

Fostering Reading Skills through Simplex Didactics and Music: Creation of an Inclusive Tool for Pupils with Dyslexia¹

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During the last decades, prevalence of pupils with Specific Learning Disorder, and more specifically with Dyslexia, is on the increase in Italian schools. It requires both researchers and teachers to investigate, adapt and adopt simplex teaching strategies. that may foster pupils learning process at primary schools by taking account of their educational needs, their learning styles and preferences. According to these premises, the following article aims to create a teaching tool that may support the reading learning process of pupils with dyslexia, during the first years of primary schools, by adopting the simplex principle of detour and the educational potential of music.

Keywords: music, simplicity, specific learning disorders, inclusive education, reading skill

Introduction

During the last decades, prevalence of pupils with Specific Learning Disorder (SLD), and more precisely with Dyslexia, is increased thanks to an awareness about the difficulties and implications on the teaching-learning process of basic skills (reading, writing, and calculating). In the 2018-2019 school year, the 4,9% of the total pupils attending Italian schools have a diagnosis of SLD and pupils with dyslexia represent 3,2% of the total number of pupils attending primary and secondary schools (MIUR, 2020 p.6). Moreover, SLD may be considered as an *umbrella term* (Cornoldi, 2007) because of a wide range of impairments that pupils with these disorders may show related to peculiar cognitive and learning processes, such as the inability to *pay attention* and select stimuli in a useful manner; to *focus* on a specific objective; to *memorize* and to effectively. Therefore, it seems important to reflect on how teachers may adapt their teachings to foster pupils' attention, their ability to select stimuli in a useful manner and to focus on a specific task, during the reading process, using compensatory tools that take up pupils' sensory preferences and their impairments. Inclusive teaching in classrooms with pupils with dyslexia and other SLD should consider these

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¹The article is the result of a collaboration between the authors. However, Alessio Di Paolo wrote paragraphs “2. Promoting reading skills through music and simplex didactics” and “3. Method”; Emanuela Zappalà wrote paragraph “1. Introduction” and “4. Conclusions”.

peculiarities and teachers should adapt their teaching process to promote pupils with dyslexia and other SLD learning.

This awareness requires both the teachers and researchers to select and adapt teaching strategies to address their educational needs, guarantee the right to education also by adopting specific compensatory tools and methods to foster reading skills of pupils with dyslexia and other SLD. In fact, in contrast with other daily life abilities, the reading one requires the use of specific teaching methodologies that consider the biology of pupils with dyslexia learning process, but also the influence of the educational environment. In this sense, consistent with several Italian studies of Didactics (Rossi, 2011; Rivoltella, 2012; Sibilio, 2013; Sibilio & Di Tore, 2014; Sibilio, 2015), it may be considered as a form of adaptation, also when the learning object is that of favouring reading competence (Di Tore et al., 2016), and it requires the teachers to find sophisticated and simplex solutions by using innate laws and tools to regulate their behaviour and teaching action (Aiello, Sharma, & Sibilio 2016; Sibilio 2013). Based on these premises, the theory of simplicity may be considered as

“a possible toolbox that provides a set of solutions which actors in an epistemically complex system such as education, manage to understand the system and accomplish important things from their own perspective. In other words, by taking cognisance of inner capacities and resources, teachers may feel more confident in dealing strategically with the emerging situations they are often faced with in inclusive classrooms” (Aiello, Pace, Sibilio, 2020, p. 3).

This framework may be *a passe-partout to face complexity* (Aiello, Pace, Sibilio, 2020) in inclusive classrooms attended by pupils with dyslexia, doing *detour* (Sibilio et al., 2017, p. 66), choosing non-linear and more complex solutions to make a problem simpler to resolve (Aiello, Pace, Sibilio, 2021) by selecting efficient strategies to support the pupils on developing reading skills:

- recognizing their learning preferences,
- respecting their needs and learning rhythm yet more efficient methods of assisting students in learning new information and skills.

Thus, it becomes clear that didactics should consider the principles that underlie adaptation and simplex didactics (Sibilio, 2013, p. 86) may be a proper theoretical framework to meet it. Sibilio (2015) sustains that:

“In this framework, teaching represents an activity able to find a common ground for interaction among the different *umwelten* of the actors involved in the process: ‘We should think about learning environments in terms of the students’ *umwelten*, because these contain the structures that students perceive and act towards. It is these *umwelten* that change as students interact with their peers, teachers, and material structures’. Hence, always within the field of didactics, simplicity could be defined as an adventure between the simple and the complex; a set of principles and rules which do not dissolve the complexity of their own object. More specifically, this means responding to the need of new interpretative schemes, new modalities of

adaptation and problem-solving practices which have never been used [author trad.]” (p. 489).

Hence, the use of the theoretical framework of Simplex Didactics seems to be appropriate to develop a compensatory tool that may foster pupils reading skills development: the *graphic-musical alphabet*. More specifically, its development follows the didactics principle of *detour* and the educational potential of music. In Didactics this principle may be viewed as an example of creative thinking that may provide teachers with a wide range of options, as it may support to identify educational strategies and various teaching methods that would benefit the learning process in a vicarious way (Sibilio, 2020; Sibilio, 2017; Zollo, Sibilio, 2016). In this sense, music may be a possible non-linear and creative trajectory not only for its enjoyable and engaging characteristics that may foster pupils’ participation at the teaching-learning process. Furthermore, music also shows educational potential for the development of several skills, such as: social and communication skills (Chiappetta Cajola & Rizzo, 2016); reading (Darrow, 2008), writing (Morais et al., 2020) and spatial orientation skills (Rauscher et al., 1997; Aintila, 2020). For that reason, it seems appropriate on reflecting on a possible connection between the Simplex Didactics and the music, but also on creating a new tool that may be aligned with it and be tested to examine its effectiveness.

Promoting Reading Skills through Music and Simplex Didactics²

Several studies showed how performing arts have a Didactic potential, especially in class attended by pupils with special educational needs (Derby, 2011; Sack et al. 2019; Hatzer et al. 2019). Music seems to be a useful tool to improve language and social skills since its structural characteristics are recognizable and easy to detect for its uniqueness (Adamek & Darrow, 2005). It may also be adopted in all classrooms to support social and communication skills development (Chiappetta Cajola & Rizzo, 2016), and to reduce emotional stress (Lucisano, Scoppola & Benvenuto, 2012) by proposing transdisciplinary and transversal activities. Furthermore, music may be considered as an educational mediator that may foster the acquisition of basic skills, such as reading (Darrow, 2008) and writing (Morais et al., 2020), as well as spatial orientation skills (Rauscher et al., 1997; Aintila, 2020). Music and language are both characterize by components that may equally compared because of the influence of frequency, *duration*, *intensity*, and *timbre* on the *morphological*, *phonological*, *semantic*, and *pragmatic level* (*language components*), and on *rhythm*, *melody*, and *harmony* (music constituents). For example, the practice of singing is used to foster accents assimilation and rhythm (*tactus*). Rhythm also represents a characteristic component of spoken language to improve both sound articulation and vocal emission (Andrenelli et al, 2018; Azewaka & Lagasse, 2018; Schellenberg, 2005). As pointed by Minsky (1982) and the group of Eskine (2020), a good sound

²The following readings are recommended to go to deepen the topic of Simplexity and its relation to Didactics: Aiello (2013; 2018; 2021); Sibilio (2013; 2015; 2017; 2020).

emission leads to a greater understanding of the meaning of the word itself. These abilities are pivotal also when pupils are learning to read since phonological awareness is pivotal to foster expressive, verbal language abilities and text comprehension (Preis et al., 2016; Zumbansen & Tremblay, 2019; Baigina, 2019).

Having awareness on these topics may be useful when considering difficulties that pupils with dyslexia may show while developing basics skills, such as reading, whose impairments are also related both to language and executive functions impairments (Di Tore, 2016; Di Tore et al., 2016). In fact, pupils with dyslexia may show difficulties on decoding some letters, recognizing words, reconstructing the overall phonetic representation of the word read and, eventually, accessing its semantic content, because of an impaired “serial processing [used] to convert each grapheme into the corresponding linguistic sound (syllable and phoneme) [author trad.]” (Franceschini, 2012, in Di Tore, 2016, p. 38). Additionally, children with dyslexia may also manifest impairments on the graphic sign discrimination and, consequently, a difficulty on associating a sound with it or on correctly reproduce the sound associated with a letter (Gosse & Van Reybroeck, 2020; Galliussi et al., 2020). Hence, it would be important to reflect on how music may be used to promote the teaching-learning process of pupils with dyslexia by using specific compensatory tools and design activities to improve reading skills (MIUR, 2011, p. 5).

Sharing the assumption that “reading is an ability that does not form part of the natural development of the individual but needs to be learnt; hence is considered as an adaptive strategy” (Berthoz, 2009, in Di Tore et al., 2016, p. 1), its development may be supported by using teaching approaches based on the principles of adaptation, as simplex Didactics does (Sibilio, 2013), taking into account the *educational potential* (Frauenfelder et al., 2004; Sibilio, 2013) of pupils with dyslexia. In fact, Simplicity improvement into the didactic field would be outlined as the assumption of an operational trajectory that attempts to combine elements such as *complexity, simplicity, theory, praxis*, through a synergy between *epistemology* and *pragmatics* (Sibilio, 2013, p. 79). According to this operational perspective, “Studies on didactic action are strictly connected to the concept of Simplicity, whose meaning refers to the intentional dimension of the act and that is considered as the minimum “simplified” unit of the didactic system) [author trad.]” (Sibilio, 2012, p. 11). The importance of simplifying action is threefold. Firstly, it aims to search for strategies for deciphering educational complexity; secondly, to search for ways through which intervene from a design perspective to deal with complexity; finally, through action, to intervene on complexity actively not to eliminate complexity itself, but rather to be able to manipulate it, to manage it concretely without attempts at exemplification, but rather through flexible adaptation actions. Furthermore, it also requires the teachers to be able to constantly *redesign* their action due to the constant changes occurring in the educational system, which may be considered as an unpredictable system where the emerging characteristics of the context appear to be strongly influenced by the *present* and *past* where they belong to (Sibilio, 2013, p. 86). Thus, the ability to design by adapting the practice to the environmental needs require the use of six properties (tools) and six principles (laws) that may orient teachers’ actions.

Simplex properties are:

- *specialisation and modularity*, which in didactics is understood as a function that allows the teacher to use only one communication channel in a well-defined time module (hourly unit) to be able to act with his or her students;
- *speed*, which in didactics indicates the teacher's ability to respond in a timely manner to the continuous feedback received from students;
- *reliability*, which didactically implies the full correspondence between the objective to be achieved and the actual action that enables the teacher to do so;
- *flexibility, vicariance and adaptation to change*, which are essential to be able to select the right strategy from a repertoire of choices to resolve a problem, and perceive, capture, decide, or act depending on the context the system finds itself in.
- *memory*, as the characteristic on which present action relies to predict the future consequences of an action;
- *generalization*, the final property of complex adaptive systems, which refers to the competency of capitalising patterns of interactions, and transferring these from one context to another, even if they are not two completely analogous situations (Aiello et al., 2021, p. 7).

All these rules are fundamental in decision making, problem solving, creative thinking, coping with stress and emotions, initiative taking and the spirit of entrepreneurship.

With regards to the rules, they are:

- *inhibition and the principle of refusal*, which didactically implies the possibility for the teacher to follow didactic trajectories by resorting to some actions rather than others, respecting the characteristics of individual learners;
- *specialisation and selection*, which implies the possibility for the teacher to analyse, to examine each individual aspect of his or her learner, his or her perceptual bubble, finding useful operational strategies to create effective didactic proposals that respect the individual's individuality;
- *probabilistic anticipation*, which didactically envisages the possibility for the teacher to anticipate didactic actions based on previous experiences that allow the teacher to already understand the consequences of what is being carried out;
- *detour*, which didactically implies the possibility for the teacher to choose *non-linear* operational trajectories, capable of leaving room for creativity, novelty, experimentation with his or her students;
- *cooperation and redundancy*, which didactically implies the use of several coordinated systems in order to structure didactic actions;

- *meaning*, which in didactics corresponds to the law that establishes the link and the functionality between meaning and the act itself (Aiello et al., 2021, p. 7).

All simplex tools and rules may be adapted to both music and inclusive teaching but, in this investigation, we have chosen the *detour* defined by Berthoz (2009) as a system that organisms possess for *non-linear problem solving*. Sometimes, simplification results precisely from detour in this non-linear domain. In didactics, this mechanism translates into the attempt to search for different ways of didactic transposition that offer the teachers a plurality of solutions to ensure greater control of the system (Sibilio, 2013). It means that the transmission of a given concept or the pathway for the acquisition of a skill may pass through a plurality of possible systems, and that they still allow the attainment of the set goal. Such solutions, although seem simple, are characterised by flexible paths that are open to change. It involves, for example, posing problems in different ways according to the cognitive styles of the learners, preparing complex teaching material to make the explanation simple in the teaching action, and realising branched teaching plans that allow, through flexible and differentiated learning paths, to marry the needs of each individual learner.

Method

Objective

The aim of this contribution is to design a teaching tool that may foster the reading learning process of pupils at risk of dyslexia during the first years of primary schools.

Instrument

The graphic-musical alphabet is structured considering the theoretical framework of simplex didactic and, more particularly, of the principle of *detour* (Berthoz, 2009, p. 20; Sibilio, 2013, p. 89). In fact, the tool aims to offer multiple sensory stimuli to address the educational potential of pupils with dyslexia, their peculiar cognitive styles, and music, too. The combination of graphic sign with the auditory stimuli may support those who prefer learning through the auditory, visual stimuli, or the mix of both. To address this purpose the research group use [@Scratch.mit.edu](https://scratch.mit.edu), which is an open-source web platform easily accessible and usable both by teachers and students, to create the tool. This choice is related to the awareness of technological power of mediate multiple stimuli simultaneously using multiple mediators thanks to its multimedia.

The design of the tool was articulated on three phases:





- bibliographic analysis with respect to Specific Learning Disorders, the methods of intervention already carried out, the relationship between



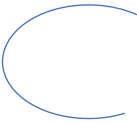

music and Specific Learning Disorders and the advantages that music can have in the teaching-learning process.

- alphabetical design
- practical experimentation of the alphabet and analysis of the collected data.

The starting point for the work was the analysis of the letters of the alphabet. As each letter is generally composed of the union of straight and curved lines, the preliminary study focused, firstly, on the prevailing lines and their frequency of use for the construction of each letter. About the area of straight lines, the straight line with downward orientation has a frequency of use of 15/43, while the straight line with right-hand orientation has a frequency of use of 13/43. Regarding the use of straight lines with oblique orientation, the straight line with top right orientation has a frequency of use of 5/43, the straight line with bottom right orientation of 9/43, the straight line with left orientation of 1/43. Shifting our attention to the curved lines, we note that the left-facing curved line has a frequency of use of 7/12, the right-facing line 4/12. The downward-facing curve has an orientation of 1/12, the curve starting at the top left and converging at the top right has a frequency of 1/12. Based on the frequency, musical notes were assigned within the diatonic musical scale and connected to generate major-type chords. In fact, the students are particularly inclined to listen to major rather than minor chords, collected according to triads, intervals of fourths and fifths. Specifically, the association made is as follows:

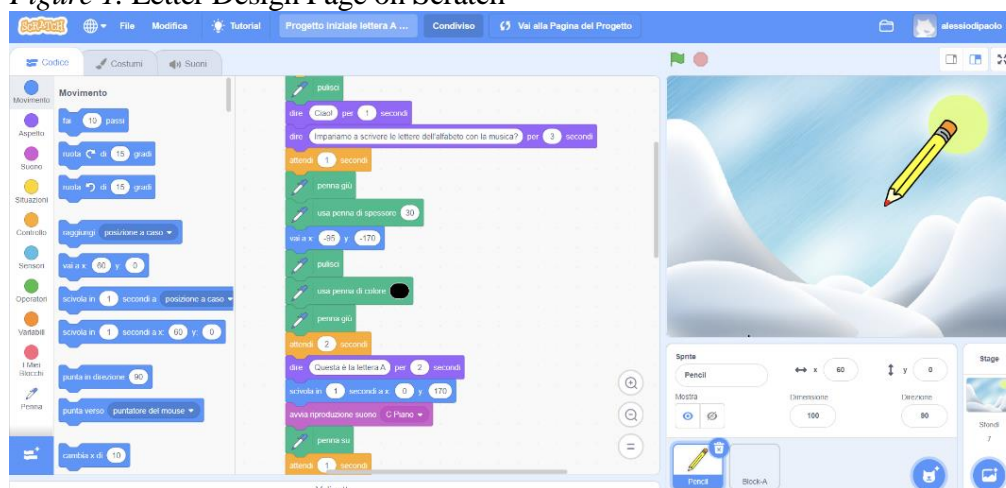
Table 1. Association between Lines Forming the Letters of the Alphabet and Musical Notes

Line	Associated note
	D
	G
	C
	E

	G#
	F#
	B
	C#

Another important element of the alphabet is the way in which the grapheme, the letter, is structured. As stated by Cornoldi et al. (2010), cognitive processes involved in reading depend above all on the way the grapheme that makes up the letter is written and its characteristics (Cazzaniga, 2005). The choice of a good font may be useful in speeding up and improving the reading mechanism in dyslexic students, according to parameters such as letter spacing, shape and size (Di Tore, 2016). For the alphabet, a sans-serif font was used specifically, as it lacked redundant elements that 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 style. The choice of the classic font, with no more marked sections than others, also simplifies the approach and memorisation of the letter. As already mentioned, now the work is focused on the construction of capital letters only, as these are the first to be learnt during the initial phases of work in Primary School and are often used in the subsequent years of work, when a student presents severe reading problems, such as the difficulty of recognising lower case or italics.

Figure 1. Letter Design Page on Scratch



Moreover, other investigations were carried out and it was found that most of the educational tools currently offered to learn the alphabet are structured in such a way as to generally associate the letter with animal verses, songs to associate the letter with a melody. However, it seems that there are any tools that associate a note with each individual line that makes up the letter. At a later stage, studies were carried out on the actual possibility of being able to connect a note to each individual line of the letter, to form the triad. It emerged that students, even with dyslexia, tend to learn with the aid of musical triads, especially if these are major rather than minor (Proverbio, 2019). Based on this scientific evidence, an initial prototype was made, starting with those letters of the alphabet that consist of straight lines. This is because the Scratch system makes working on curved lines more time-consuming and difficult, as it consists of a Cartesian graph at its base, which therefore requires the input of precise coordinates to be able to generate the graphic sign.

Moreover, the alphabet is realised according to a *visual* and *auditory* system. In fact, a demo-pencil traces in three/four times each line used to make the letter of the alphabet, depending on the number of lines that make up the letter itself. As the pencil-demo traces each sign, it reproduces a musical note that, together with the other notes associated with the other signs, generates a chord. Once the pencil traced the entire letter and played the three notes separately, the system repeats the sound as a final chord, so that the triad can be memorised more easily. This way of functioning relay on the volunteer of the researcher to personalize the tool on the peculiarities of the pupil, to its individual cognitive styles, to avoid asking the pupil only to focus on visual stimuli using a *non-linear trajectory*, by also stimulating the auditory channel. In fact, as stressed by Gardner (1987), a student may have multiple intelligences, and the teachers should properly choose the most proper teaching strategies according to students' personal cognitive styles. In the case of graphic-music alphabet, the pupil will not only mechanise the graphic sign that, combined with other signs, gives life to the letter, but can also resort to memorising the note or the triad of musical chords linked to it. The paths traced to

achieve the same objective are multiple within a single instrument, just as multiple are the ways of learning of different students within class groups.

Taking account about that, some Simplex principles, and properties of Berthoz' and Sibilio's framework were adopted to personalize the tool during its development. For example, the principle of *specialisation and modularity*, offered the opportunity to use specific buttons to choose between the use either the visual or the auditory channel to support the learning process of the letter. The principle of *inhibition* is promoted giving the pupil the chance to autonomously choose whether to memorise the letter using the graphic or musical stimulus and vice versa. The possibility of choice, of selecting one stimulus rather than another, is a symbol of greater autonomy and self-determination for the student who should use his/her metacognitive abilities to accomplish to this task. At last, it is also consistent with the principle of *meaning*, which implies that the action match to the learning goals, previously set by the teacher who propose the tool.

To date, the creation of the tool is still in progress. Right now, it only consists of letters made up of the union of straight lines. The making of the prototype letters, as mentioned above, are set up according to a demo-system in which a pencil encourages the pupil to learn the letters of the alphabet with music, inviting him to see how they can be made. The student can therefore watch how the pencil makes the letter, while also listening to the chords connected to it. In a subsequent phase, the learner is expected to realise and recognise the letter independently with the support of the associated musical notes.

Conclusions

In conclusion, the use of the alphabet may offer the opportunity to use *non-linear trajectories* to support the learning process of pupils with dyslexia respecting their peculiar cognitive styles and by foster their engagement. Actually, because of its multimedia characteristics and in line with the inclusive principle of full inclusion (Sibilio & Aiello, 2015; Aiello & Pace, 2020) this tool may be useful to foster learning of every pupil by respecting their peculiar learning style (Di Gennaro et al., 2018). In fact, the alphabet may promote the association of a letter to a specific sound, offer a second way to connect a graphic input and the sound thanks to a direct link of a specific sign with a musical chord. Moreover, through a specific auditory stimulation, resulting from listening to the chords linked to individual letters, pupils may improve letter comprehension, as the sound-letter interconnection becomes a phonological as well as auditory support element of auditory-graphic association, also useful to improve reading skills. However, to date, it is not possible to estimate the extent of the benefits for pupils with dyslexia. According to the literature review it could be an effective means of working with children with these impairments by considering their personal needs and individual learning styles. But further studies need to be done to test it. Although it has not yet been tested in practice, it intends to answer the following questions: "How is it possible to guide the pupil with dyslexia, during the Primary Education period, in order 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 hope is that such a tool will in some way be useful to intervene not only to support the student in memorising letters better by associating the relative musical triad with them, but also to reinforce the area of motivation, by proposing a technological tool that can generate interest in the student towards learning, integrating the technological medium with the musical.

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