al mismo tiempo, existen muchas investigaciones que resaltan el papel beneficioso que la música y diversas actividades musicales pueden jugar en el habla oral y escrita, ya que uno de los factores que lo fortalece es el desarrollo del vocabulario. Los resultados del presente estudio muestran que la mejora de la percepción rítmica tiene resultados positivos y mejora en los niños con dislexia en sus habilidades lingüísticas (vocabulario, sintáctica, ortografía y comprensión escrita). Se necesitan más investigaciones sobre el uso de la música como herramienta terapéutica a través de programas educativos innovadores diseñados específicamente para personas con trastornos del lenguaje.

En primer lugar, es muy importante mencionar que en una sociedad con cambios y desarrollos constantes, en la que cada uno de nosotros evoluciona y cambia, así sería correcto que ocurriera en el proceso educativo. Los métodos de enseñanza deben diferenciarse según la población estudiantil y sus posibles dificultades. Por este motivo, el docente debe estar constantemente atento y tratando de cubrir las necesidades que se presenten. Es importante que para realizar una investigación se utilicen de forma continua preguntas de investigación, herramientas para estimular el interés de los estudiantes y para pasar el tiempo de la lección disfrutando agradablemente de diferentes actividades.

Una de las principales limitaciones que surge es la propia naturaleza de la investigación. La característica de la investigación cualitativa es la capacidad reducida para generalizar los resultados, por lo tanto, los resultados en este caso se refieren a la unidad escolar específica, por lo que no se pudo presentar para representar a toda la comunidad escolar griega.

Además, se encontró que el cambio en la forma tradicional de enseñar, que no se caracteriza por actividades especializadas para la población en aprendizaje con dislexia y la satisfacción de las necesidades, fue el principal motivo de esta implicación en la exploración de nuevas actividades. Toda investigación puede ofrecer no solo al investigador mismo, sino que también puede contribuir a la realización de mejores formas de enseñanza y mejores escuelas.

Una tercera limitación fue la dificultad de la investigadora con sus múltiples roles. La observación activa, organización y coordinación del orden para la realización de la investigación requirió una atención y concentración constantes, así como el mantenimiento del elemento de neutralidad para que la observación sea lo más objetiva posible.

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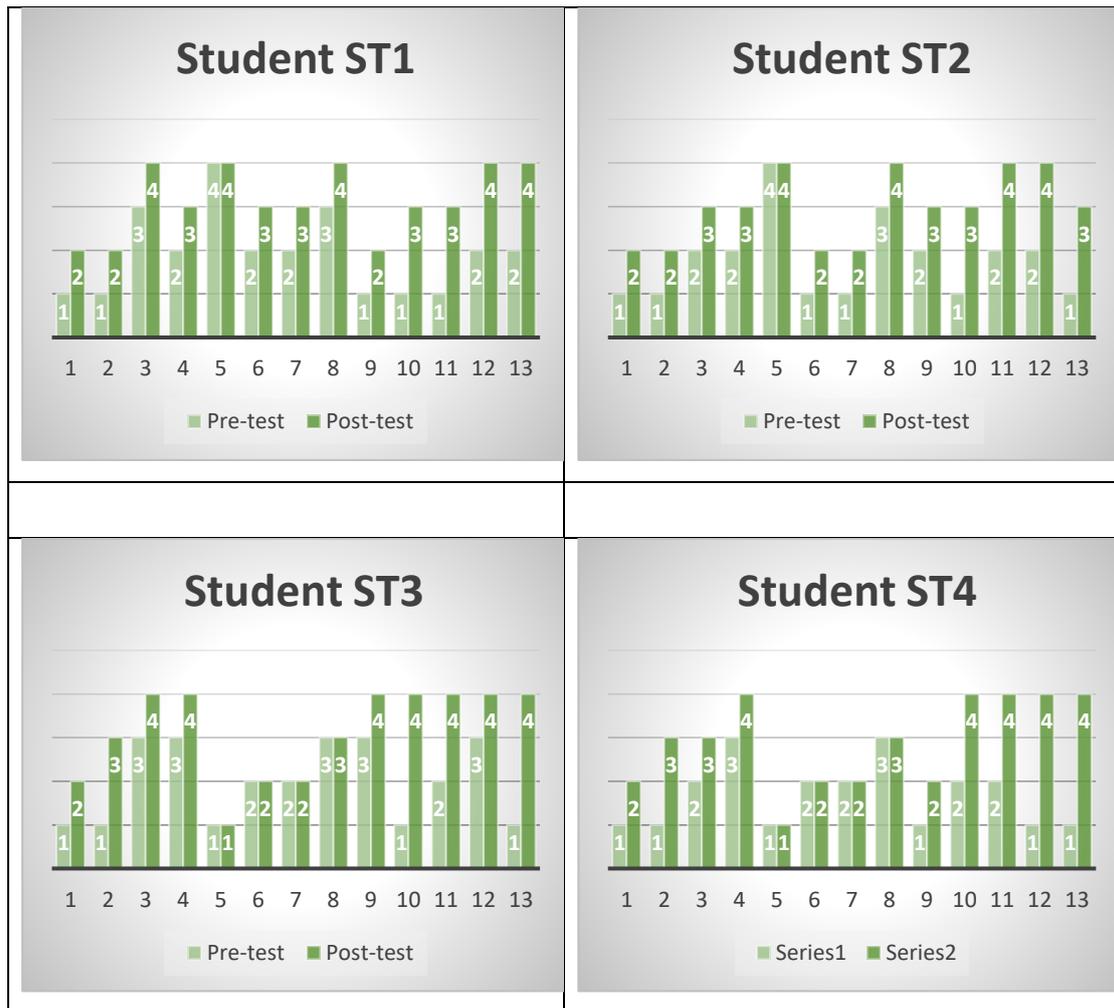
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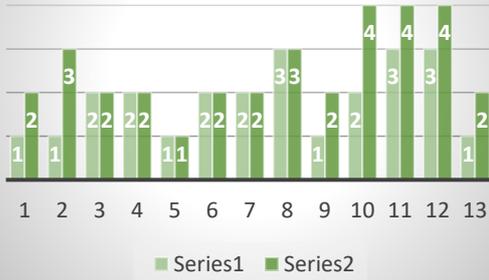
# APPENDICES

## Appendix A

Results of students with dyslexia after the interventional program



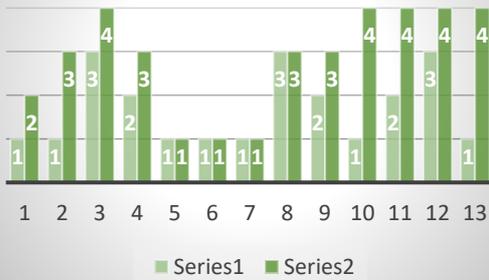
### Student ST5



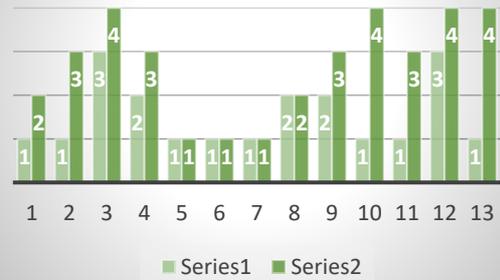
### Student ST6



### Student ST7



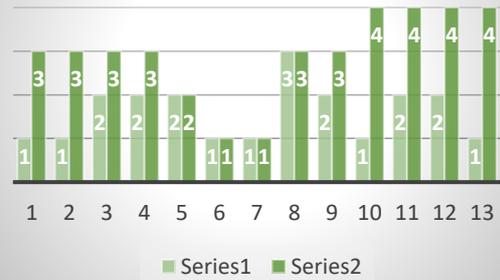
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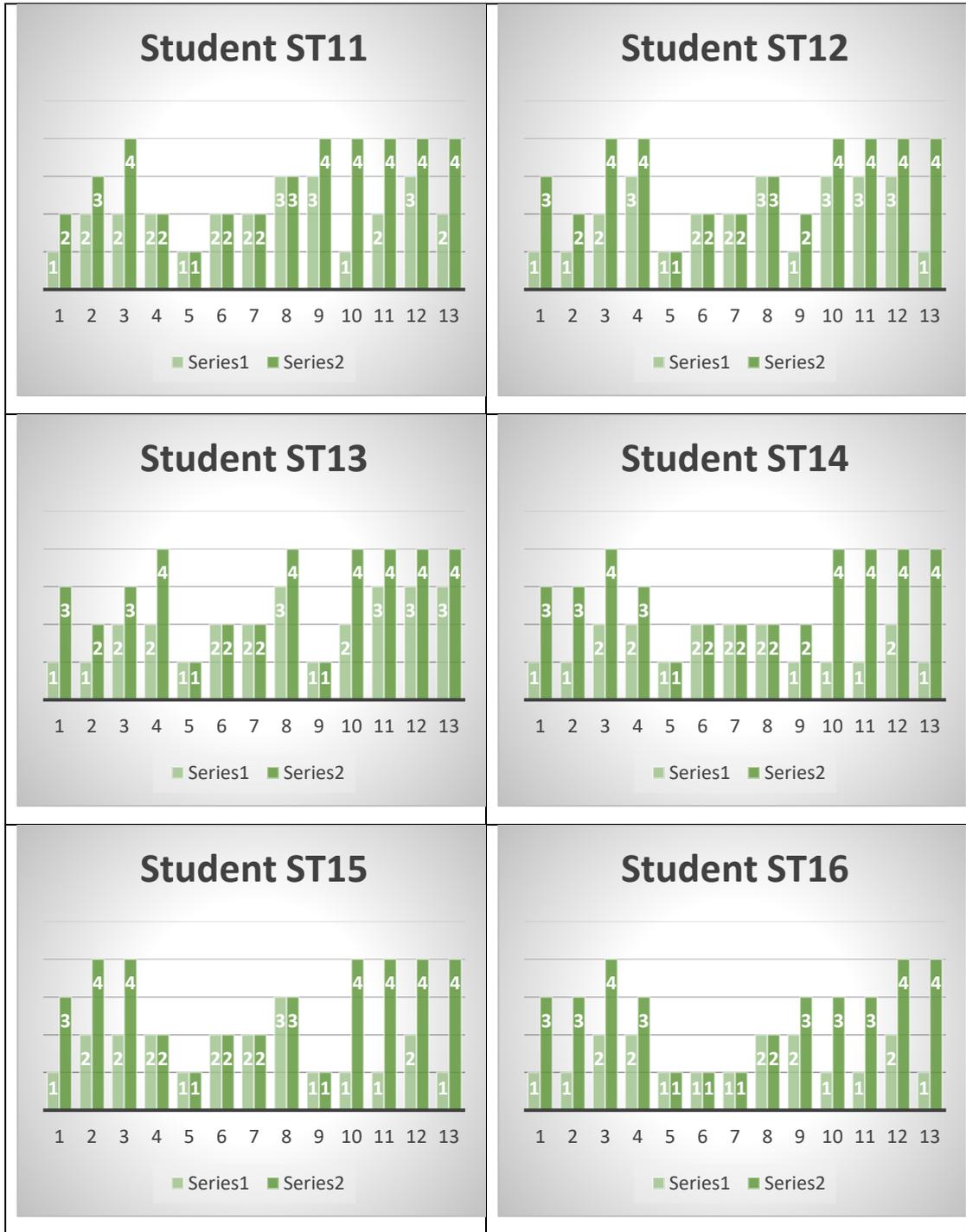


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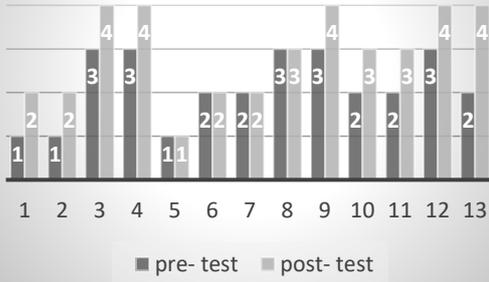
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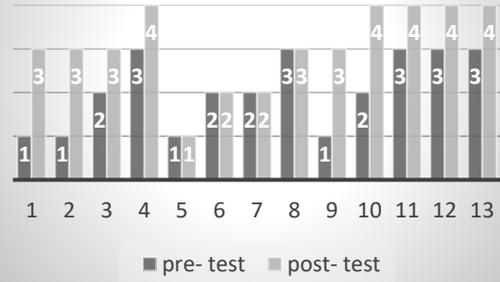


Results of students with dyslexia after the curriculum program

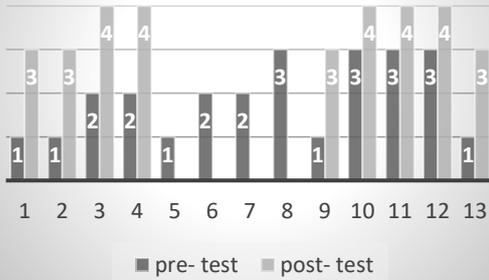
### Student ST1\_c



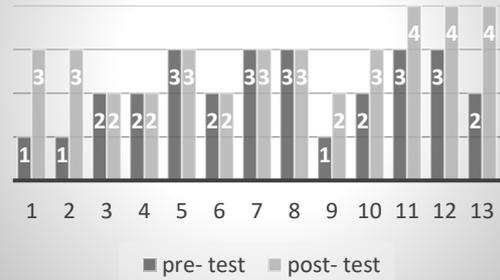
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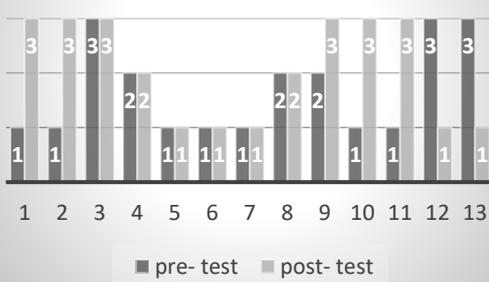
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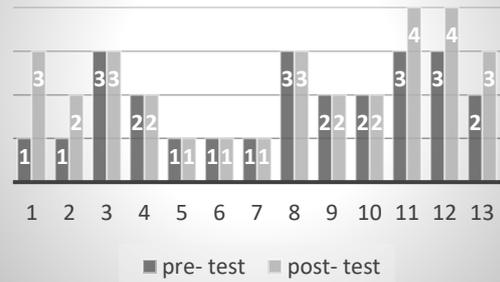
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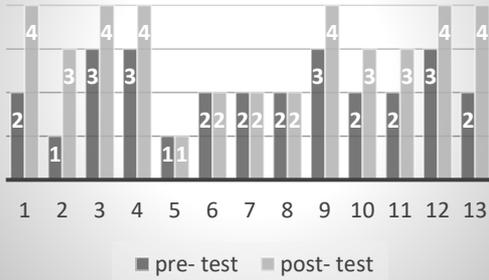
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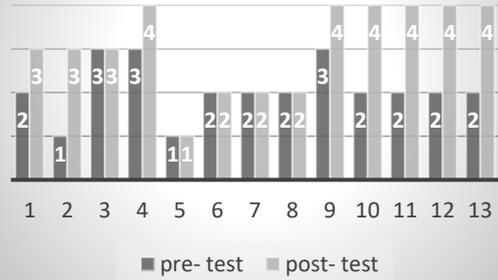
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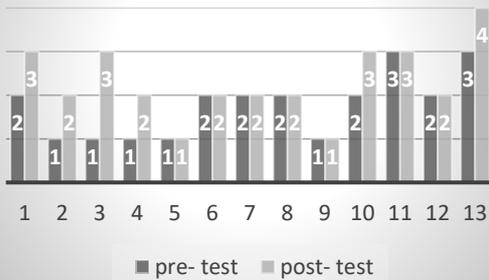
**Student ST7\_c**



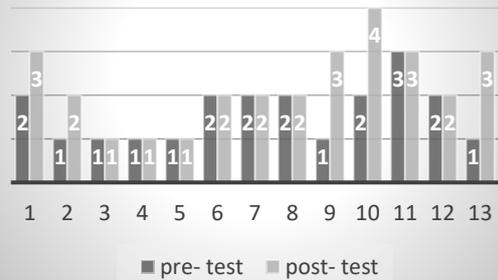
**Student ST8\_c**



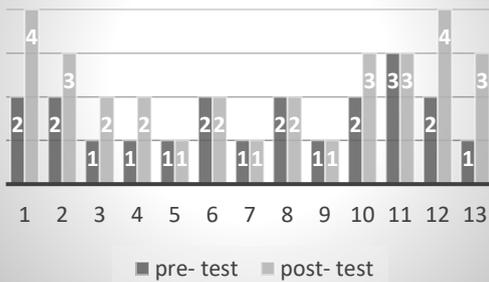
**Student ST9\_c**



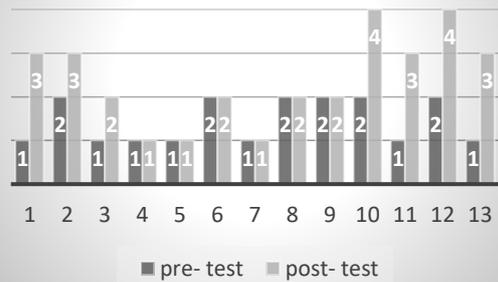
**Student ST10\_c**



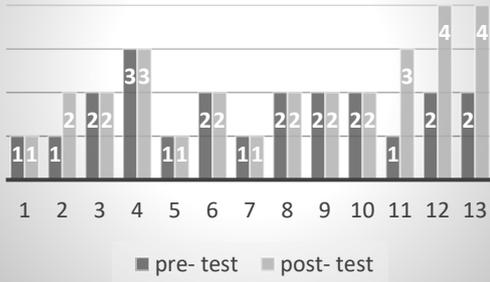
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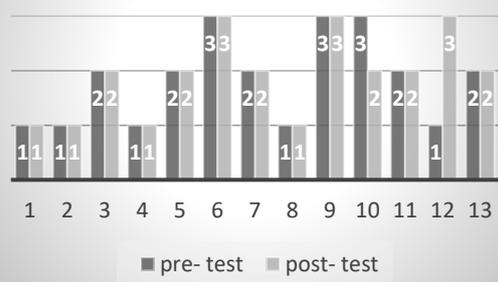
**Student ST12\_c**



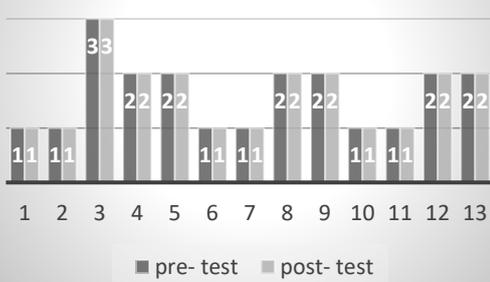
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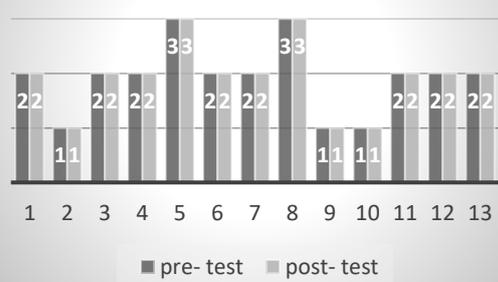
**Student ST14\_c**



**Student ST15\_c**

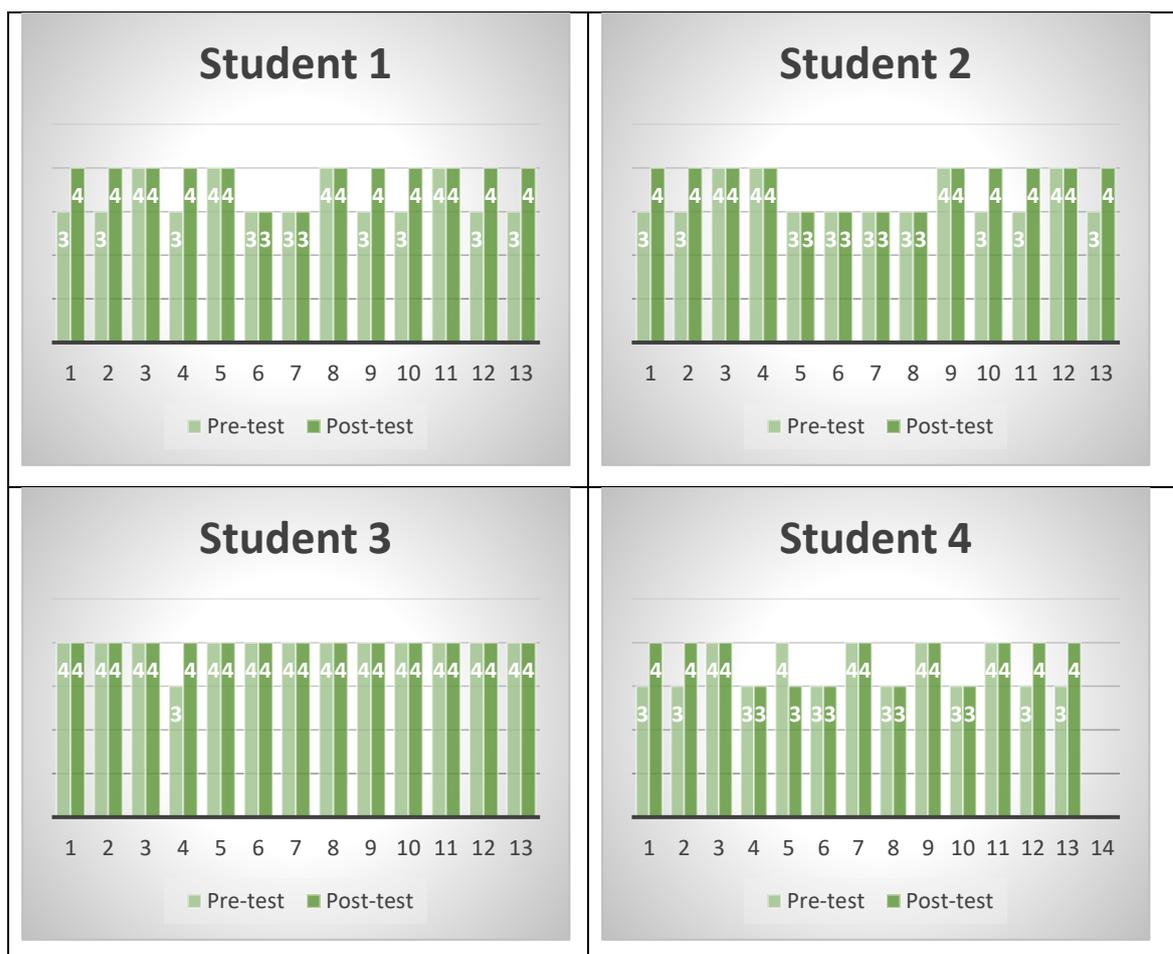


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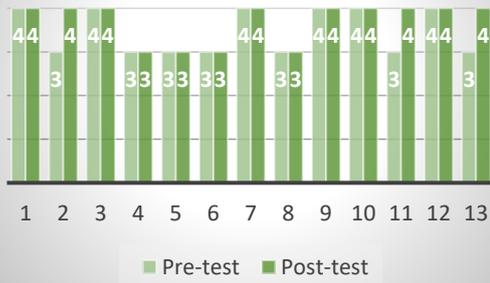


## Appendix B

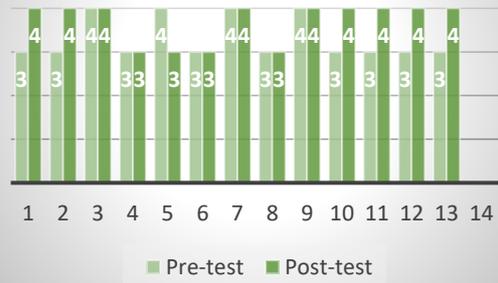
Results of typical students after the intervention program



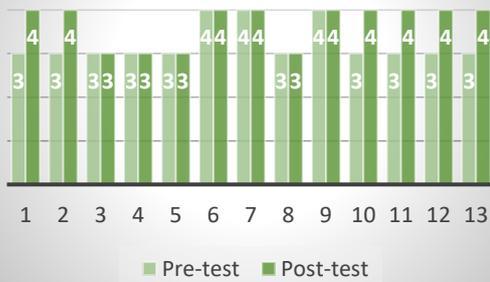
### Student 5



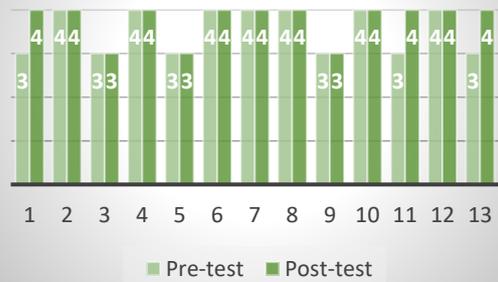
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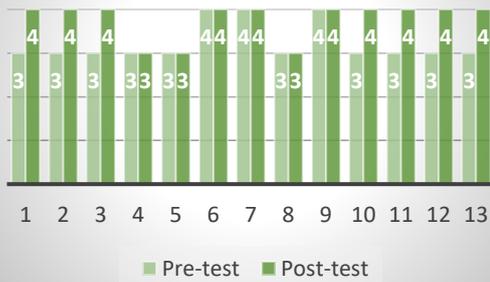
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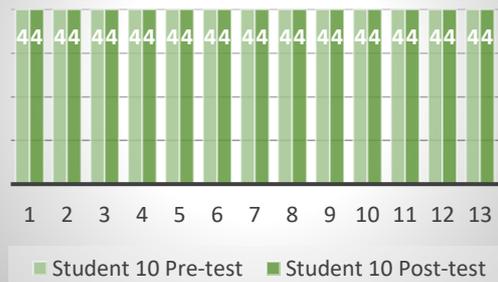
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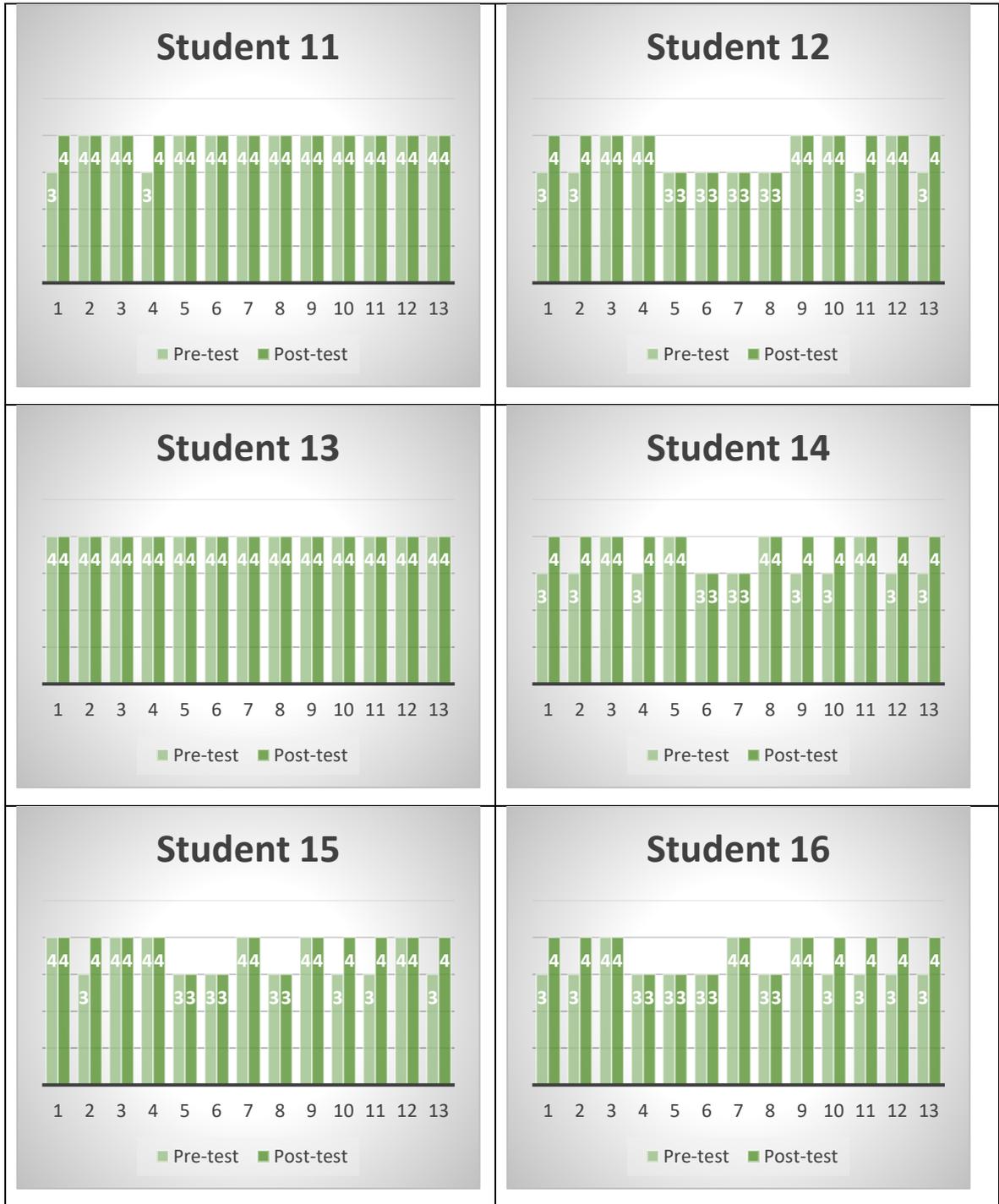


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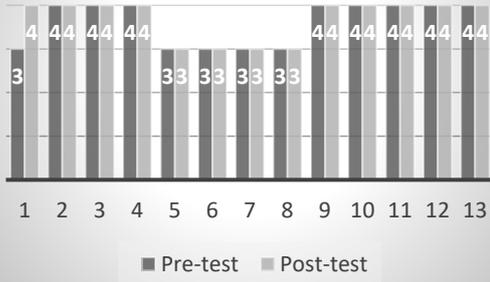
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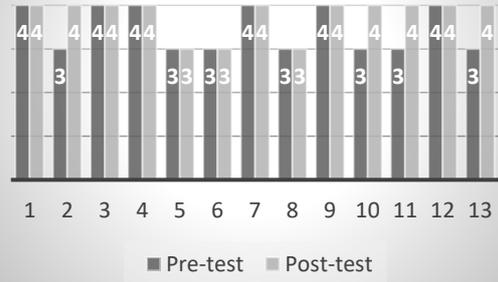


Results of typical students after the curriculum program

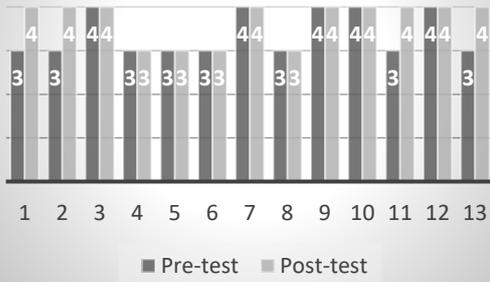
### Student 1\_c



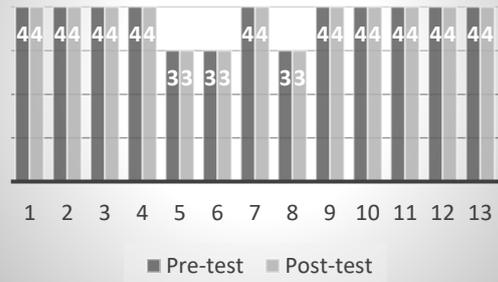
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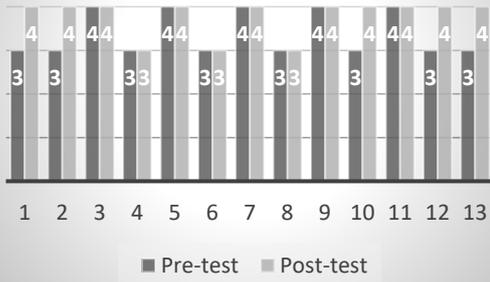
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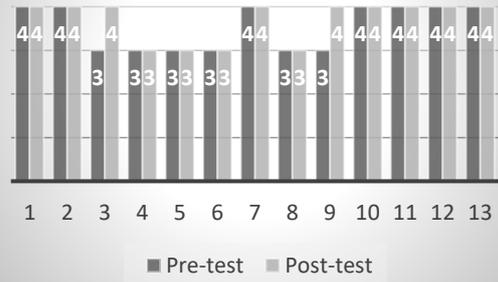
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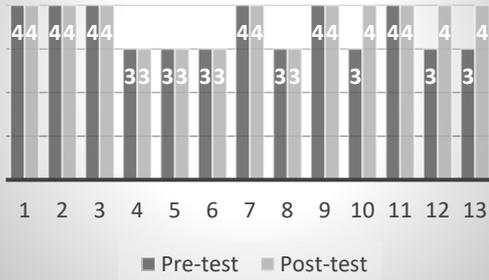
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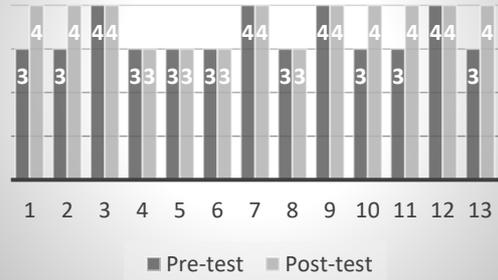
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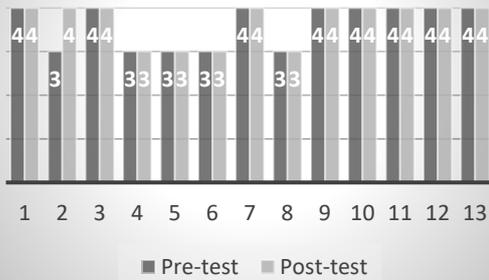
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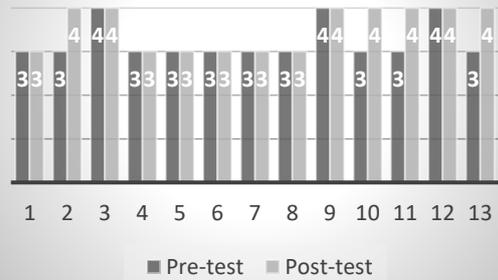
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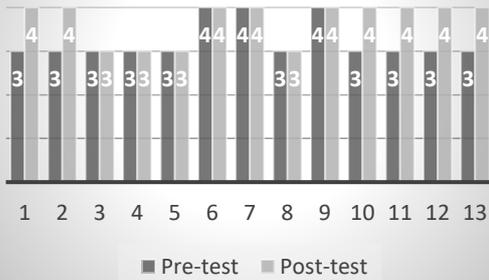
### Student 9\_c



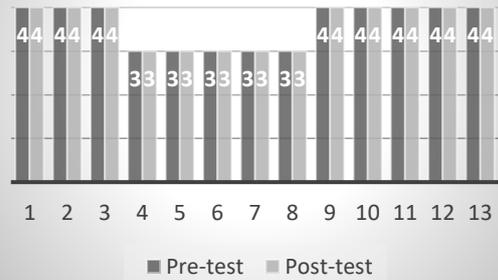
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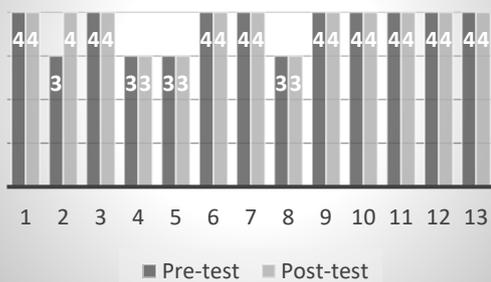
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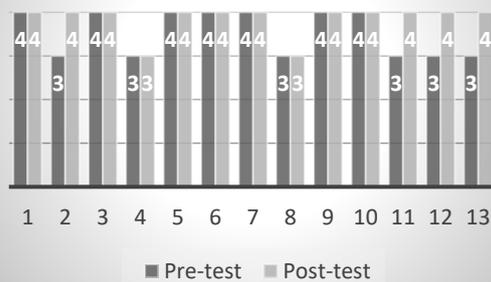
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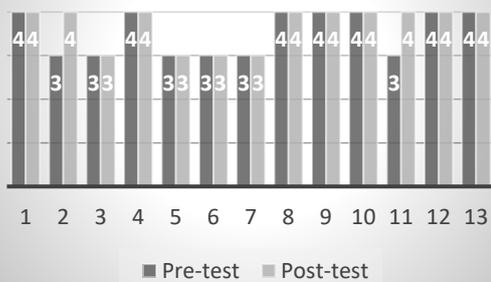
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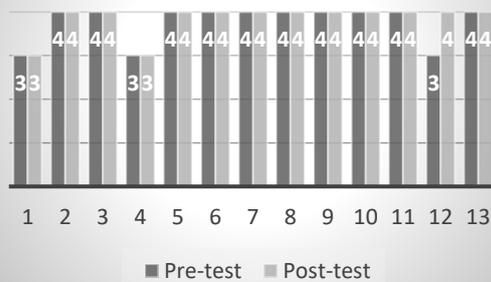
### Student 14\_c



### Student 15\_c

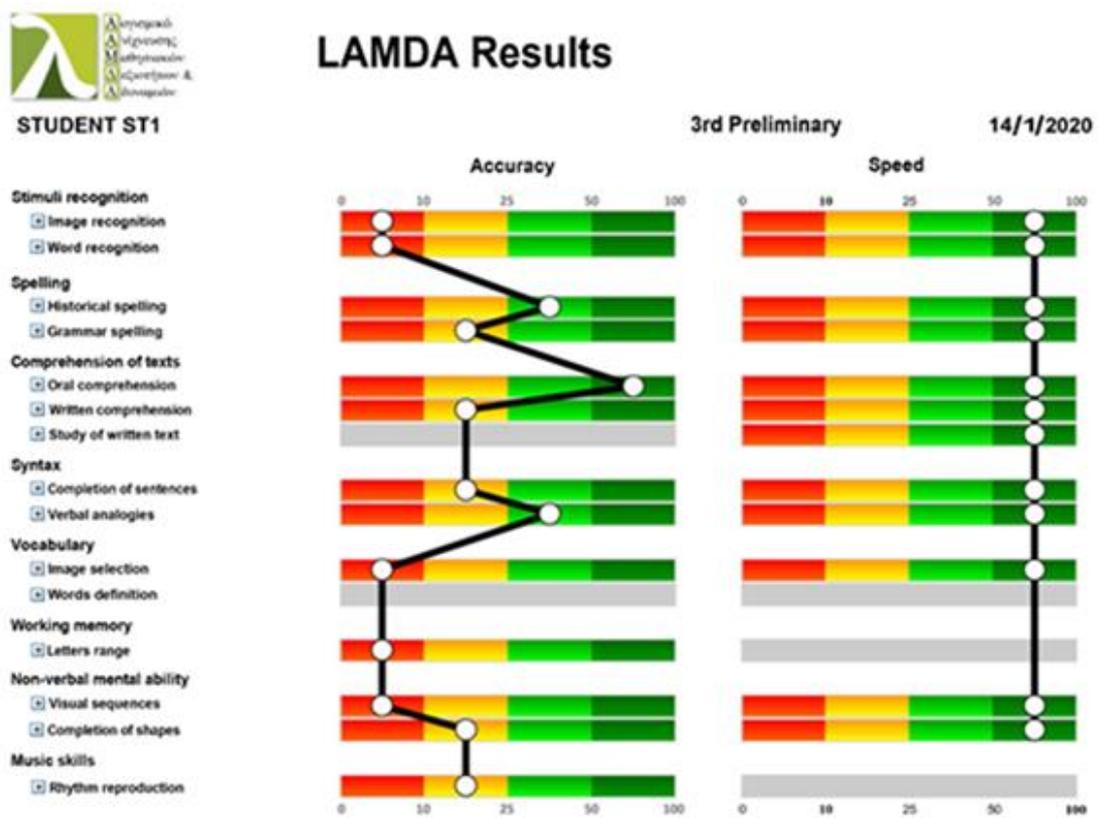


### Student 16\_c



## Appendix C

Exemplary LAMDA assessment test (tentatively translated to English by the author)



- In the accuracy chart, red denotes more errors than the 90% of classmates, yellow denotes more errors than the 75% of classmates.
- In the speed chart, red denotes slower than the 90% of classmates, yellow denotes slower than 75% of classmates.
- The LAMDA performance profile does not constitute a diagnosis. It provides indications of limited reliability which should be evaluated by qualified personnel.