Semiautomatic Study of Handwriting Development in Basque Children at Primary School

Jose Mari Arriola, University of the Basque Country, Spain
Mikel Iruskieta, University of the Basque Country, Spain
Irune Ibarra, University of the Basque Country, Spain
Asunción Martínez, University of the Basque Country, Spain

Abstract
The aim of this case study is to understand the connections between process factors of writing, such as bursts and fluency/speed, and product factors related to linguistic complexity and the quality of the final text. With this purpose, we conducted a (pilot) study with 13 developing writers in Basque from the second year of Primary School in two scholar periods to compare their progress in writing. The analysis of the process factors was based on bursts' measures and pauses duration described using HandSpy, a tool that allows one to describe and observe the process of handwriting in a digital platform. Thus, the HandSpy tool automatically analyzed the bursts and pauses, but the linguistic analysis of the texts produced were manually coded by aggregating a linguistic classification at both sentence- and word-levels while taking into account all the letter revisions that the child attempted. A cursory analysis of our data points to a link between the length of the bursts and the child's fluency, on the one hand, and the complexity /quality of the text produced, on the other. The overall study is a valuable contribution for education practitioners to encourage them to consider not only the handwriting product, the final text, but also the entire process of writing to address the needs of a wide diversity of learners and design new forms of feedback when teaching writing.

Keywords: HandSpy, On-Line Handwriting Research, Teaching Basque Handwriting

Introduction

Because handwriting is a basic tool used in many tasks –taking notes, doing classroom tasks and exams in almost every area of content– handwriting can have a widespread effect on school performance (Vanjari et al., 2023). The detection and intervention of writing difficulties from the beginning of schooling is very important for the development of the student learning process, since currently most school assessment systems at Basque primary schools are based on written production (Ibarra et al., 2021). However, despite its importance, we perceive that the Bassque educational community does not have enough clear guidelines on how to teach handwriting and how to perform early detection of potential literacy problems.

We present a pilot study of 13 students by analysing the handwriting process with the HandSpy tool (Monteiro y Leal, 2013). In the literature, it is a well-established fact that writing development should be best understood from a process perspective (Pascual et al., 2023). More specifically, Hayes (2012) states that graphomotor activity, captured by bursts, is closely associated with linguistic competence. This author speculated that the length of bursts could help the diagnosis of writing problems. Our work is in that vein and the research questions that guides our case study were as follows:

1. What is the connection between fluency (burst length) and text quality in Basque primary school students?
2. What are the linguistic features that play a role to determine the quality of written Basque by developing writers?

Figure 1 shows a preliminary coding system used to determine the linguistic features taken into consideration in this study:

TRANSCRIPTION							
Hiposegmentation	YES	WHERE	joansen	apurtusuen			NOTE: Same pattern+ verb auxiliary
Hipersegmentation	YES	WHERE	ospita lera	lagune xxekin			NOTE: Same pattern Noun+morphology (declension/affixation)
Spelling deviations from Standard Basque	-x instead of tx						
	z instead of tz						
	s instead of ts						
	-s/z letter mixing		Basen	joansen	apurtusu en	bisiklet arekin	
	-h omission	bein					
	-ts/tz mixing	pertzone					

Figure 1: Coding system example.

This study can benefit the educational community (students, teachers and families), giving information about those students' handwriting abilities or disabilities, which can be applied for designing personalized intervention plans. For example, Ibarra & Iruskieta´s 2022 work shows a contribution of this kind of approach to detect children with dysgraphia problems.

In what follows, we summarize the pilot study by means of HandSpyand describe the linguistic features identified for the linguistic analysis. Then, we show the validity andreliability of HandSpy as well as its value in moving writing research forward,In our empirical investigation, we compared the same group of students´handwriting in two periods of the same school year to compare their progress in writing.

The Pilot Study

In order to delve into the nature of the process of handwriting of Primary education students, we conducted a pilot study with 13 developing writers in Basque from the second year of Primary School in two periods of the academic year. g. The analysis of the process factors was based on bursts' measures and pauses duration thanks to the use of HandSpy, a tool that allows one to observe handwriting in real-time.

In the academic year 2021-2022 for the first data collection, we arranged a visit to a school of the Basque Autonomous Community to talk to the teachers about the need for more instruction in writing and explain the objective of our study: to know and improve the writing of the students. We explained to the teachers the goal of the project and what each child would do in their classes. Three tasks were performed:

First, the student was asked to write the alphabet in small case by heart, after hearing a song that everyone knew in which the names of the letters in Euskara are sung.

The student was then asked to copy a series of common Basque words in one minute.

Finally, they were asked to write a brief narrative text from an illustration (Jiménez, 2018). After 30 seconds for the student to look at the image and plan a story, s/he was asked to remember a similar story that would have happened to him or her, or someone s/he knows and to write it.

These three tasks were performed in two stages of the school calendar of the year 2021-2022: a) In November/December 2021 (T1), the children completed the three tasks for the first time. Here, half of the class first wrote the alphabet and then copied the words, while the other half did the reverse order. Everybody wrote the narrative text at the end. b) In May 2022 (T2) all completed the tasks in the same order: first, they wrote the alphabet, then copy the words and ended with writing the narrative text.

The three tasks gave us an idea of the development point of writing in which this group of stu dents find themselves. In general, the texts produced were brief and the children did not perform text reviews or post hoc reviews. Moreover, we observed, as expected, that students needed fewer seconds to complete the tasks both at T2 and at T1.

We will concentrate on burst analysis, and we will leave out of our work the analysis of pauses, which may be due to multiple and complex causes (Prunty et al., 2014). In line with this, a study by Alves and Limpo (2015), found that neither handwriting nor spelling made a significant contribution to explaining variance in pause length in primary school children between the ages of 7 and 12. In their work they established that the length of writing bursts, in turn, explained significant variance in text quality (narrative or expository) at all grade levels.

In particular, we will focus on studying the bursts of the third task from a linguistic point of view. Regarding the quality of the writings of the third task, we addressed the question of how these children write, paying special attention to the spelling, punctuation marks and syntax of standard Basque (Euskara batua). As for the linguistic analysis itself, we used some NLP tools for Basque (Otegi et al., 2016) to analyze the texts produced by the students, but we need to complete the analysis with manual labeling, because the tools were not designed for this type of texts. Two linguists examine the texts according the following features:

    i. The number of lemmas. We compared the text that corresponds to what they have written (transcription) with production, and only the correct lemmas are counted.
    ii. Spelling errors
    iii. Letter omissions
    iv. Hiposegmentations
    v. Hypersegmetations
    vi. Language errors. Among the most frequent are the lack of agreement with the verb.

In general, we observed an improvement in terms of the reduction of words written together or hiposegmentations, but we appreciate that there are still quite a few deviations from the conventions of the written language in the two stages of the school year. We were able to document gaps of spelling nature, either by writing words together or separated hiposegmentation or hypersegmentation respectively, or deviations from standard by syntactic issues.

The third task was the most demanding for these participants, as they had to plan, generate a text, transcribe and review from an illustration. In this task, we observed apart from the length of the bursts, the most common linguistic structures that appear in the longest bursts:

    i. Many of them are periphrastic verbs. These verbs must inflect with the help of an auxiliary verb.
    ii. There is a greater use of past tense verbs.
    iii. Noun phrases with the determiner bat "one".
    iv. Coordinating conjunction eta "and" as the linking element for the longest bursts.

It is important to note that the building of an auxiliary form in Basque implies to choose all its agreement markers or the paradigms of agreement morphology. While longer bursts in many cases do not constitute whole sentences, verbal forms are complex. In this line, Kim's work (2022, p. 216) points to the relationship between burst length and text linguistic quality: "In other words, children who wrote more words and letters per burst episode had higher quality of written composition, even after controlling for the included language, transcription, and domain-general cognitive skills".

We must add that Basque, unlike Romance or Germanic languages, is a rich morphology agglutinative language, so that the students should know the form of the paradigms involved in each case. Thus, in addition to the length of the bursts, we consider that morphology is the cornerstone to understand the development of Basque handwriting.

Conclusions

We consider that HandSpy has been a valuable tool for analyzing writing in real time, mostly for research purposes. It has been the starting point of our research design and we have applied this methodology in this pilot study. To sum up, we consider that to improve our study we need to extend the corpus and refine/rethink the linguistic categories for the study of

children's writing corpus. We agree with Durrant (2022), when he notes that "defining linguistic and textual categories is a crucial step in designing research into children's writing".

One of the linguistics features that plays an important role in Basque is morphology. Bartlie et al. (2022) consider that it has not received proper attention in former studies: "Still morphology has received little attention in previous studies of language minority children".

Finally, we consider that we have contributed to promote written Basque and to pay attention to the importance of children's handwriting at Primary or elementary school level. Limpo and Graham (2020), in their work, offer an extensive summary of the extant evidence on this topic, which subject, highlights the importance of researching and promoting handwriting.

References

Alves, R. A., & Limpo, T. (2015). Progress in written language bursts, pauses, transcription, and written composition across schooling. *Scientific Studies of Reading, 19*(5), 374-391.

Bratlie, S. S., Brinchmann, E. I., Melby-Lervåg, M., & Torkildsen, J. V. K. (2022). Morphology—A gateway to advanced language: Meta-analysis of morphological knowledge in language-minority children. *Review of Educational Research, 92*(4), 614-650.

Cameron, D. (2001). *Working with spoken discourse*. London: Sage.AGE.

Durrant, P. (2022). Studying children's writing development with a corpus. *Applied Corpus Linguistics, 2*(3), 100026.

Hayes, J. R. (2012). Modeling and remodeling writing. *Written communication*, *29*(3), 369-388.

Ibarra Lizundia, I., & Iruskieta Quintian, M. (2022). Disgrafia hobetzeko esku-hartzea idazkailu digitala erabiliz. *Uztaro: Giza eta Gizarte-zientzien aldizkaria, 121*, 155-178.

Jiménez, J. E. (2018). *Early Grade Writing Assessment: A report on development of an instrument*. United Nations Educational, Scientific and Cultural Organization.

Kim, G. Y. S. (2022). Do written language bursts mediate the relations of language, cognitive, and transcription skills to writing quality? *Written communication, 39*(2), 200-227.

Limpo, T., & Graham, S. (2020). The role of handwriting instruction in writers´education.. *British Journal of Educational Studies, 68*(3), 311-329.

Monteiro, C. & Leal, J. P. (2013). Managing experiments on cognitive processes in writing with HandSpy. *Computer Science and Information Systems, 10*(4), 1747-1773.

Otegi, A., Ezeiza, N., Goenaga, I., & Labaka, G. (2016). A modular chain of nlp tools for basque. In *Text, Speech, and Dialogue: 19th International Conference, TSD 2016, Brno, Czech Republic, September 12-16, 2016, Proceedings 19* (pp. 93-100). Springer International Publishing.

Pascual, M., Soler, O., & Salas, N. (2023). In a split second: Handwriting pauses in typical and struggling writers. *Frontiers in psychology, 13,* 1052264.

Prunty, M. M., Barnett, A. L., Wilmut, K., & Plumb, M. S. (2014). An examination of writing pauses in the handwriting of children with Developmental Coordination Disorder. *Research in developmental disabilities, 35*(11), 2894-2905.

Vanjari, N., Shaikh, F., Shah, V., & Sunesara, M. H. (2023, May). Review on Dysgraphia Prediction using Handwriting Recognition. In *2023 4th International Conference for Emerging Technology (INCET)* (pp. 1-7). IEEE.