

Is Dys-Vocal effective for pupils with dyslexia? A preliminary experimental study

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Abstract

The purpose of this study was to determine whether the Dys-Vocal tool improves dyslexic pupils' reading skills when they are learning either English or Dutch as a second language. Our initial results show that the usage of Dys-Vocal improves pupils' reading abilities (especially comprehension). The data provided suggests that Dys-Vocal also increases pupils motivation.

Key words : Dys-Vocal, dyslexia accommodations, foreign language learning, reading

Introduction

A sizeable fraction of the pupil body at Wallonia-Brussels Federation (FWB) has specific learning disabilities including dyslexia. Specifically, between 6 and 8% of pupils are dyslexic, according to the Belgian Association of Parents and Professionals for Children with Learning problems (APEDA), and the problems brought on by this disorder appear to have a negative impact on school learning (www.apeda.be). Dyslexia appears to have a detrimental effect on pupils' reading and writing abilities. The challenges faced by dyslexic pupils are particularly related to reading and decoding written information as well as understanding letter-sound relationships. According to Habib (2014) and to Habib and Camus-Charron (2019), dyslexia is a neurological disorder with a biological base that manifests itself despite ordinary IQ, emotional, affective, sensory or favorable socioeconomic factors and development. Phonological awareness, fluency, and phonological memory are weaknesses in dyslexic pupils. The fundamental characteristic of dyslexia, difficulties with phonological processing, appear to have a direct effect on pupils' reading and writing abilities and may ultimately have a detrimental effect on the development of reading comprehension. When pupils are forced to learn a new modern language (other than their mother tongue), the challenges engendered are likely to be even more severe, especially if that language has a more "opaque" orthography than French (more non-equivalent grapheme-phoneme correspondences) (e.g., Habib, 2014; Habib & Camus-Charron, 2019). Dyslexic pupils need accommodations so that they can integrate into the classroom and into the learning process more effectively. Currently, there

exist tools (devices) that account for the challenges dyslexic pupils face and allow them to customize their learning (e.g., Loty & Mazeau, 2020).

This study focused on Dys-Vocal, a digital tool that might be used to facilitate dyslexics learning. It supports sequential grapheme-phoneme and phoneme-grapheme as well as multimodal learning (the tool can provide concomitant written, oral, and visual learning). These features are likely to help dyslexic pupils improve their comprehension, decoding, and acquisition of vocabulary and grammar in foreign languages (e.g., Wery & Diliberto, 2017; Zorzi et al., 2012; Goac, 2018). For modern languages, Dys-Vocal permits customizations (e.g., use of unique fonts, colored syllables, spacing between words, lines, and texts). Additionally, it allows customized instruction, which is expected to improve newcomers' chances of learning. (e.g., Le Goaëc, 2018; Wery & Diliberto, 2017; Zorzi et al., 2012). Several studies have shown that multimodal learning—including oral, written, and visual—helps individuals with certain learning difficulties integrate new foreign language (e.g., Cappelli & Noccetti, 2016; Hall et al., 2000). On the other side, computer-assisted learning also appears to favor the acquisition of new linguistic information (oral, written vocabulary, etc.). Given this, we hypothesize that using Dys-Vocal and customized linguistic materials will help dyslexic pupils learn new modern language concepts, and that these impacts will also indirectly help pupils be more motivated. Furthermore, given that English has more orthographic opacity than Dutch (more grapheme-phoneme inconsistency ; e.g., Aro & Wimmer, 2003), these advantages may be even more obvious when the learning material is presented in Dutch as opposed to learning material presented in English. Additionally, a number of psychological and linguistic elements, such as the vocabulary used in foreign languages and learners' motivation, also appear to positively affect the acquisition of foreign languages (e.g., Al-Daihani et al., 2016; Boonchum, 2020; Khasinah, 2014; Tániczikné, 2017). Given these aspects, we applied two types of measures to try to control for some of these factors (level of motivation, level of passive or receptive vocabulary in the foreign language): a vocabulary test designed to measure lexical comprehension abilities in English and Dutch (Dunn et al., 1982) and a self-report questionnaire (adapted from Anckaert et al., 2020) designed to measure pupils' motivation to learn the foreign language.

The potential benefits of Dys-Vocal on the comprehension abilities of dyslexic foreign language learners of English and Dutch have not yet been examined in any studies. The current study's objective was to assess how well Dys-Vocal affected the reading abilities (reading comprehension and decoding) of dyslexic pupils learning English and Dutch (LE) in the classroom. Our main purpose was to evaluate the Dys-Vocal digital tool's potential efficacy. By evaluating such effectiveness objectively, we could find resources that could help dyslexic pupils learn to read, especially in foreign languages (English and Dutch). Any positive outcomes seen at this level may offer new insights into the digital resources that help dyslexic pupils learn foreign languages. Given that pupils who are dyslexic are also likely to be less motivated than pupils who are not dyslexic (e.g., Habib & Camus-Charron, 2019; Loty & Mazeau, 2020), another goal of this study was also to determine whether any positive effects brought on by the use of Dys-Vocal may have an indirect effect on pupils' motivation.

Methodology

Participants

An experimental study conducted in FWB schools examined the efficacy of Dys-Vocal and its potential effect on student motivation. From January through May 2021 and June 2022, about 90 schools were contacted with the goal of enlisting dyslexic and non-dyslexic pupils into the study. However, a number of these institutions resigned as a result of the Covid-19-related issues, which made it impossible to carry out the project. Finally, eight schools consented to participate in the experiment. There were 23 test subjects assessed : 16 dyslexic primary and secondary pupils were tested in English and Dutch (they make up the experimental group) and 7 non-dyslexics (4 ten-year fourth graders, 5 eleven-year fifth graders, 6 twelve-year six graders, 4 third-teen year-old pupils in secondary grade and 7 non-dyslexics tested in English and Dutch). The "normo-reader control" group, which consisted of readers without reading or spelling issues, included two 10-year primary fourth graders and six 12-year primary old 6th graders enrolled in basic education. Eight pupils took the tests with Dys-Vocal in English, and eight in Dutch.

The subjects attended 8 urban schools in the FWB (area of Brussels and Liège) and were exposed to two hours of foreign language instruction (either English or Dutch) each week. In order to examine potential differences between these two groups, we chose to compare dyslexic pupils (the "experimental" group; pupils with reading and spelling difficulties) to non-dyslexic pupils (the "control" group; normal readers).

The profiles of the subjects as "dyslexic" and "non-dyslexic" were determined after discussions with the educational teams (teachers, speech therapists, integrating teachers), as well as parents. Only pupils with an official diagnosis of dyslexia were included in the study's dyslexic experimental group (4 participants ultimately were dropped from the study since a valid diagnosis of dyslexia had not yet been made).

Tasks and material

Regarding the experimental investigation, three tasks were used during two testing sessions to evaluate the impact of Dys-Vocal on the acquisition of the foreign language (English or Dutch) on deciphering, decoding, and reading comprehension skills but two of them (task 1 and 2) were dopped during the experiment due to an increased complexity non-adapted to pupils current foreign language levels.

At the start of testing session 1, a motivational questionnaire (modified from Anckaert, et al., 2020.) was used to gauge pupils' desire in learning a foreign language. At the end of this first session, we used a second part of the same questionnaire (2), specially designed to assess how well pupils decoded and understood texts written in a foreign language by using Dys-Vocal. We also made an effort to learn more about the characteristics of the test subjects by asking the parents to fill out a questionnaire at home about the pupils' socioeconomic

status, affective, emotional, and motivational profiles (among other things). The questionnaire asked numerous questions about characteristics, including comorbidities, existing language or neurological deficits, exposure to complementary second languages, potential logopedic treatment, attentional and emotional difficulties, memory issues (and more) were all specifically addressed in the inquiries. The parents were sent this questionnaire at the beginning of the testing period (February 2021; May 2022) and were repeatedly reminded to complete it (via the class teacher). However, despite these reminders, several parents ultimately failed to do so. Finally, only two parents completed the questionnaire.

Here is a detailed description of the tasks used :

1) The purpose of the first task (adapted from Cambridge Assessment English and freely available on [cambridgeenglish.org](https://www.cambridgeenglish.org)) presented as a written text, was to gauge the pupils' deciphering and decoding abilities for English-language written texts by using Dys-Vocal. Following the findings of De Leeuw's dissertation research (2010), this task text was implemented in a "baseline" control version (A4 sheet, Times New Roman font, 11) as well as with Dys-Vocal adjustments ("special dys" font, double line spacing, etc.). For kids in primary 4, 5, and 6, a different text was translated into Dutch (from the British Council). Two conditions were therefore tested for each of the two texts: one was a "control" condition in which the text was presented in its "normal, written, traditional" version (Times Roman font, size 12), and the other was a "control" condition in which the text was presented in its "normal, written, traditional" version (Times Roman font, size 12) and a "adapted" version containing adaptations created using Dys-Vocal. The subjects were instructed to read the written material on the screen as best they could throughout these two conditions (the "control" condition and the "experimental" condition), and to explain what they understood in respect to the content. The second part of this task was to test the pupils' generalization for reading abilities, learned through the first part of the task. Consequently, this task evaluated the pupils' capacity to transfer the rules they had learned as a result of the adjustments made with Dys-Vocal. Precisely, this task was used in order to observe any transfer skills (use of the same patterns and rules) potentially used when applying the part one of the task. In order to gauge overall reading comprehension, more generic questions about the texts' substance were also used. This report does not include the results for this task. Our clinical observations of the pupils assessed show however that the use of Dys-Vocal results in a more fluid, less jerky reading. This was observed during the application of the second part of the task. Pupils who benefited from Dys-Vocal adjustments also produced fewer phonological errors and, in some cases deciphered certain words. Our observations (made after the completion of the first session of pupil testing) revealed that the complexity level of task 1 was also relatively high for pupils, despite the fact that some words were correctly decoded by each student after reading these texts. In light of this finding, we created an additional that was less challenging the texts proposed in task 1. Our goal in designing this was to create a reading assessment that was more engaging and age-appropriate for children, contained multimodal educational material (with an emphasis on oral and written learning paired with visuals), and was more interactive.

2) The second task tested the pupils' reading comprehension (decoding in English and Dutch) using a list (that we will call "6 words" in both English and Dutch; annex 1 and 2). This task was specifically created for the current study, as a result of observations that texts 1 and 2 (within task 1) were too complex for the pupils and prevented an accurate assessment of their foreign language reading abilities. In this task, six common words were used within both versions of the task (control condition vs. experimental condition). The "control" condition was first shown to pupils. In this version, the items were given to the pupils in their "simple" written form (Times New Roman font, 12), and they had to read the words out loud in English and then respond in French to a question about whether they understood what the words meant ("Sais-tu ce que c'est?" ; "Do you know what it is?"). The same set of words was then given to them with Dys-Vocal adjustments (enlarged letters, usage of a "dys" typeface, orally, in writing, and in the form of accompanying visuals). This approach, of presenting words in a multimodal format, was put forth to promote the usage of many learning modalities and aid pupils in "hanging on" to written words in their graphical, conceptual form. These were brief, "imageable" words with a low level of phonological and orthographic complexity (typically consonant-vowel-consonant structure; CVC), as well as a low level of "overlap" between phonological and orthographic form. In order to promote the best possible encoding of information in memory, our sequence was restricted to six elements (words). These were "less" academic elements that were probably foreign to the pupils. This process was adopted in order to assess the "contribution" of Dys-Vocal problems to learning efficiently. The children were instructed to read each word aloud after listening to it be "read" by a Dys-Vocal (global word -> sounds -> syllable -> global word procedure to encourage encoding of the sound and written form of the items given the phonological and orthographic processing deficits of dyslexics. After this modified reading, the first control task used at the beginning of the test—which contained the six words in their "simple," "classic" form—was used again, and the pupils were once more asked to indicate the meaning of the words. This time, the words were presented in written form without any accompanying images or auditory versions, in size 12, New Times Roman. Additionally, it should be emphasized that repeated training (increasing repeated reading of the suggested phrases) may have an impact on our results; nevertheless, at this time, we are unable to rule out this repetition effect. Not using this method (progressive and repeated word reading; global word -> sounds -> syllable -> global word) would prevent pupils from engaging in "real" reading and instead simply expose them to the words' sounds and visual (orthographic) representations. This would not be "real" encoding of written information, but rather global reading (in the initial phase), which is not currently supported by the literature (McCandliss, Beck, Sandak, Perfetti, 2003; Schaars, Segers, Verhoeven, 2017). Additionally, without this repeated reading, participants run the danger of just remembering "residuals" of orthographic forms connected to an image or concept, which is not ideal for long-term retention. The main goal of this sequence was to create a simpler learning material that would probably inspire and drive pupils to learn more quickly. This method of progressive reading (and implicitly repeated word reading) was used to make word encoding easier. As of right now, we are unable to rule out a potential bias caused by the suggested tasks' repeated use of certain items or material (words, texts). In a subsequent study, we hope to be able to better control these effects. To achieve this, a list of non-mots and pseudo-mots that adhere to English grammar rules and have phonological and orthographic structures resembling those

of French might be developed and proposed. In order to prevent "giving" the pupils access to the associated semantic (of sense) information, the objects included should be unknown to them. To ensure an optimal selection, teachers should also introduce pupils to the grammatical and pronunciation guidelines for these non-mots and pseudo-mots in advance. The heterogeneity of our dyslexic profiles, in particular, may make it difficult to control all the potentially interfering individual factors. These effects could also be controlled using a "design," such as a comparison of control task-control task vs. control task-task with Dys-Vocal adaptations. Such a design (comparison control task-control task vs. control task-task with Dys-Vocal adaptations) refers to the idea of comparing two groups of dyslexic pupils with the same profile, but using a comparative design, the first with two tasks ("control" vs. "control") and the second with a control task vs. an experimental task (containing the Dys-Vocal adaptations) in order to evaluate in a controlled way the improvements brought about by Dys-Vocal. Two of the words presented during the "6 words" task had a partially identical sound but an obviously different meaning: "schotel" or flat vs. "schoen" (or shoe). This procedure of progressive reading (and implicitly repeated reading of words) was also used to facilitate the encoding of words that were phonologically and orthographically closer but semantically different. Salient visuals were linked to these words (with a partially "common" sound) to help pupils "memorize and connect these items to their conceptual system. Only one word was displayed at a time, during this task, in order to prevent the pupils from becoming visually "overloaded." In order to promote more effective learning and effective encoding in memory, the majority of the words presented had various orthographic structures (compositions).

3) Through the third task ("An English restaurant"), we tested a dyslexic subject, at a school in the province of Liège. N. is a dyslexic 6th grader, who had been exposed to English as a foreign language since the beginning of his 6th grade. This task, was proposed by the class teacher. Time New Roman, 11 and other "classic" fonts were used, along with adjustments specific to the Dys-Vocal application (Dys typeface, line spacing). The reading assignment "An English restaurant" is a written text that depicts a conversation between a "lambda" customer and the waiter of a restaurant "x" regarding the menu and a possible dinner the customer might choose. N. made predictions (had to analyze the text's substance and the events it depicted in order to do so) based on the images that went along with it. The text was given in "simple" format (12-point text, one-space lines, etc.). The entire class participated in this activity, but N. was our only pupil of interest (target subject). To prevent a potential "priming" impact on N. through knowledge that might have been provided by peers, N. reading the text and answering questions. In order to acquire a "purer" indicator of N.'s comprehension, decoding, and deciphering abilities in foreign language, a "baseline" type procedure was utilized to ascertain what he actually knew about the text (or what he had understood based on connected images). The teacher asked N. (the focus subject of this section of the study) the following question to gauge his general comprehension of the text: "What did you understand from this text?" Afterward, he asked N. many "guide" questions in an attempt to generate a response (given his lack of responsiveness) and "guide" him in formulating assumptions regarding the events depicted in the book.

General procedure

The 23 pupils who have been examined thus far were evaluated in the settings (January-May 2021; June 2022) throughout the course of 2 experimental sessions that lasted roughly an hour each. Subjects were assessed in the classrooms (January-May 2021; June 2022) throughout the course of one or two experimental sessions that lasted roughly an hour each. Two questionnaires, one measuring motivation (part 1 and 2) and a second anamnestic one (which gathered data on socioeconomic status, affective and emotional issues) were given out during these sessions. The parents each filled out the anamnestic questionnaire at home. The different tasks proposed and the questionnaire used to gauge the pupils' motivation to learn a foreign language as well as their decoding, interpreting, and reading comprehension abilities were used during the test with the experimenter.

Results

Preliminary findings for our "6 words" task show that using Dys-Vocal improves pupils' reading or lexical decoding abilities (pupils show higher reading quality and noticeably greater reading comprehension). No matter the academic year or the language of instruction, all participants improve on this task, according to a quantitative analysis (T-tests for independent samples) ($t(44) = -20.22$; $p = 0.00$; rate of accurate responses increasing from 0-1 to 4-5-6 for each subject). We are unsure of the precise adjustments (e.g., special policy, Dys, multimodal learning) that could account for this advantage at this time. These aspects still need to be researched and developed. If these positive impacts on reading comprehension in foreign language learning are sustained over time (design style: testing -> extended pause -> re-testing), further research at this level will also need to be done. However, according to our findings, there is a significant difference between "motivation" indicators (motivational questionnaire per Anckaert et al., 2020) evaluating the level of "joy" in learning English or Dutch before vs. after the use of Dys-Vocal ($t(44) = -2.29$; $p = 0.00$). At a later stage of the study, we plan to add more people in an effort to get more definitive results.

Regarding the activity "An English restaurant" used to demonstrate the efficacy of Dys-Vocal in the classroom, pupil N. does not appear to have benefited from the adaptations of Dys-Vocal (e.g., use of Dys-Police, multimodal exposure to didactic material). His response to the content was a somewhat ambiguous ("people eating") suggesting that this tactic did not appear to be effective. The same material was then shown to him via computer with Dys-Vocal adjustments (Dys typeface, line spacing 2, letter spacing, colored words with corresponding visuals, etc.), which N. had to read. Following the adjustments made by Dys-Vocal, questions regarding the text were posed to determine comprehension of the material ("Are there words you know? What did you comprehend about this text?"). N. claimed that, in the end, he had understood nothing and that the adjustments offered by Dys-Vocal had not improved his ability to decode (understand) the text. This tendency is also seen in the responses to the motivational questionnaire, where N. answered that Dys-Vocal had not made it easier for him to comprehend the material for every question. To explain these findings, a number of

assumptions were advanced. N. is a student who is generally unmotivated or motivated for a type of "awakening" activity and only when supervised or in small groups according to level and/or needs, according to the information received from teachers (foreign language, French, and math teachers) and parents. Along with having attentional, behavioral, and memory issues, N. is also a nervous, stressed-out, and hypersensitive pupil. The teachers claim that N. needs to "manipulate and experience learning" in order to learn more effectively. These elements emphasize how crucial it is to consider both personal factors (psychological: affective, emotional, motivational; cognitive: type of impairment, preserved cognitive skills, strategies, IQ level, etc.) and learning-related school components and school-related factors that affect learning (such as the learning context, learning methods, and learning objectives, the severity of the disorder, etc.), but also to think about the potential use of Dys-Vocal to take into account the student's preferences, or to put it another way, to take into account motivational factors to encourage the pupil's learning. The multiple profiles of the subjects recruited (see profile of N. with dyslexia associated with a central hearing disorder) further highlight the significance of "controlling" the profiles' heterogeneity and taking it into consideration when establishing the interventions carried out in class. It should be emphasized that our study did not take into consideration a wide range of variables related to the pupil's perception and the Dys-Vocal tool. These factors include the pupil's perception of the use of Dys-Vocal in the classroom, the "gaze" of others (particularly colleagues) and any fear felt by pupil N. concerning the use of Dys-Vocal, the representations of others (colleagues) concerning the use of adaptive tools in the classroom (used only with N. in the current case), the representations or perceptions of the English teacher with regard to the use of adaptive tools in class (agree/disagree), N.'s level of "comfort" using Dys-Vocal in class (does he truly prefer to use Dys-Vocal or does he prefer to adopt compensatory tactics and continuously be on double-task?). If this project is to be continued, each of these several factors needs to be taken into account and controlled for.

Overall, initial findings on a small sample size (N=23) show that Dys-Vocal has a beneficial impact on pupils' reading abilities (increased reading and considerably better reading comprehension after applying the "6 words" lexical task in English). To get definitive results, however, additional assessments are required. It should be highlighted that the dyslexic participants in this study had a unique profile and were consequently challenging to "recruit". Due to the limitations of this criterion (the "dyslexia" profiles) imposed on student recruitment and selection, we currently have a relatively limited sample size (N=23). In order to evaluate pupils (minors), parental permission was also needed, and establishing the project with this need proved challenging.

Our findings suggest a substantial difference between the indicators in the questionnaire evaluating the level of motivation or "pleasure" in studying English or Dutch after the use of Dys-Vocal with reference to the indirect effect of Dys-Vocal on pupils' motivation. When using the adjustments suggested by Dys-Vocal, pupils' motivation to learn a foreign language seems to be higher overall. The data suggest that, as a result of Dys-Vocal, the subjects tested with this test read more fluently, with less jerking, made fewer phonological errors, and some subjects even managed to make accurate assumptions about the content of the texts for the first two experimental tasks used (texts applied in English and

Dutch). These results were observed, following qualitative evaluations of the individuals' responses. Given our extremely small sample size (N=23), these findings should, however, be regarded with some caution. The individual qualitative evaluations also reveal that some respondents used adaptive techniques (conserved skills) to score better on the assessments after Dys-Vocal's adaptations. This highlights the importance of using employing (exploiting) compensating preserved skills (auditory, visual) to support learning. In a later study, we intend to better manage these consequences. To achieve this, a list of terms that adhere to English grammar rules and have phonological and orthographic structures similar to French could be proposed. The pupils should not be aware of the aspects analyzed in order to prevent giving them access to the accompanying semantic (meaning) information. In order for the pupils to decode these non-words/pseudo-words/words as well as possible, they would also need to get prior instruction in the structural and pronunciation rules of these words. The heterogeneity of the dyslexics profiles, in particular, may make it difficult to control all the potentially interfering individual factors. These effects could also be controlled using a design, such as a comparison of control task-control task vs. control task-task with Dys-Vocal adaptations. Such a design ("comparison control task-control task vs. control task-task with Dys-Vocal adaptations") refers specifically to the idea of comparing two groups of dyslexic pupils with the same profile, but using a comparative design, the first with two tasks ("control" vs. "control") and the second with a control task vs. an experimental task (containing the Dys-Vocal adaptations) in order to evaluate in a managed way the improvements brought by Dys-Vocal.

Conclusions

The study's preliminary findings imply that Dys-Vocal has a beneficial impact on reading comprehension in English and Dutch. All of the pupils "performed" better on the "6 words" task with Dys-Vocal adaptations, testing written lexical comprehension in English and Dutch (students go from 0 to 4-5 or 6 correct answers). This was the case for all pupils, regardless of their academic level (4th, 5th, 6th primary graders and 1st secondary graders), language (English or Dutch), or age (10, 11 or 12-13 years). It is important to look into these beneficial benefits over the long run to see if they persist. Our analysis reveals a significant difference between "motivation" indicators (motivational questionnaire according to Anckaert et al. (2020) measuring the degree of "pleasure" or motivation in learning English or Dutch before vs. after the application of Dys-Vocal). We have just 23 subjects in total, which is much too few to be able to discover meaningful results (Bujang & Baharum, 2016). To get clearer and more definitive results, this study should be continued with more participants. Therefore, in order to obtain results that are statistically more significant, additional, more significant effect factors will need to be evaluated due to the limited size of our sample. It should be mentioned as well that, at this time, we cannot completely rule out the role of repetition effects, which are caused by reading the same items from the used experimental tasks repeatedly. When the study is perhaps continued in the future, these effects should be better managed. It appears that Dys-Vocal is ineffective during classroom activities, at least

not with the dyslexic student N. who we tested in our first attempt to validate Dys-Vocal within the classroom (through the activity designed in cooperation with N.'s foreign language teacher). The professors of the French, math, and foreign language English classes have stated that N. is a pupils who is generally unmotivated or motivated only for one type of activity, who frequently fears failing at school, and who frequently is not paying attention during class activities. These unique traits emphasize the value of individualized, personalized interventions. Future studies should therefore take into account the unique traits, needs, and preferences of dyslexics pupils (in addition to adopting special "dys" resources geared to their needs). Future studies should try to control as many school factors as possible, as well as individual factors (linked to learning conditions), as well as psychological, motivational, cognitive factors (IQ, phonological ability, memory and processing skills, etc.), and more external factors, linked to living conditions (such as controlling the socioeconomic status). Although we made an effort to account for some of these characteristics, the large proportion of parents chose not to complete the anamnestic questionnaire, which would have allowed us to quantify and control them. Our observations, analyses, and conversations with the educational teams also highlight the importance of a more in-depth, multidisciplinary analysis and intervention where factors related to individual profiles (such as unique academic and cognitive skills) are taken into account and linked to more "academic" factors (such as classroom learning methods and resources, adaptive strategies for supporting pupils).

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