THE VICARIANT FUNCTION OF MUSIC IN THE DESIGN OF A GRAPHIC-MUSIC ALPHABETISER FOR STUDENTS AT RISK OF DYSLEXIA
LA FUNZIONE VICARIANTE DELLA MUSICA NELLA PROGETTAZIONE DI UN ALFABETIERE GRAFICO-MUSICALE PER STUDENTI A RISCHIO DI DISLESSIA

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ABSTRACT

The contribution proposes the description of an alphabetiser designed for Primary School students and integrating the graphic medium with the musical medium. It presents the vicarious function of music in the alphabet, i.e., taking on a different function from the original one. Specifically, in the alphabet box, music becomes a support tool for the acquisition of reading-writing skills, respecting the different cognitive styles of the pupils, in an inclusive perspective.

Il contributo propone la descrizione di un alfabetiere destinato a studenti della Scuola Primaria ed integrante il mezzo grafico con il mezzo musicale. Presenta la funzione vicariante della musica nell'alfabetiere, ovvero assumente una funzione diversa rispetto a quella di origine. Nello specifico, nell'alfabetiere la musica diviene strumento di supporto per l'acquisizione di abilità di letto-scrittura, nel rispetto dei diversi stili cognitivi degli allievi, in prospettiva inclusiva.

KEYWORDS
Music, vicariance, dyslexia, graphic-musical alphabet, assistive technologies
Musica, vicarianza, dislessia, alfabetiere grafico-musicale, tecnologie assistive

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1. Introduction

The present work aims to present music as a vicariant tool in a graphic-musical alphabetiser.

This alphabet was designed considering that the current school context presents a plurality of students with specific needs as well as specific learning styles. By virtue of these traits, therefore, teachers must respond to students' individual needs and difficulties, adapting from time-to-time methodologies and teaching materials that meet the cognitive and learning styles of each individual learner, also and above all through alternative and *non-linear* approaches (Sibilio, 2015)

In this perspective, the aim of inclusive education is precisely that of searching for non-rigid ways of transmitting knowledge, but based on non-linearity, in which components such as biology and culture come into play (Frauenfelder 2001, 2018), which interact and constantly change people and contexts, leading those who act didactically to assiduously transform their operating methods, by virtue of the diversifications provided by the system. The construction of knowledge becomes interacting, innovative, and makes pedagogical operativity and didactic action possible at the same time.

The same didactic methodologies can be applied according to a different scheme from the one originally possessed. In this sense, the construct of vicariance comes into play.

Vicariance means precisely finding diversified strategies to be able to adapt flexibly to a changing environment, characterised by the fluid, by the elusiveness of what constitutes it and which, precisely because of sudden changes, requires the subject to be able to search for suitable strategies to be able to adapt to what surrounds him (Berthoz, 2015). As Sibilio (2017) points out, by analysing the same construct and proposing a declination of it in didactics, vicariance implies, for the teacher, the identification of new trajectories to follow to improve the learning processes of his or her students, while respecting their singular cognitive styles and potentialities. The teacher has the arduous task of finding more paths, perhaps not yet explored, to flexibly adapt to his or her students, respecting their individuality, guiding them towards educational success through an education that is not founded on the mere transmission of knowledge, but on the construction of their own life project (Pavone, 2008), in the perspective of lifelong learning.

The graphic-musical alphabetiser that we intend to present precisely has the objective of using music with a function other than the aesthetic one, i.e., aimed at

adapting to the different cognitive styles of the child, to his or her peculiarities, to lead to an improvement in the discrimination of the letters of the alphabet. This can be especially useful in work with students with dyslexia. In the first section of the paper, a description of the construct of vicariance and the polysemy of its meaning will be presented; this will be followed by a description of the vicariant potential of music applied in didactic; the last section of the paper will focus instead on the description of the graphic-musical alphabetiser, drawing in the conclusion on how music in it assumes a vicarious function.

2. The polysemy of term vicariance

The term vicariance derives from *vicarius*, which literally means "*substitute*", and which recalls the Latin word *vicis*, i.e., "*change*". Vicariance represents "*a creative deviation made possible by diversity*" (Berthoz, 2015, p. XIV). It represents an instrument at the disposal of living beings, characterised by a multiplicity of meanings, for example to the ecclesiastical practice of the *vicar* as a substitute for the bishop (able to take over his powers, except for the strictly spiritual ones, which are the responsibility of the Church, such as the ordination of priests). Vicariance, moreover, can refer to the social area, indicating the capacity of everyone to assume attitudes of tolerance, generosity, acting with the other in a flexible manner, in order to find solutions to different problems, or using the solution of a given problem to address a different one. The description stressed a fundamental aspect: organisms, as well as human beings, can change their functions to achieve certain goals, also on the basis of the different relationships that are built when both biological and contextual conditions change, and which often generate dysfunctions that need to be corrected. The vicariant process, therefore, becomes a mode of *adaptation* and *learning*, through which everyone, *drawing on past experiences*, finds the way through which to *project himself* towards future actions, recognising in the actions already implemented other ways of applying them to different situations and problems.

According to Berthoz (2015), vicariance can be twofold: *functional* and *of use*. Starting with the first type, it indicates the ability of living beings to achieve the same purpose through a plurality of different functions. For instance, when one wants to reach a place with the help of a “GPS” or a traditional map, one can choose between several actions aiming at a single end. At the same time, one identifies the *vicariance of use*, i.e., the possibility of being able to use the same object or element to perform several different functions or substituting another to perform the same task. Human beings can also take on several functions. For example, a doctor who can also be a family man at the same time, or the shopkeeper who can become an

informant when giving directions when required (Berthoz, 2015, p. 11). What causes the object to change is the social context in which it is placed, and which changes its original function, readjusting it to the new emerging needs. Of course, vicariance is a concept adaptable to different fields, from ecology to biogeography, and is applicable to multiple objects, even to the human body itself and the gestures made with it, for instance through the substitution of a particular organ in place of another to compensate for dysfunctionality.

Vicariance, moreover, according to Berthoz, offers the opportunity to "*give the subject the freedom to find his own path [...] means recognising everyone's diversity*" (Berthoz, 2015, p. 129). Everyone has their own way of learning and, as the author adds, "*the challenge for learning and teaching is not to find the good method, but to discover the most appropriate method for each brain*" (Berthoz, 2015, p. 132). This implies, in the educational sphere, the recognition and valorisation of differences, understood as a resource, as elements of positive singularity and originality, constitute one of the fundamental values of the inclusive teacher (Aiello, 2015).

Sibilio (2017), referring to the potential that this paradigm to design teaching and inclusive actions, recognises that this modus operandi can serve the function of *building contexts* that respond to the different needs emerging from learners. Firstly, it recognises the need for a vicarious process when a teacher has the arduous task of aligning his or her teaching action with the needs of his or her learners, identifying strategies that respond to their individual needs, including their different potentials. This operational process is rooted in the practice of didactic transposition (Chevallard, 1985, p. 39), i.e. in the teacher's ability to convert his own possessed knowledge into knowledge transmitted to his students, with a initial identification of their personal and varied cognitive and learning styles, in such a way as to make knowledge flexibly adaptable to all, following *non-linear trajectories* (Sibilio, 2014; Sibilio Zollo, 2016), with the use of possible variations of action where necessary (Berthoz, 2011). This mechanism can transform the learning environment from *complex* to *adaptive* (Gell-Mann, 1992), through specific adaptation rules, which ensure a good coexistence between various interacting biological systems, due to specific characteristics of each (Sibilio, 2017, p. 19). In this sense, vicariance would be understood as a possible principle for the improvement of inclusive didactics implying the teacher's search for new solutions and operational strategies, *flexible*, through the simultaneous *inhibition* of immediate solutions, apparently simple and consolidated in practice, allowing the teacher to find, in the complexity of the teaching system, tools to be able to

guarantee the learning process for all, giving rise to inclusive and non-marginalising didactic process.

Sibilio, moreover, recognises in the learner-teacher relationship a possible third way to vicariance, that is, *inter-individuality* (Sibilio, 2017, p. 25), given by the *mutual action of teacher and learner*, or by peers themselves for the construction of knowledge and the development of competences. In the teaching-learning process, the teacher becomes simultaneously the *learner of his own learner and then the teacher of his own learner*, just as the learner becomes simultaneously the teacher of his own learner as well as the learner of his own teacher. The interchange of functions, characterised by a flexibility of *roles*, of changing *interactions*, of mutually reversing functions, makes the very function of teacher and learner *vicarious*. In an inclusive perspective, the teacher's ability *to take the learner's perspective*, *to grow and learn through the needs* shown by his student, especially if he has special needs, is the key to realising actions that are truly inclusive and attentive to the needs of the individual.

The interchange generated, moreover, during the *vicariant inter-individual action*, offers the actors of the educational, teaching-learning process the possibility of *co-acting* and *co-evolving* (Rivoltella & Rossi, 2017) while respecting the characteristics of others as well as personal individuality and freedom, generating inclusive contexts, in which the fundamental centre of the system is given by the *autonomy of being able to express one's own potential for action*, in the knowledge that any gaps or difficulties can be filled by the intervention of one's peers or one's teacher, support for overcoming one's limits (d'Alonzo, 2018). It is no coincidence that the ICF focuses on the role of the teacher, who can become both facilitator and barrier for his or her learner, depending on the way he or she interacts, depending on the way he or she organises his or her materials and chooses the correct teaching methodologies, taking care that they meet the needs of the children. The teacher, therefore, becomes a promoter of his learners' learning through an effective didactic *re*-modelling, *child-centred*, based on the latter's personal abilities (Aiello et al., 2013).

This offers a new perspective, since vicariance would seem to assume its own value also in the compensation, from an educational point of view, of those abilities lacking in subjects with special needs. Learning environments consequently become social spaces in which man becomes able to modify himself, build new relationships, both *physical* and *mental* (Rossi, 2011). Learning itself becomes social, a tool for establishing relationships, building extensive relationships even beyond the school environment, in everyday life. The skilful construction,

therefore, of educational contexts following the trajectory of vicariance, would turn out to be an effective operational model to guarantee the child the development of personal, social skills, for a correct inclusion in the *flow of society*.

3. Vicariance and music in didactics

Kandinsky, in the text *Point and Line to Plane* (2004), leads a reflection on music and its characteristic traits. Starting his study from the point and its significance within the arts, the author confers a section of the work to understanding the extent to which music can support the production of graphic and pictorial art. Firstly, he recognises how music is able to produce points in a plurality of ways, through the use of the most varied musical instruments, while highlighting how the piano is able to generate melodies through the combination and succession of sound points. The association of the points gives rise to the line, which makes it possible to identify the timbre, whose intensity (from pianissimo to fortissimo) depends on the sharpness of the line itself and its degree of brightness, while the tempo depends on its colour. The unity of the lines also generates the staff, which defines the pitch of a specific note according to its position. From this first description, a possible reflection can be outlined: music, which represents an artistic discipline, is able through its structural elements to *generate other art and in art itself to take on several functions*, several meanings, depending on the way its constituent objects can be used. The musical point takes on several functions and yet is unique, as is the case of the line, which diversifies in its tasks according to the context in which it is inserted and according to the characteristics it takes on in it. Thus, the perspective of a musical vicariance seems to emerge, generating multiple functions with a reduced selection of objects.

Music and art are instruments with vicariant potential, because they can act as cultural, historical, training devices, capable of guiding men and women to the development of thought, to the capacity to recognise beauty, while at the same time identifying the value of their territory and the culture they represent. For this reason, music becomes an effective didactic *mediator* to work with students with Special Educational Needs, as its function would not be limited to just listening, but to being interconnected with a variety of other disciplines, as it can be flexibly adapted in activities belonging also to different operational domains. The *power of music* is not only *evocative* but also operational, capable of acting as a stimulus to *creativity*, to *divergent thinking*, to the possibility of *creating possible worlds* (Aiello, 2017) through a transformative process in which the sound element can, by means of a functional *transfer*, lead to the valorisation of differences, a fundamental objective of special pedagogy.

It is also possible to recognise in the studies that the philosopher De La Garanderie (1989) carries out on listening, auditory perception, and gesture, both physical and mental, how these can develop, through a single channel, a plurality of functions, among which attention, memorisation, comprehension, the construction of new meanings and imagination stand out. Therefore, sound becomes the instrument through which to mature skills or reinforce them if these are particularly lacking. In the same fixation pathway that information takes, the author recognises a starting point on the perceptive type of encoding, to then move on to the cerebral one, through which the brain maintains the information, transforming it into an evoked mental image. Music, therefore, like art, is not merely an aesthetic element, but a tool for developing reflexive and mental skills. It is no coincidence that Gardner speaks of *mental stretching*, referring to the potential that music can have under the cognitive profile in people who use it as a communication tool (Gardner, 1987). Music becomes a *training ground for the mind*, a way to stimulate the human being to forms of cognitive enhancement, able to keep the thinking constantly trained. It operates directly on the emotionality of the subject-agent, as it guarantees significant work on the self and one's personality, which consequently also improves one's relationship with the other, making man more inclined to relationship and sociality with those around him (Sloboda, 2002), avoiding attitudes of social withdrawal and isolation (Concina, 2019). The result, therefore, is an adaptive function and flexibility guaranteed in music and with music. This is a further example of how music is a vicarious medium capable of operating on multiple levels, from the personal to the interpersonal, and how the vicariant application of music is further useful in working in didactics with students to ensure their personal and relational improvement.

Berthoz's (2009) studies on critical periods in child development, and with reference to Gitelmann's story of the weeping camel, the author analyses how a camel that is about to give birth and has complications often tends to be detached from her child in the post-natal period, and this can result in imprinting being impaired. Through listening to the sound of the violin, the camel is moved and regains that affection for her baby. Music, therefore, has a therapeutic effect on the camel and can activate, through sound, both a cerebral and emotional mechanism that triggers the animal's affective response. Music takes on the function of a re-educational tool towards affectivity. Stramaglia himself (2021) recognises how music can also have a spiritual value, to dilute the emptiness that human beings feel in the separation from their primary instance, e.g., their mother, their land, their true love, making the subject able to conceive of themselves as sharing in the other.

Wanting to focus more on the educational side, there are numerous studies analysing how music can support various disciplines to ensure that students acquire certain skills, especially when characterised by Special Educational Needs. There are analyses that show how music can support learners in the development of phonological awareness (Vidal et alii, 2020), or is a support for the creation of social relationships in the classroom, *flexibly adaptable* to peer-to-peer methodologies to increase competences in students with severe disabilities (Draper et alii, 2019) or with functioning disorders (López et alii, 2018). Music, notes, instruments, assume different functions for the creation of activities aimed at the acquisition of reading, writing and calculation skills, in an *inter* and *trans*-disciplinary perspective (Chiappetta Cajola, Rizzo, 2016). Furthermore, the vicarious potential of music could be identified when it becomes a means of constructing learning environments. The musical element no longer has a mere accessory function or merely enhances the physical space but is characterised as a preponderant tool for the architecture of operational settings (Szymańska-Stulka, 2019). An example is given by Music Design. Underlying this design is the idea of constructing entirely musical environments, which partially replace the physical, to ensure that students, especially those with disabilities, are fully immersed in a space that is designed to enhance their learning process, based on an organisational structure in which sound becomes part of the environmental design (Ölgen, 2020). Music, moreover, assumes a stimulating function in relation to new technologies, in the era of Mobile Learning, as it allows sensory stimulation as well as the creative and didactic involvement of the learner (Ciasullo, 2021).

Music, therefore, while retaining its original function, becomes a highly flexible tool that can be used in multiple contexts, taking on different functions. The peculiar elements of this art, such as the notes or the musical instruments themselves, can be used in a plurality of different ways, to implement skills, cognitive functions, social and psychological functions in the subjects who enjoy them. The result, therefore, is further diversified functions of the same, which allow us to understand even more its vicariant function, and how this function is necessary to build, with music, not only inclusive activities, but also environments of a hybrid nature, halfway between reality and virtuality.

Music becomes a true *Umwelt* in which the subject, bearer of needs, can immerse himself, manipulate his knowledge, using the sensory and auditory channel to do so. The Umwelt takes on a double meaning, compared to that of environment, referring both to the modes of action by which the subject perceives the things that are in the world, and the way in which the things that make up the world allow the

subject experiencing them to adapt to it (Aiello, 2017, p. 270). This implies that music evolves as a flexible, adaptive, and adaptive tool for each individual subject, a tool for enjoyment and immersion, due to its adaptability in any time and context (Ruitz, 2020). This vicariant function of music, therefore, respecting the individuality, the singularity of each actor in the educational process, as well as the changing educational conditions in place, would make it a *multifunctional tool*, respectful of each student and their individuality, their *Umwelt*, in full compliance with the principles of *personalisation* and *individualisation*, which represent the concrete application of the inclusive process.

4. Presentation of a graphic-musical alphabetiser

4.1. Research questions and objectives

The research questions from which the project was initiated are:

- How is it possible to guide the pupil with dyslexia, during the Primary Education period, to enhance reading skills? What tools can be used to implement educational action in this regard? - How can music be integrated with the virtual to improve this basic skill?

The objectives are:

- To research intervention tools that integrate technology and sensory manipulation, especially through music, to improve reading skills in students with dyslexia. - Check and analyse the possibility of making the pupil use these tools in a simple way, with a view to study autonomy.

4.2. Project Phases

Once the research questions and objectives had been defined, a possible subdivision of operational phases was drawn up, threefold as follows:

The first research phase was focused on the analysis with respect to tools and materials already present or presented on an experimental basis, aimed at students with Specific Learning Disorders, specifically dyslexic, using music as a means of improving reading-writing skills.

Initial research has shown that there are instruments on the market aimed at supporting children in the acquisition of grapheme-phoneme correspondence, structured according to the letter-melody or letter-animal verse association mode. With reference to music, all the instruments analysed present a letter-song or letter-sound association type of musical instrument. Therefore, no tools were

found that specifically work on letter construction using musical notes by recognising the constituent lines of the letters of the alphabet associated with specific musical notes or triads. International experimental studies (Rauschenberger et alii., 2017; Leloup et alii, 2021) have shown that the implementation of tools that integrate new technologies with music, not only in terms of songs or listening to the sounds of musical instruments, but rather listening to individual notes and the rhythm associated with them, produce beneficial effects on pupils with dyslexia, both phonologically and rhythmically, as listening to the sound corresponding to a letter and working with rhythm induces improvements in vocal emission, letter memorisation and correct rhythmic execution. The technological medium is also particularly appreciated by the children.

These suggestions led to the design of the graphic-musical alphabetiser. The alphabetiser is designed to attempt to support the child at risk of dyslexia in acquiring basic reading skills, while respecting his or her learning style, as it is suitable for a type of learning based on auditory, visual, and digital stimuli (the graphic-musical alphabetiser uses Scratch as a transmission system), which is also suitable for the student who learns by unifying the various channels simultaneously. It is therefore proposed to offer a unique but adaptable medium, capable of tracing different operational trajectories to achieve the same objective: the improvement of the learner's reading skills.

The second phase of the work, which is currently being concluded, is dedicated to the design of the graphic-musical alphabet. For the realisation of the alphabet, Scratch.mit.edu was chosen, an open-source web platform, easily accessible and usable by both teachers and students. It proves to be a good technological mediator as it enables direct manipulation by the pupil, the direct design of objects, as it is based on the association of logical blocks, in a manner like construction and close to the child's way of working.

In the graphic-musical alphabet the prototype letters are designed according to a demonstration system in which the student, by pressing on the green button of the Scratch Stage, will see a pencil appear, which will encourage him to practise reading the letters of the alphabet through music, inviting him to see how they can be realised. The student can then, at first, observe how the software realises the letter, while listening to the chords associated with it (**Fig 1 and 2**).

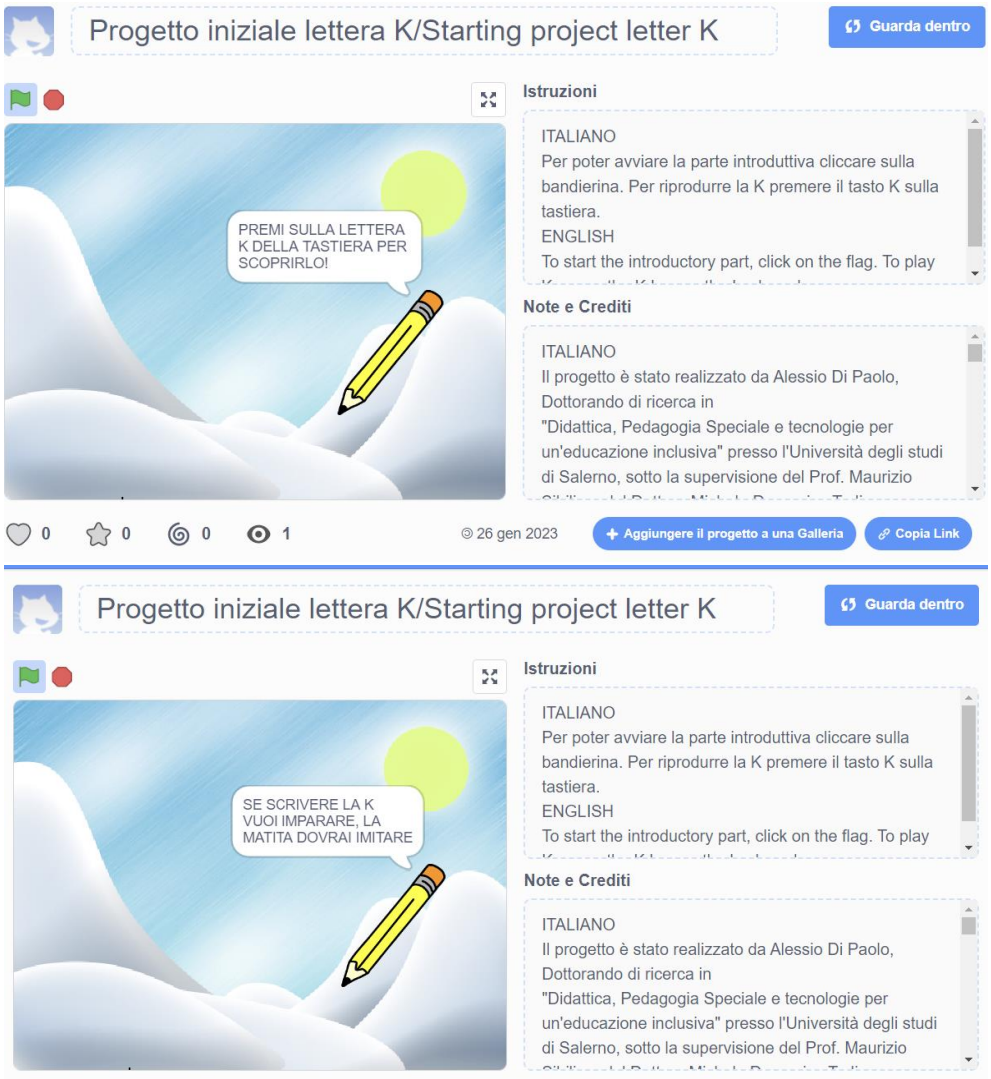

Fig 1, Fig 2 Screen showing the prototype letter encouraging the student to learn how to write and read the corresponding letter.

At a later stage, the student is expected to recognise the letter independently, with the support of the associated musical notes (**Fig 3 and 4**). The project also focuses on the construction of capital letters, as these are the first to be learnt during the initial work phases in Primary School and are often repeated in later years, when a student has reading problems, such as difficulty recognising lowercase or cursive letters.

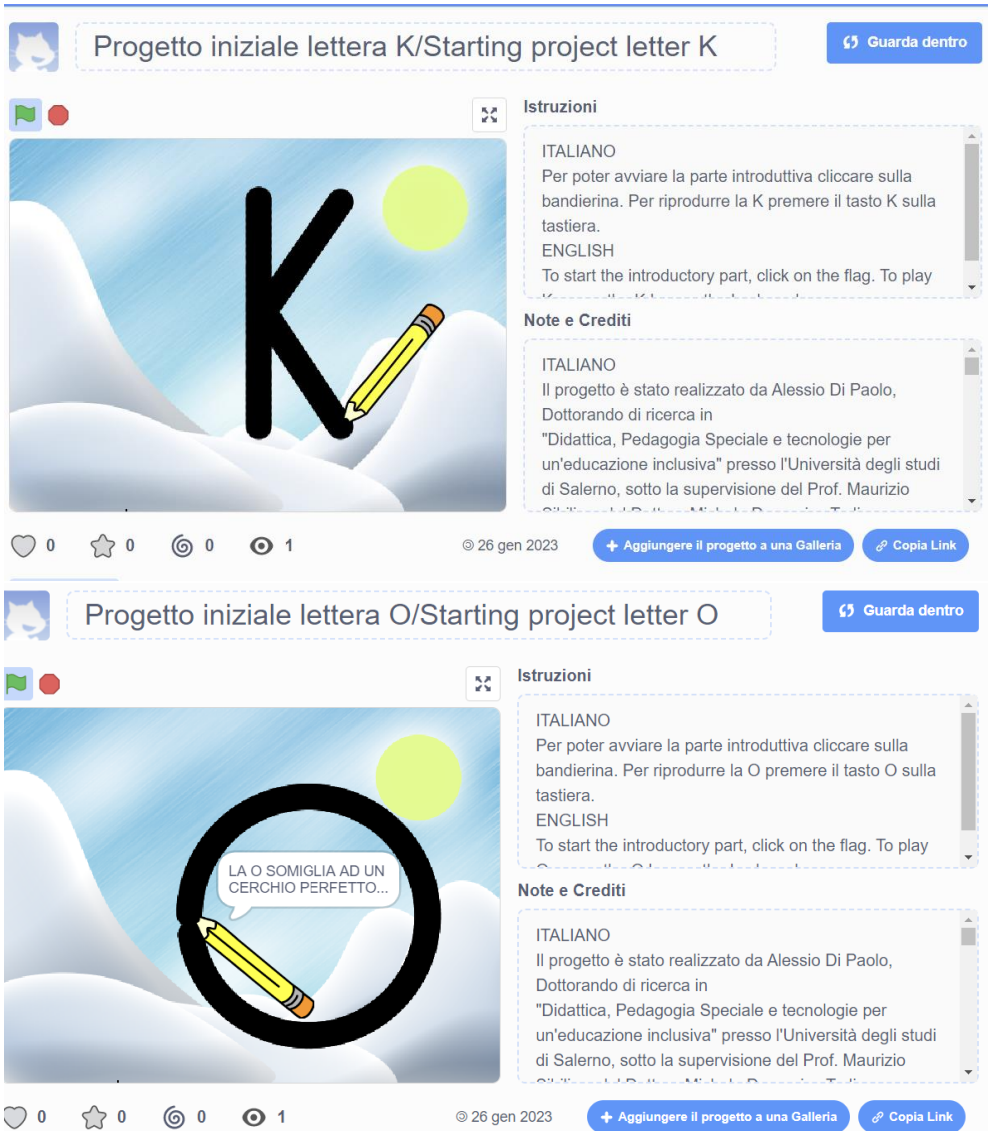

Fig 3, Fig 4 Screen presentation of the pencil making the prototype letters straight and curved.

The final project phase, planned by A.Y. 2022/2023, envisages that the prototype letters will be tested within the first/second classes of the primary school, to verify the actual effectiveness of the tool on all students, specifically dyslexic students.

4.3. Letter design

Since each letter of the alphabet is generally composed of the union of straight and curved lines, the initial design stage focused on their percentage of use in the composition of the letters of the alphabet. The analysis showed that as far as the percentage of straight lines is concerned, the straight line with downward orientation has a usage percentage of 35%, while the straight line with right orientation has a usage percentage of 30%. Regarding the use of straight lines with an oblique orientation, the straight line with top right orientation has a usage percentage of 12%, the straight line with bottom right orientation of 21%, the straight line with left orientation of 2%. About the creation of curved lines, it should be noted that the left-facing curved line has a usage rate of 54%, the right-facing line 33%. The downward-facing curve has a percentage of 8%, the curve starting at the top left and converging at the top right has a frequency of 7%. Based on the percentage, musical notes were assigned, taking care that the lines with the highest percentage corresponded to the association of a musical note representing the harmonic base for the construction of major chords (**Fig 5**), particularly appreciate by students (Mado Proverbio, 2019).

Alfhabet Letter	Corresponding musical note or chord	Alfhabet Letter	Corresponding musical note or chord
A	C-E-G	**N**	D-E-A
B	C-F#-F#	**O**	C#-F#
C	B	**P**	C-F
D	C-F#	**Q**	C#-F#-Bb
E	D-A-A-A	**R**	C-F#-E
F	D-A-A	**S**	Bb-F#
G	B-C-G	**T**	A-D
H	D-A-D	**U**	D-B-D
I	D	**V**	E-C
J	C#	**W**	E-C-E-C
K	D#-C#-G#	**X**	E-G
L	D-A	**Y**	E-G-D
M	D-E-C-G	**Z**	A-G-A

Fig 5 Alphabet letter and relative major chords

Another important element of the alphabet is the way in which the grapheme, the letter, is structured. Cornoldi (2010) states that the cognitive processes involved in reading depend above all on the way the grapheme that makes up the letter is written and its characteristics. The choice of a good font can be useful for speeding up and improving the reading mechanism in dyslexic students, based on parameters such as letter spacing, shape and size (Di Tore, 2016). For the alphabet, a sans-serif font was specifically used, as it has no graces, which could create reading difficulties in the child. In fact, the preference was for the Arial font, one of those most suggested by the British Dyslexia Association. Preference was given to the use of a simple font that maintained a clean and dry style. The choice of the classic font, with no more pronounced sections than others, also simplifies the approach and memorisation of the letter.

4.4. Participants and timeframe

The project involves experimenting with the alphabet in the first/second classes of the primary school. In the first phase, an exploratory trial of the alphabet book on the entire class group is planned, to also verify the effect that the use of this tool can have on all pupils. The selective criterion will be preference for classes with pupils with reading difficulties, at risk of dyslexia, aged between 6 and 7, under the guidance of headmasters and curricular and support teachers. The project will be presented in schools in the Salerno and Naples areas, in agreement with the Department of Human, Philosophical and Educational Sciences of the University of Salerno. It is envisaged that the alphabetiser will be tested by A.S. 2022/2023, with the corresponding collection of data on the improvement of reading skills. The experimentation envisages an initial stage in which the pupils' reading skills will be tested with the aid of a tachistoscope, a digital instrument for measuring the speed at which they read letters, syllables, or words, calculating the number of errors made. Having collected initial data on the reading speed of few letters, in a fraction of 10-20 seconds, the graphic-musical alphabetiser will then be presented through lessons, organised in weekly meetings for 3 months (approximately April-May). In a final phase, the pupils will be asked again to read the letters through the tachistoscope, to check both the possible increase in reading speed and the possible reduction in the number of errors, following the presentation of the graphic musical alphabetiser.

Conclusions

From the description conducted it emerges how music, depending on its use, can take on different functions, not necessarily linked to the sphere of beauty, its

purpose being to create pleasure in whoever listens to it, anchoring to a mere aesthetic dimension. Music presents itself as a medium that can combine with other media to support the development of specific skills, depending on the recipients. In the case of the graphic-musical alphabet, sound is associated with the visual, the graphic, to become support in the acquisition of reading-writing skills in students at risk of dyslexia. In addition, the musical medium, combining with the technological medium, also has an aesthetic function, in that it creates pleasure and stimulates the child who enjoys it. In these terms, therefore, music becomes vicarious, thus assuming different functions while being the only medium of use. A possible use of the musical element, tailored to the student, adapted to his or her needs in terms of cognitive and learning style, could be a valid support for a didactic aimed at the individual and his or her peculiarities. In the alphabet, there are three means at the same time, precisely the graphic sign, the sound, and the digital. This could allow for meaningful learning as well as enabling the development of transversal skills related to listening and visual stimulation. The graphic-musical alphabet, therefore, could be an inclusive medium that could be used in school contexts in which there are not only students with dyslexia, but also students who need to make use of different learning media in order to learn, to learn according to a non-linear modus operandi, respectful of the individual, of individual characteristics, of personalised learning based on the person and what distinguishes him or her from others in terms of learning.

References

Aiello P., Di Tore S., Di Tore P. A. & Sibilio, M. (2013). Didactics and simplexity: Umwelt as a perceptive interface. *Educational Sciences & Society*, *4,* 27-35. http://riviste.unimc.it/index.php/es_s/article/view/709/489.

Aiello P. & Di Tore S. (2015). *Traiettorie non lineari della didattica speciale*. Disponibile su*:* http://www. traiettorienonlineari. com/bologna/wp-content/uploads/2015/07/aiello. ditore.pdf.

Aiello P. (2017). *Creare mondi possibili. Una sfida per la pedagogia dell'inclusione.* In Sibilio M. (2017). *Vicarianza e didattica*. *Corpo, cognizione, insegnamento*. Brescia: La Scuola.

Berthoz A. (2009). *La semplessità*. Torino: Codice.

Berthoz A. (2015). *La vicarianza: il nostro cervello creatore di mondi*. Codice: Torino.

Chevallard Y. (1985) *La transposition didactique. Du savoir savant au savoir enseigné, La Pensée Sauvage.* Grenoble.

Chiappetta Cajola L. & Rizzo, A. L. (2016). *Musica e inclusione. Teorie e strumenti.* Carocci: Roma.

Ciasullo A. (2021). La sonorità nel Mobile Learning. *Journal of Inclusive Methodology and Technology in Learning and Teaching*, *1*(1). https://inclusiveteaching.it/index.php/inclusiveteaching/article/view/16.

Concina E. (2019). *Bisogni educativi speciali e didattica della musica. Indicazioni teoriche, obiettivi, strategie operative e di valutazione*. Roma: Carocci.

Cornoldi C. (2017). *Le difficoltà di apprendimento a scuola*. Bologna: Il mulino.

D'Alonzo L. (2018). *Pedagogia speciale per l'inclusione* (pp. 1-256). Brescia: Morcelliana.

De La Garanderie A. (1989). *Défense et illustration de l'introspection. Au service de la gestion mentale*. Parigi: Centurion.

Di Tore S. (2016). *La tecnologia della parola. Didattica inclusiva e lettura*. Milano: Franco Angeli.

Draper E. A. Brown L. S. & Jellison J. A. (2019). Peer-interaction strategies: Fostering positive experiences for students with severe disabilities in inclusive music classes. *Update: Applications of Research in Music Education*, *37*(3), 28-35. DOI: http://dx.doi.org/10.1177/8755123318820401.

Frauenfelder E. (2001). *Pedagogia e biologia: una possibile "alleanza"*. Napoli: Liguori.

Frauenfelder E. (2018). *Perché una relazione tra pedagogia e biologia*. Napoli: Sezione RTH Brain Education Cognition.

Gardner H. (1987). *Formae mentis. Saggio sulla pluralità dell'intelligenza.* Milano*:* Feltrinelli.

Gell-Mann (1992) Complexity and Complex Adaptive Systems*. The Evolution of Human Languages. Santa Fe Institute Studies in the Sciences of Complexity*. n.11. https://resolver.caltech.edu/CaltechAUTHORS:20150924-152125116.

Kandinsky W. (2004). *Punto, linea, superficie: contributo all'analisi degli elementi pittorici*. Milano: Adelphi.

Leloup G., Anders R., Charlet V. Eula-Fantozzi B., Fossoud C. & Cavalli, E. (2021). Improving reading skills in children with dyslexia: Efficacy studies on a newly proposed remedial intervention- Repeated reading with vocal music masking (RVM). *Annals of Dyslexia*, *71*(1), 60-83. DOI: https://doi.org/10.1007/s11881-021-00222-4.

López G. Quesada L. & Guerrero L. A. (2018). *Alexa vs. Siri vs. Cortana vs. Google Assistant: A Comparison of SpeechBased Natural User Interfaces.* In I. L. Nunes (Ed.), *Advances in Human Factors and Systems Interaction*. New York: Springer International Publishing.

Mado Proverbio A. (2019). *Neuroscienze cognitive della musica. Il cervello musicale tra arte e scienza.* Bologna: Zanichelli.

Ölgen B. (2020). A literature review on the use of music in architectural design education. *Design and Technology Education: an International Journal*, *25*(2), 74-88. https://files.eric.ed.gov/fulltext/EJ1265252.pdf.

Pavone M. (2008). Il progetto di vita per lo studente disabile. *L'integrazione scolastica e sociale*, *7*(2), 120-125.

Rauschenberger M. Rello L. Baeza-Yates R. Gomez E. & Bigham J. P. (2017). Towards the prediction of dyslexia by a web-based game with musical elements. In *Proceedings of the 14th International Web for All Conference* (pp. 1-4). DOI: http://dx.doi.org/10.1145/3058555.3058565.

Rivoltella P. C. & Rossi P. G. (2017). *L'agire didattico. Manuale per l'insegnante*. Brescia: La Scuola.

Rossi P. G. (2011). *Didattica enattiva. Complessità, teorie dell'azione, professionalità docente*. Franco Angeli: Milano.

Ruiz A. B. (2020, August). Digital technologies in the music classroom to support equity and inclusion in secondary school. *34th World Conference on Music Education* (p. 80). DOI: http://dx.doi.org/10.1017/S0265051711000039.

Sibilio M. (2014). Le simplexité en didactique. In Berthoz, A., Petit, J.L. (2014). *Complexité-Simplexité*. College De France, 217-225. DOI: 10.4000/books.cdf.3339

Sibilio M. (2015). Simplex didactics: a non-linear trajectory for research in education. *Revue de synthèse*, *136*(3), 477-493. DOI: http://dx.doi.org/10.1007/s11873-015-0284-4.

Sibilio M. & Zollo, I. (2016). The non-linear potential of didactic action. *Education Sciences, Society-Open Access*, *7*(2). DOI: http://dx.doi.org/10.3280/ess2-2016oa3947.

Sibilio M. (2017). *Vicarianza e didattica*. *Corpo, cognizione, insegnamento*. Brescia: La Scuola.

Sloboda J. A. (2002). Doti musicali e innatismo in *Nattiez* (2001-05), vol. II, pp. 509- 29.

Stramaglia M. (2021). *Compendio di pedagogia dello spettacolo. Educare nell'epoca del neo-divisionismo.* Roma: Editoriale Anicia.

Szymańska-Stułka, K. (2019). Music and environment in research perspective. *SWS Journal of social sciences and art*, *1*(2), 81-95. DOI: http://dx.doi.org/10.32591/coas.ojsa.0202.03057k.

Vidal M. M., Lousada, M., Vigário, M. (2020). Music effects on phonological awareness in children. *Research@ua*, *11*, 39-39. DOI: http://dx.doi.org/10.1017/S0142716419000535.