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Classification of young readers within an immersive learning model

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Abstract

Using data obtained upon reading aloud of a narrative text in the Basque language, 151 university students were categorised into different reading profiles, and the link between these profiles and a number of sociolinguistic variables was assessed. The study used K-means clustering based on six prosodic variables (total reading time, total articulation time, total pause time, speech rate, articulation rate, and time per pause), which yielded a stable classification into five groups. The quantitative characterisation of the profiles ranged from fast readers with short pauses to slow readers with longer, more frequent pauses. Contingency table analysis revealed no significant links between the reading profiles and the categorical variables analysed (first language, Basque language acquisition setting, and gender). Moreover, the homogeneity observed in reading style —regardless of linguistic background— highlights the effectiveness of immersive learning. The methodology used here can be applied to other types of texts, in other languages, with readers at any stage of learning. It also allows for contrasting results between educational models.

Keywords: Oral reading; reading fluency; immersion programmes; bilingual education; Sociolinguistic; college students.

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Clasificación de jóvenes lectores en un modelo de aprendizaje inmersivo

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Resumen

Con información obtenida en la lectura en voz alta de un texto narrativo en lengua vasca se ha clasificado a 151 jóvenes universitarios en perfiles lectores y se ha evaluado la asociación entre estos perfiles y variables sociolingüísticas. La clasificación K-mean basada en seis variables prosódicas (tiempo total de lectura, tiempo de articulación, tiempo de pausa, velocidad de habla, velocidad de articulación y tiempo por pausa) ha proporcionado una clasificación estable en cinco grupos. La caracterización cuantitativa de los perfiles ha revelado un gradiente desde lectores rápidos con pausas cortas hasta lectores lentos con pausas más largas y numerosas. El análisis mediante tablas de contingencia no ha mostrado asociaciones significativas entre los perfiles de lectura y las variables categóricas estudiadas (primera lengua, ámbito de aprendizaje del euskera y sexo). La homogeneidad observada en la forma de leer, independientemente del origen lingüístico, ha evidenciado la efectividad del modelo de aprendizaje inmersivo. Este planteamiento metodológico es reproducible con otro tipo de textos, con lectores en otras etapas de aprendizaje y en otras lenguas. También permite contrastar resultados entre modelos educativos.

Palabras clave: Lectura en voz alta; fluidez lectora; programas de inmersión; sociolingüística; educación bilingüe; estudiantes universitarios.

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INTRODUCTION

While the capacity for language acquisition is sometimes regarded as an innate human ability (Chomsky, 1965), it has also been linked to imitation, repetition, correction and reinforcement, as well as to pattern processing through neural networks. In addition, social interaction and cultural context are thought to play a role (Skinner, 1957; Chomsky, 1965; Vygotsky, 1978; Bruner, 1985; Elman et al., 1996; Spada & Lightbown, 2006). The acquisition of reading skills, however, is more complex. This process involves psycho-socio-affective, environmental, cultural, neuromotor, and neuropsychological factors (Urquijo, 2007). Furthermore, the ability to read depends on the phonological identification of letters and syllables —i.e. decoding and phonological awareness—as well as the visual- orthographic recognition of words, and semantic identification (Bravo, 2000; Lorenzo, 2001).

Reading is an interactive process through which meaning is constructed (Carrell & Eisterhold, 1983; Pearson & Gallagher, 1983; Grabe, 2003). Within this process, several strategies have been observed, consisting of intentional, cognitive operations performed by learners to derive meaning (Baker & Brown, 1984; Keene & Zimmerman, 1997; Adler, 2001; Block & Pressley, 2002; Pressley, 2006; Lai et al., 2013). These cognitive strategies are: abstraction, analysis, synthesis, inference, prediction, and comparison (Santiago et al., 2007). Predictive processes are conducted prior to reading, using cues such as the title or an image, while abstraction and inference help to understand vocabulary, expressions, and the central theme of the text. Finally, the learner's comprehension is verified by means of synthesis, comparison, and contrasting ideas (Yana et al., 2019). Thus, these processes occur before, during, and after reading a text (Solé, 1992; Condemarin & Medina, 1998; Trabasso & Bouchard, 2002). Furthermore, the entire process of decoding and comprehension is influenced by word recognition, text complexity, environmental conditions, mood, interest or motivation, and health status, among other factors (Dennis, 2008; Gilakjani & Sabouri, 2016).

Some of the factors mentioned are related to the language being learned, both at the cognitive level (such as vocabulary identification and text difficulty) and at the affective-emotional level (such as motivation, interest, and mood). In general, reading can become challenging when the reader's first language differs from the teaching language and lacks the resources required for lexical and syntactic decoding (Jiang, 2011), or when confronted with a specialised text from a specific field (Cassany, 2008). Language immersion is an educational method used to aid second language acquisition through intensive exposure within the school setting. In multilingual environments, language immersion programmes are among the most common learning strategies applied at school level. Becoming proficient in a second language in the shortest possible time requires not only a thorough knowledge of vocabulary and grammar, but also the optimal development of communicative competence. To implement this approach effectively, the learning model must be adapted to the specific context; therefore, it is essential to take into account the sociolinguistic and sociocultural factors that are unique to each community (García, 2011; Baker, 2011; Cenoz et al., 2017).

Modern language immersion originated in Saint-Lambert (Canada) in 1965, in response to demand from anglophone parents for their children to become bilingual. This led to anglophone students being educated in French (Lambert & Tucker, 1972). Today, language immersion in Canada remains one of the most established and successful models worldwide. With steady growth, and waiting lists due to a lack of teaching resources, more than 400,000 students are enrolled in the programme (Lazaruk, 2007; Hermanto et al., 2012; Canadian Parents for French, 2023). In the United States, the aim of language immersion is to integrate immigrant students while preserving linguistic heritage. Inspired by the Canadian model, immersion programmes are delivered in either a single language (typically English) or two languages (dual immersion), with more than 3,600 programmes opting for the latter (American Councils for International Education, 2022).

In Europe, multilingualism is present both at the continental level (European Union) and nationally (within member states). The European Union itself has 24 official languages, while several member states have more than one official language at the country level (e.g. Belgium: Dutch, French and German; Finland: Finnish and Swedish; Ireland: Irish and English), and more than 60 official languages at the

regional level. Given this multilingual context, language immersion takes place using a combination of one or two languages as the medium of instruction (Coyle et al., 2010).

In the case of Spain, Spanish coexists with three co-official languages (Catalan, Basque, and Galician). In Catalonia, language immersion is delivered in a single language: Catalan. In the Basque Country, both monolingual and dual-medium (Basque-Spanish) models coexist. In Galicia, a bilingual (Galician-Spanish) model is implemented, which varies depending on educational stage and subject area (Lasagabaster, 2001; Generalitat de Catalunya, 2018; Erdocia, 2020; Loredo & Vázquez-Grandío, 2022; Eustat – Basque Statistics Office, 2025).

Aside from public acceptance and what motivates parents to enrol their children in immersion models (Amorrortu & Ortega, 2009), their characteristics, benefits, and limitations have been widely discussed in the literature. From a political and technical perspective, language immersion finds strong support in numerous studies that highlight its significant contribution to students' academic performance, as well as to their linguistic and literary development in two or more languages, while simultaneously fostering cognitive skills (Genesee, 1987; Cummins, 2000; Lazaruk, 2007; Nicolay & Poncelet, 2013; 2015; Purić et al., 2017; Zhang et al., 2021; Trebits et al., 2022).

Currently, in the Autonomous Community of the Basque Country, 73.5% of students have Spanish or a language other than Basque as their first language. Nonetheless, the majority of parents (61.8%) send their children to Model D schools, (Soziolinguistika Klusterra, 2021), where Basque is the main medium for teaching. In this model, everything is taught in Basque except for the subjects of Spanish Language, Spanish Literature, and English. In this context, immersion facilitates the linguistic normalisation of Basque, addressing the existing imbalance between the two official languages and nurturing social equality in their use. Going beyond identity and cultural aspects, bilingualism supports equal opportunities among students. To achieve its aims, this programme is supported by a number of specific schemes, such as the government's reading initiative.

Alternatively, parents may opt to enrol their children in one of the other available linguistic models. In Model A, the medium of instruction is Spanish, with all subjects taught in Spanish except for Basque Language, Basque Literature, and English. This option, chosen by 5% of parents, does not ensure balanced bilingualism of the community's two official languages. Spanish is the dominant language both at school and in the students' home environment (Eusko Jaurlaritza, 2016). Meanwhile, Model B schools teach some subjects in Spanish and others in Basque. This option is preferred by 31.2% of parents.

The Department of Education of the Basque Government has established three strategic pillars linked to reading acquisition: learning to read; reading to learn; and fostering a love of reading, i.e. a reading habit. These correspond to the stages of Early Childhood Education, Primary Education, and Compulsory Secondary Education, respectively, each with a set of clear reading phases and specific skills to be developed.

In the first two stages, up to the fifth year of Primary Education, learning-to-read consists of three reading phases: a) familiarity with print b) naming speed; and c) phonological awareness. The last two stages develop the skills of lexical awareness, syllabic awareness, and phonemic awareness. The 'phonetic' reading phase also falls under learning to read, encompassing specific skills such as the alphabet and punctuation marks. Another part of learning to read is the 'reading fluency' phase, which corresponds to the third and fourth years of Primary Education and includes specific skills in reading accuracy, intonation, and speed.

From the fifth year of Primary Education onwards, reading to learn is applied, focusing on the stages of vocabulary, reading comprehension, and effective reading. For the first two phases, emphasis is placed on comprehension strategies, treating them as specific skills, while the final phrase—effective reading—focuses on comprehension strategies and techniques (see Table 1).

To encourage recreational reading among students, the platform *e-irakurzaletasuna* enables them to read from anywhere at any time, creating virtual communities in which to share reading experiences, with challenges and quizzes to motivate learners.

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Table 1

Reading strategy for the Basque education system (Source: Department of Education of the Basque Government)

School's Reading Strategy						
Stage	Level	Age		Pillar		Reading phases	Specific skills
Infant Education	1	1	Fostering reading		Reading habit	Knowledge of print	
	2	2					
	3	3		Learning to read		1. Naming speed 2. Phonological awareness	Lexical awareness; Syllabic awareness; Phonemic awareness
	4	4					
	5	5					
Primary Education	1	6				3. Phonetics	The alphabet; Punctuation marks
	2	7					
	3	8				4. Reading fluency	Reading precision; Intonation; Velocidad
	4	9					
	5	10		Reading to learn		5. Vocabulary 6. Reading comprehension	Comprehension strategies
	6	11					
ESO	1	12				7. Effective reading	Comprehension strategies Comprehension techniques
	2	13					
	3	14					
	4	15					

Reading is the gateway to knowledge and, in multilingual environments, can serve as an indicator of linguistic inclusion. To advance in this direction, we classified 151 young university students into reading profiles based on the reading aloud of a narrative text, and assessed to what extent their reading profile has any relationship to their first language (Basque/Spanish, or both), their Basque-learning environment (home/school), or gender (female/male). Classification by reading profile offered a breakdown of the linguistic reality. Narrative is the literary genre most commonly used by teachers in compulsory education (Valdés-León, 2022), and the extent to which a learner's reading profile is influenced by their sociolinguistic background —as revealed by contingency tables— can reflect the degree of linguistic inclusion within the school setting.

METHODOLOGY

Text and Informants

The text used was a traditional Basque-language story entitled 'Peru eta Maria' (Badihardugu Euskara Elkartea, 2023). It consists of 47 words distributed among 13 phonetic groups, where 'phonetic group' is understood as a chunk of discourse occurring between two successive pauses, indicated by punctuation marks (Gil, 2007). The story alternates between the voice of the narrator and those of

the characters, with all sentences being declarative, with the exception of one interrogative and three imperative sentences. The original text in Basque is as follows:

> *Peruk zeukan oholezko etxea, Mariak zeukan gatzezkoa.*
>
> *Peruk Mariari: "Emaidazu gatz pixkatxo bat" eta "Ez!"*
>
> *Ekarri zuen euri zaparrada handia. Urtu zitzaion Mariari etxea eta gero Peruren etxera joan zen, oholezko etxera.*
>
> *Eta ez zuen hartu. "Zeuk ere ez didazu gatzik eman, ezta? Orain egin lo kalean".*
>
> English translation:
>
> Peru had a house made of wood, Maria had one made of salt.
>
> Peru said to Maria: "Give me some salt" and she said "No!"
>
> There was a big rainstorm, and Maria's house dissolved, so she went to Peru's house, to the wooden house.
>
> But he didn't open the door. "Well, you didn't give me any salt either, did you? Now you're going to sleep out on the street."

The informants consisted of 151 young university students from the Education Degree program —110 female and 41 male. All of them are bilingual and completed their studies in the Model D educational option. 116 acquired Basque at school, and 35 at home. Basque was the first language for 19 students, Spanish for 113, both Basque and Spanish for 18, and Arabic for one. The oral reading of the text was recorded in the *Irakurlab* reading laboratory using a ZOOM H1n recorder, after participants had first read through the story, since numerous authors agree that prior silent reading helps prepare the intonation and expressiveness necessary for oral reading (Cassany et al., 1994; Condemarín & Medina, 2000; Alliende & Condemarin, 2002). The transcription and labelling of the text were conducted using Praat software (Boersma & Weenink, 2025).

Statistical Analysis

The classification of readers was based on information provided by six prosodic variables that comprise the 'reading fluency' phase: total reading time (seconds), total articulation time (seconds), total pause time (seconds), articulation rate (syllables pronounced/articulation time), speech rate (syllables pronounced/total reading time), and time per pause (total pause time/number of pauses, in milliseconds). Since these are continuous quantitative variables without qualitative significance, similarities and differences between readers were quantified using Euclidean distance. To remove the influence of differing units and scales, standardisation was applied to the dataset.

The classification of readers was obtained using the K-means method, which minimises variability among readers within each group. To determine the number of groups, two statistics were used: the Pseudo-F statistic and the Silhouette statistic (Caliński & Harabasz, 1974; Rousseeuw, 1987). In both cases, the absolute and relative maxima were identified when testing group numbers g = 2, g = 3, g = 4, g = 5, g = 6 (where g is the number of groups). To characterise the groups, the mean value for each variable was calculated, and the groups were represented in a reduced-dimensional space using the metric multidimensional scaling (MDS) visualisation procedure. For each variable, the Fisher–Snedecor F-test was used to assess the significance of differences between group means.

To assess the potential relationship between the reading profiles obtained from the classification and the variables of first language (Basque/Spanish, or both), Basque learning environment (home/school), and

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gender (male/female), contingency tables were constructed and the χ^2 test was employed to assess possible homogeneity.

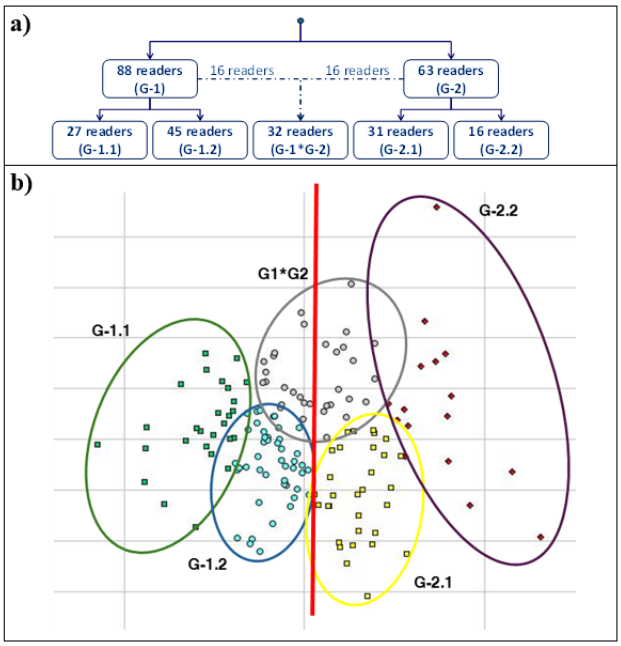
RESULTS

Classification into Groups

At g = 2 the Pseudo-F and Silhouette are maximised when considering the range of values at g = 1, g = 2, ..., g = 6 (Pseudo-F = 132.04, Silhouette = 0.4121) and a relative maximum is obtained at g = 5 (Pseudo-F = 98.07, Silhouette = 0.3070). Consequently, the structure of the information provided by the six variables assessed is consistent with a classification into both two and five groups. The two-group classification yielded a partition in which group G-1 comprises 88 readers and group G-2 comprises 63 readers. The five-group partition subdivided group G-1 into three parts, where 27 readers form group G-1.1, 45 readers form group G-1.2, and the remaining 16 readers are combined with the other 16 readers from group G-2 to form a transition group: G-1*G-2. Meanwhile, group G-2 was also subdivided into three parts: 31 readers make up group G-2.1, 16 readers make up group G-2.2, and the remaining 16 readers belong to the transition group G-1*G-2 (see Figure 1).

Figure 1

Classification of readers into two and five groups (g = 2 y g = 5): a) distribution into groups and subgroups; b) MDS representation of the groups and subgroups



Interpretation of the Groups

In simple terms, the classification into two groups (g = 2) yielded two reading profiles. Readers in group G1 read faster and had shorter pauses between phonetic groups than those in group G2. In both cases, no repetitions or slips were observed. For a more detailed evaluation, the classification into five groups (g = 5) revealed a gradient with two extreme groups and three intermediate groups. The 27 readers in group G-1.1 read the fastest, made the fewest pauses, and had the shortest pauses between phonetic groups. In contrast, the 16 readers in group G-2.2 read the slowest, made the highest number of pauses,

and these were also longest. The 45 readers in group G-1.2 and the 31 readers in group G-2.1 exhibited intermediate characteristics across all variables. The positive correlation between articulation time (speed in reading prosodic groups) and pause duration characterises the gradient across groups G-1.1, G-1.2, G-2.1 and G-2.2. Meanwhile, the 32 readers in group G-1*G-2 displayed characteristics of both groups (fast reading, as in group G1; but longer pause duration, as in group G2). Descriptive statistics for each group and subgroup are shown in Table 2.

Table 2

Reading variable means (TT: total time, AT: articulation time, PT: pause time; SR: speech rate; AR: articulation rate, TpP: time per pause)

	Group	TT	AT	PT	SR	AR	TpP
g = 2	G-1	21.46	15.99	5.47	4.97	6.66	411.73
	G-2	26.48	17.98	8.50	4.03	5.94	573.81
g = 5	G-1.1	19.68	15.08	4.60	5.41	7.03	345.37
	G-1.2	22.03	16.69	5.34	4.82	6.37	404.42
	G-1*G-2	24.11	15.94	8.17	4.42	6.67	578.55
	G-2.1	25.55	18.56	6.99	4.16	5.72	477.61
	G-2.2	29.41	18.52	10.88	3.63	5.78	721.17

Contingency tables

To evaluate and analyse the relationship between the reading profiles for g = 2 (G-1 and G-2) and the categorical variables of Basque learning context, first language, and gender, three contingency tables were compiled (Table 3; a, b and c). According to the collected data, no dependency relationship was observed between the reading profiles for g = 2 and the place of Basque language acquisition (school/home), $\chi^2_{exp} = 0.06$, $p = 0.8137$. Similarly, no association was found between the reading profiles for g = 2 and first language (Basque/Spanish, or both), $\chi^2_{exp} = 0.76$, $p = 0.6826$. Nor was any connection observed between the reading profiles for g = 2 and the reader's gender (female/male), $\chi^2_{exp} = 1.33$, $p = 0.2491$.

Table 3

Contingency tables for reading profiles (g = 2) and categorical variables

	a) Acquisition		b) First language			c) Gender	
	School	Home	Basque	Spanish	Both	Female	Male
G1	67	21	10	66	12	67	21
G2	49	14	9	47	6	49	14

With lower statistical power in the hypothesis tests, no association was observed between the reading profiles for g = 5 (G-1.1, G-1.2, G-1*G-2, G-2.1 and G-2.2) and the categorical variables analysed: $\chi^2_{exp} = 2.23$ and $p = 0.6938$, for place of Basque language acquisition; $\chi^2_{exp} = 3.13$ and $p = 0.9256$, for first language; and $\chi^2_{exp} = 3.72$ and $p = 0.4451$ for gender. The gender imbalance observed in the sample reflects the actual composition of first-year students in education and does not affect the results, which remain homogeneous for this variable.

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DISCUSSION

The results obtained from the classification of readers revealed five distinct reading profiles (g = 5). Readers in group G-1.1 read quickly, with brief pauses corresponding to the number of phonetic units indicated in the text. Conversely, readers in group G-2.2 read slowly, producing longer pauses that exceed the number of phonetic units marked in the text. Forming a continuum, readers in groups G-1.2, G-1*G-2, and G-2.1 display intermediate characteristics across all the variables assessed. More generally, the classification into two groups (g = 2) differentiates between readers who read faster and those who read more slowly (Figure 1b and Table 2).

From an interpretative standpoint, our attention is focused on the extreme groups. The particular characteristics of readers in group G-1.1 may be linked to comprehension and habitual reading practice. Meanwhile, for texts of lower difficulty, slow reading, prolonged pauses, and a greater number of pauses than those marked by punctuation are thought to be associated with difficulty recognising and converting letters into sounds or reading unfamiliar words, as well as slow cognitive processing, anxiety or nervousness that may be elicited by reading aloud, or the reader's effort to aid the listener's understanding (Miller & Schwanenflugel, 2006, 2008; Riedel, 2007; Tan et al., 2007; Binder et al., 2013; Landi & Ryherd, 2017; Wang et al., 2020).

Furthermore, the results obtained regarding the reading of a narrative text demonstrate homogeneity in the reading profile (reading style), regardless of the first language or the place of language acquisition (school/home). The academic achievement reflected by the absence of repetitions or slips during reading, and by the participation of younger students, could be thanks to the Basque Government's active language normalisation policies, as well as the reading acquisition strategy promoted by the Department of Education and implemented by schools.

Article 17 of Law 10/1982 of 24 November, the Basic Law for the Normalisation of Basque Language Use (the revised version in force since 16 July 2022), establishes that:

> The Government shall adopt measures aimed at guaranteeing that students have a real opportunity, on an equal footing, to acquire sufficient practical knowledge of both official languages upon completion of compulsory education, and shall ensure the environmental use of Basque, making it a normal means of expression in both internal and external activities, as well as in administrative procedures and documents.

Furthermore, Article 20 specifies that all teaching staff must be proficient in this language:

> The Government, to ensure the effective right to education in Basque, shall establish means aimed at teaching staff's progressive proficiency in Basque. Furthermore, it shall determine the teaching roles or units for which knowledge of Basque shall be compulsory.

In 1981, the Basque Government created IRALE to train bilingual teaching staff in the Autonomous Community's two official languages. One year later, in 1982, the Basque Service of the Basque Government's Department of Education launched EIMA, a scheme to promote the production of teaching materials in Basque aimed at non-university education (Eusko Jaurlaritza / Gobierno Vasco, n.d.-c). Furthermore, in 1984, NOLEGA was established for the creation and implementation of the abovementioned Normalisation Law. NOLEGA's work focuses on two main areas: the promotion of Basque within the school environment and the Basque proficiency of the Education Administration. These initiatives take place outside formal Basque lessons in schools but significantly influence students' acquisition, development, consolidation and use of Basque. Among these efforts are the design of Basque normalisation school projects (the Ulibarri scheme), oral expression activities (theatre, songs, storytelling and radio), extracurricular courses, linguistic immersion stays, school partnerships, literary competitions, and talks by professionals such as writers and journalists.

To address diversity, specific inclusion schemes for immigrant students have been implemented during the periods 2003–2007, 2007–2010, 2012–2015, and 2016–2020. These schemes focused on

reinforcing and advancing oral and written language skills, promoting positive linguistic attitudes, and fostering academic, social, professional, and intercultural development. Additionally, the Framework Plan for the Development of Inclusive Schools (2019–2022) (Eusko Jaurlaritza / Gobierno Vasco, n.d.-a) identifies the development of basic competencies —both transversal and discipline-specific— as one of the most important principles of education. It encourages autonomy in the approach taken by each educational centre according to its needs, as well as collaboration between schools, universities, and families.

As part of diversity-focused efforts, other specific initiatives and schemes have been implemented to address linguistic needs, including targeted linguistic and educational reinforcement, support outside school hours, curricular diversification, and complementary schooling programmes (Eusko Jaurlaritza / Gobierno Vasco, n.d.-b).

Limitations

The results obtained apply to narrative texts and young university students. Narrative texts are the simplest and most commonly used genre to promote linguistic inclusion, including in extracurricular activities. To consolidate and expand on these findings, further replication of the study is required using other types of texts, in educational institutions with readers at different stages of education and other socioeconomic profiles. Furthermore, prosodic features that complement segment duration include intonation, reading speed, and segmental intensity. For this reason, it would be worthwhile refining the classification obtained by incorporating data on intonational patterns.

Conclusions

The results of the prosodic analysis conducted have significant practical value for the improvement and development of reading aloud, as they provide empirical evidence on the acoustic parameters that characterize reading performance. The objective identification of these prosodic patterns enables the design of specific and personalized pedagogical interventions, aimed at improving reading fluency through strategies focused on temporal management and discourse segmentation. In particular, the diagnosis derived from this study provides insights to optimize didactic-methodological work with students who exhibit a slower reading pace, characterized by longer and more frequent pauses.

AUTHORS' CONTRIBUTIONS

Aitor Iglesias: Conceptualization; Data Curation; Writing - Original Draft; Writing - Revision and Editing; Research; Methodology; Resources; Software; Supervision; Validation; Visualization; Fundraising.

Aintzane Etxebarria: Project Management; Conceptualization; Writing - Original Draft; Writing - Revision and Editing; Research; Methodology; Resources; Software; Supervision; Validation; Visualization; Fundraising.

Miquel Salicrú: Formal Analysis; Conceptualization; Writing - Original Draft; Writing - Revision and Editing; Research; Methodology; Resources; Software; Supervision; Validation; Visualization.

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