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WRITING FLUENCY PREDICTED BY READING, LINGUISTIC AND COGNITIVE SKILLS IN L1 AND L2 IN THE WRITING OF BILINGUAL BISCRIPITAL PERSIAN-SWEDISH CHILDREN

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Abstract

Literacy acquisition in children's L1 and L2 contributes to academic success, and embraces and supports children's backgrounds and identity formation. However, limited education can prevent bilingual children from developing their writing fluency on the same level in L1 and L2. An analysis of writing fluency can show aspects that require more or less effort in children's L1 and L2 writing. Thus, it is important to examine writing fluency and the related reading, linguistic and cognitive skills across children's languages. Our knowledge is limited regarding the skills that could influence children's writing fluency. Previous studies have mainly focused on Latin scripts and/or one alphabetic and one non-alphabetic script. Furthermore, English has been the writers' L1 or L2. This paper investigated reading, linguistic and cognitive skills related to the writing fluency of bilingual biscriptal children in two different alphabetic scripts: Persian (L1) and Swedish (L2) across two different genres: narrative and descriptive. 23 children in years 4–9 (aged 10–15) produced four texts each using the Eye and Pen tool. Standardised tests across both languages were used to explore the participants' reading, linguistic and cognitive skills. Analyses showed that they were more fluent writers across both genres in L2. Word reading appears to contribute to writing fluency across both languages, whereas vocabulary knowledge only related to writing fluency in L1. No significant relationship was found between working memory and writing fluency in either L1 or L2.

Keywords: Handwriting, Eye and Pen, word comprehension, working memory, vocabulary, word reading

1. INTRODUCTION

Speakers of minority languages are exposed to at least two languages: one language at home, another in the society and at school. They use the minority language to mainly communicate with family members, relatives and possibly some friends. Acquisition of the other language goes through formal education and social contacts outside the circle of minority language speakers. In the literature, different terminologies are used to refer to minority languages—such as mother tongue and home language—and to the language that minority speakers used outside their home circle, such as second language, school language and even foreign language. In this paper, in alignment with the aims and scope presented on the homepage of L1-Educational studies in Language and Literature, we use the term first language (L1) to refer to the first language acquired, the minority language, and second language (L2) to refer to the language minority language speakers acquire outside home, the dominant language.

L1 literacy acquisition contributes to literacy acquisition in L2 (Bialystok, 2001). However, various factors prevent bilingual children from acquiring both L1 and L2 literacy on the same level, in formal and informal language situations (Eisenclas et al., 2015). One of these factors is the educational policy. In Sweden, language education policy stipulates that the language of instruction in most schools is Swedish, an L2 for children from minority backgrounds. It depends whether the development of L1 literacy skills in terms of “cognitive/academic or literacy-related proficiency” (CALP) (Cummins, 2005, p. 3) will be at equal level, especially for writing, which a skill typically taught at school and not in the home. The writing development might be even slower when not only the languages differ, but also the scripts. This contrast is the focus of this paper, that reports on the writing skills in L1 and L2 of children of a minority language, Persian, in Sweden, who are not only bilingual but also biscriptural.

2. CONTEXT: L1-INSTRUCTION FOR MINORITY LANGUAGE SPEAKERS AND LINGUISTIC CHARACTERISTICS

2.1 *L1-instruction for minority language speakers in Sweden*

According to official population statistics, 142,159 people living in Sweden in 2020 were born either in Iran or in Afghanistan (Befolkningstatistik, 2021). They speak Persian (Farsi/Dari), one of the ten most common minority languages in Sweden. In the academic year 2017–18, 9,682 children in years 1–9 participated in Persian L1-education classes in Sweden (SOU, 2019).

These L1-classes are generally held after school hours. Children with a language other than Swedish are entitled to attend these classes for around one hour every week (Ganuza & Hedman, 2017). The syllabus contains spoken and written language practices, as well as becoming acquainted with the cultural aspects of the target

language. However, it is not easy to follow the syllabus due to time constraints. Observations conducted by Ganuza and Hedman (2015) demonstrated that during L1-classes in Sweden, teachers barely focused on writing. Writing activities were primarily restricted to copying from what the teacher had written on the board or the children were asked to write some short replies to textbook questions. Apart from this, the children's writing activities were mainly limited to exercises at home.

L1 teachers come from diverse educational backgrounds (SOU, 2019). Some have finished teacher education programmes either in Sweden or in their home country, whereas others might be selected simply because they are native speakers, without any form of higher education or with a degree in a subject other than teaching, such as Art.

2.2 *Persian and Swedish scripts*

Persian is an Indo-European language with an alphabetic orthography. Persian orthography is written from right to left and is a modified version of the Arabic script (Khanlari, 1979). Persian has 32 letters. There are three short and three long vowels in Persian. The short vowels, (/ɛ/, /o/, /æ/), are only shown by diacritics for beginners (Baluch & Besner, 1991) and are removed from textbooks after year 1 (Rahbari & Sénéchal, 2009). In Persian, the long vowels, (/i:/, /u:/, /a:/), have their own letters and are always written (Baluch, 2006). It has a polygraphic orthography as some phonemes such as /z/ could be represented by more than one grapheme, for example, ز, ظ, ذ, ض when writing (Arab-Moghaddam & Sénéchal, 2001).

Swedish is an Indo-European language with an alphabetic Latin-based script and is written from left to right. It has 29 letters, nine vowels and 20 consonants. All the vowels have their own letters and are always written. Swedish is both polyphonic and polygraphic. It is considered polyphonic as some graphemes such as *g* can be pronounced using various phonemes such as /g/ and /j/ when reading. Swedish has a polygraphic script because when writing, some phonemes such as /h/ can be shown by various graphemes such as *stj*, *sk*, *skj* and *sj* (Rosenqvist et al., 2007; "Swedish orthography", 2019). For more information regarding the differences between Persian and Swedish scripts see Johansson, 2022.

2.3 *Cognitive perspective on writing fluency*

From a cognitive perspective, writing fluency, can be considered as an important element of writing proficiency. As writers gain more practice and experience in writing, they also become more fluent writers. Writing fluency can be investigated in terms of fluency (process) and productivity (product). Olive et al. (2009, p. 305) considered writing fluency as "the end product of all the writing processes". Writing fluency indicates the effort writers had to put in the writing. Limited exposure to reading and writing as well as limited linguistic skills, orthographic and genre

knowledge could affect the fluency of writing. It is therefore relevant to investigate writing fluency and the factors that contribute to writing fluency in children's L1 and L2.

Cognitive writing models (e.g., Hayes, 2012) have included reading, linguistic (e.g., vocabulary knowledge) and cognitive (e.g., working memory) skills that could contribute to writing fluency. To date, most writing research that has investigated these skills has mainly focused on monolingual children (e.g., Adams et al., 2015; Kormos 2012; Palmer, 2010 for an overview of studies). There have been few studies on bilinguals (particularly adults) (e.g., Bonzo, 2008; Fellner & Apple, 2006) that have examined either L1 or L2 (e.g., Bonzo, 2008; Peng et al., 2020). Furthermore, bilingual studies have mainly focused on individuals who write in Latin scripts such as English and German (e.g., Bonzo, 2008) or in one alphabetic and one non-alphabetic script such as English and Chinese (e.g., Peng et al., 2020). English is often one of the participants' languages, either L1 or L2 (e.g., Friginal et al., 2014). Some cross-linguistic studies that compared different languages also compared different groups. An examination of reading, linguistic and cognitive skills related to writing fluency in both languages could be useful as these skills could be compared within participants. We found no studies that analysed reading, linguistic and cognitive skills related to writing fluency in both L1 and L2 among biscriptal children using two different alphabetic scripts.

One could also assume that skills that are related to writing fluency could also differ across genres. For example, narration could be supported by oral skills whereas other more academic genres such as expository and description must be learnt at school. Therefore, we used two different genres, narrative and descriptive tasks, in both languages, in the current study.

The first issue to explore is what extent writing fluency within biscriptal children varies as result of the language and the genre. First there is the issue whether writing fluency depends on the language and the genre:

- 1) Do scores on writing fluency depend on the genre? And is this dependency different in the two languages?

The second issue is whether writing fluency within biscriptal children draws on the same set of language and cognitive skills, and to which these relations are language specific. The question is whether the two sets of predictors, one in L1 and one in L2, are both connected to L1 and L2 writing fluency.

- 2) To what extent do word reading, working memory and vocabulary knowledge predict writing fluency in each of the scripts and across the scripts?

The answers on these questions may indicate to which extent writing fluency is a general or a language specific construct.

3. LITERATURE REVIEW

3.1 *Writing fluency*

3.1.1 *Writing processes*

One of the most influential cognitive models of writing was proposed by Flower and Hayes (1981) and has been developed in recent decades. In the latest version (Hayes, 2012), it is suggested that four activities are present during the writing process: a *proposer* suggests ideas in a non-verbal form to the translator, then a *translator* translates these ideas into verbal forms using the writer's lexical and grammatical knowledge (Chenoweth & Hayes, 2003). Next, the *transcriber* transforms the verbal strings of language into script. The *evaluator* might examine the adequacy of the outputs of the proposer, translator and/or transcriber. A writer with greater cognitive and linguistic skills can translate ideas into verbal strings of language by, for example, rapidly accessing words and grammatical structures and, as a result, translate and transcribe larger bursts (i.e., chunks of texts). In this case, the writer does not need to interrupt the process in order to find appropriate vocabulary and grammatical structures and/or revise the proposed or transcribed text. Consequently, the writer's process is more fluent (Chenoweth & Hayes, 2001).

3.1.2 *Writing proficiency and experience*

Mastery of writing processes requires years of writing practice and instruction (Berninger et al., 2002). Writing skills and experience can influence writing fluency. For example, English monolingual children have improved their handwriting speed, writing fluency (indicated by total number of words) and lexical diversity twice as much from year 1 to year 4 (Wagner et al., 2011). Greater writing experience and linguistic skills could lead to the automation of low-level processes such as handwriting speed, spelling, word finding and free up capacity for high-level processes, such as planning and composing a text. Speeding up low-level processes, in turn, would make cognitive effort free for other key-process. For instance, a writer who has, for example, mastered handwriting, could devote more resources to other, higher-level processes than a writer who is still struggling with the transcribing component (Wagner et al., 2011).

3.1.3 *Bilingual children's writing fluency*

With regard to bilingual children, their linguistic skills, exposure to reading and writing, as well as practice and experience, could determine whether they have higher fluency in their L1 or L2. Writers appear to have higher writing fluency in their L1 than their L2 (Miller et al., 2008; Schoonen et al., 2009), probably as a result of more experience. This assumption is confirmed by a recent study by Johansson and

Lindgren (2021) suggesting that Persian-Swedish bilingual children in years 4 to 9 had higher writing fluency in their L2 (Swedish) than their L1 (Persian). These researchers reported that the children were more used to reading and possibly writing in their L2 (Swedish) than their L1 (Persian). Consequently, these children had higher verbal fluency, measured by lexical retrieval, and writing fluency, on both productivity and fluency levels, in Swedish than in Persian. Thus, it may have been easier for them to retrieve words and grammatical structures in their L2 and they therefore produced texts more fluently in this language. The present paper broadens our perspective on how the linguistic, reading and cognitive skills are related to writing fluency across and within languages and genres.

3.1.4 Resources

It is argued that individual differences in second language acquisition processes, such as cognitive skills, are crucial in developing second language learning via writing (Kormos, 2012). Hayes' (2012) regarded four resources which could support fluent transcription: *reading*, *working memory (WM)*, *long-term memory (LTM)* and *attention*. First, reading is an important resource for writers as they regularly read and re-read what has been produced thus far (Kaufert et al., 1986). Re-reading could be regarded an instance of reviewing to verify what has already been written and whether it may require revision on the content and the linguistic level and help the writer decide on how to proceed. Thus, re-reading might result in the construction of a coherent text (Hayes & Berninger, 2014). Second, the writer's available WM resources could also influence how fluently the translator could transform ideas into verbal language (Chenoweth & Hayes, 2001, 2003). For inexperienced writers, the translation process could create problems if low-level transcription skills such as spelling are still not automated or within the age-expected results (Berninger et al., 1994). Fluent translation and transcription could allow a writer to rapidly access linguistic information, such as grammar, spelling and vocabulary, as well as knowledge about the genre and topic that are presumably stored in the LTM. Third, writers with greater LTM resources on the genre and topic could construct higher quality texts in a shorter time frame (e.g., Dansac & Alamargot, 1999). Fourth, writers' attentional capacity could influence fluency when writers are more easily distracted during the process, and fluency is disrupted (Hayes & Berninger, 2014).

3.2 Genres

Writing processes can vary across different types of text (Kellogg, 2001). This may imply that writing fluency differs across genres (e.g., Yang, 2014; Yang et al., 2015). Narrative writing is regarded as being more fluent, while most of the content can be generated associatively, in a temporal sequence, whereas argumentation requires the reprocessing of content to a greater extent. The production of a written narrative can largely depend on oral experience of telling stories, which can be perceived as

an extended monologue. In the case of argumentation, the oral and written communication is different, while in oral situations, argumentation usually takes the form of a dialogue. A higher rate of knowledge and experience of a specific genre can minimise the effort required in using the cognitive processes that underlie writing, such as planning and translating, thereby resulting in a higher rate of fluency (Kellogg, 1994).

Studies report mixed results about the effects of genre on children and adult's writing fluency on a process level. For example, genre did not influence monolingual children's process writing fluency in years 2–9 (e.g., Alves & Limpo, 2015; Olive et al., 2009; Van Hell et al., 2008), whereas a recent study found that monolingual children (years 10–11) wrote narrative fiction texts at a higher speed than argumentative texts (Ten Peze et al., 2021). The difference between results among monolingual children could possibly be explained by the children's age difference. In other words, the effects of genre on fluency might be more visible as the children become more experienced writers and acquire knowledge of genre. For example, research on monolingual adults has demonstrated higher writing fluency on the process level in narrative compared with expository (Van Hell et al., 2008) and with argumentative texts (e.g., Beauvais et al., 2011; Medimorec & Risko, 2017). More consistent results have been observed when examining the productivity. Research on both inexperienced and experienced monolinguals (e.g., Beers & Nagy, 2011; Verhoeven & Van Hell, 2008) has observed the genre effect on writing productivity.

Few studies have investigated the effects of genre on the writing productivity of bilinguals. For the productivity of adults in English (Yang, 2014; Yoon & Polio, 2017) and German (Thorson, 2000) as L2, studies did not observe a genre effect on L2 writing. For example, in a study by Yang (2014), Chinese participants were given four rhetorical tasks in their L2 (English): narrative, expository, expo argumentative and argumentative. No significant effect of these tasks was found in the participants' writing fluency. Yoon & Polio (2017) asked participants to write narrative and argumentative texts in their L2 (English). They also found no significant genre effect on writing fluency. In another study (Thorson, 2000), participants were asked to write a letter to a friend and a newspaper article in their L2 (German). However, no statistical differences were found between the number of characters the writers produced in these two genres.

Studies on the effects of genres on writing fluency report less homogeneous results. For example, Ruiz-Funes (2015) found that American university students studying Spanish (L2) at an advanced level showed no differences in fluency in both argumentative and compare and contrast texts, whereas Lee (2019) found that Korean EFL university students had a higher fluency in narrative compared to argumentative texts. These differences in results might be attributable to the participants' proficiency level, but also to the absence of narrative writing in the Ruiz-Funes (2015) study. High language proficiency possibly freed Ruiz-Funes's (2015) participants' WM capacity and could help them rapidly retrieve the genre knowledge stored in their LTM. However, Lee's (2019) participants perceived that the structure

and language of the narrative texts were less difficult and, as a result, it was easier for them to write narrative than argumentative texts.

3.3 Writing fluency and reading

There is a reciprocal relationship between reading and writing (Brand & Brand, 2006; Clay, 2001). This could be attributed to common knowledge such as text knowledge, orthographic knowledge and cognitive skills that they rely on such as short and long-term memories (e.g., Shanahan et al., 2006). For example, from years 1–6, reading on a word and sentence level is associated with different aspects of writing, such as spelling and writing quality, and from preschool to year 3, with children's writing productivity and fluency (Abbott & Berninger, 1993; Berninger et al., 2002; Kent et al., 2014; Kim et al., 2011).

There is also a body of research which support that children could use their literacy skills across languages (for a review, see Cummins, 2005). For example, Goodrich and colleagues (2016) examined whether reading and writing skills such as orthographic knowledge and phonological awareness were related across Spanish and English in a group of Spanish-speaking minority children. Their results showed that children could apply knowledge gained from acquiring to read and write in their L1 while practicing and acquiring to write in their L2.

Reading experience and linguistic skills could impact the size of the chunks of text that writers tend to read and possibly revise. This reading process appears to be more automated in the dominant language than in the minority language (Kormos, 2012), which positively affects the fluency score. The same is true for transcribing processes, which require more effort and attention in L2 compared to L1 if the children use two distinct orthographies (Kormos, 2012). This possibly slows down the children's writing fluency.

3.4 Working memory and writing fluency

It is assumed that WM capacity influences writing quality and fluency (McCutchen et al., 1994; Swanson & Berninger, 1996); the greater the writer's WM capacity, the more fluent the writing process and the better the text quality. For example, planning, translating ideas into words, transcribing words into written language and reviewing a written text can place heavy demands on WM capacity (Chenoweth & Hayes, 2003; Olive, 2004). Thus, a high WM capacity could result in higher writing fluency and better text production (Gathercole & Alloway, 2008; Kellogg, 1999; McCutchen et al., 1994; Olive, 2012), particularly when the tasks are more demanding.

L2 text production can be more challenging since it might require more attention and higher WM capacity (DeKeyser et al., 2007) because it can be more difficult for writers to access words and grammatical structures in their L2 (Kormos, 2012). This could slow down the children's process writing fluency. This effect might decrease

with increased L2 reading experience and L2 linguistic proficiency. For example, L2 studies of Hungarian-English (Kormos & Sáfár, 2008; Michel et al., 2019) and French-English (Adams & Guillot, 2008) bilingual children aged 11–16 found no significant association between the participants' WM capacity, writing composition and writing scores in their L2 (English).

3.5 Vocabulary knowledge and writing fluency

Vocabulary knowledge, presumably stored in the LTM, has been regarded as a measure of general language proficiency (Meara, 1996). Studies have found a positive relationship between vocabulary knowledge and oral language fluency (e.g., De Jong et al., 2012; Koizumi & In'nami, 2013; Uchihara & Saito, 2019) in children aged 14–18, English second language learners (Koizumi & In'nami, 2013) and adults (Uchihara & Saito, 2019). Few studies have investigated the relationship between vocabulary knowledge and the fluency of the writing process. Grewal and Williams (2018) report a significant negative relationship between lexical retrieval and writing fluency.

3.6 This study

Focusing on cognitive factors that can influence writing fluency, in terms of speed (fluency) and text productivity (product) draw on resources described in Hayes's (2012) model, we set up a study to investigate the relationship between a number of reading, linguistic and cognitive skills that are relevant for writing fluency on the resource level, such as word reading (WR), vocabulary knowledge (VK), (presumably stored in the LTM) and WM, in both L1 (Persian) and L2 (Swedish) of a group of Persian-Swedish biscriptal children in years 4 to 9 across two different genres.

To exploratively answer the research questions, we set up a two-factor (genre * script/language) within-subject design, with fluency and productivity as the dependent variable and WR, WM and VK as the explanatory variables, all measured in both languages.

We explored the construct of writing fluency in both languages and genres (research question 1) and the co-variance between the explanatory and the dependent variables (research question 2).

4. METHODS

4.1 Participants

A permission was received from the Swedish Ethical Review Authority (approval number/ID: 2016/177-31Ö) to conduct this research. The project and the criteria for identifying participants were announced on social media and on Persian radio channels in Sweden. The first author also contacted around 1,200 people including

Persian mother tongue teachers, special educational teachers and school principals. Most of the participants were found on Facebook. 26 Persian-Swedish children in years 4–9 (10 to 15 years with a mean age of 12.6) participated in the project.

We are aware of the small sample size and the large age range of the participants. We had hoped to find a more balanced group. However, all the participants were required to speak, understand, read and write both Persian and Swedish. A higher number of participants could have been involved in the study if they had not been required to be bicultural and we were only interested in Persian-Swedish bilinguals who could read and write in Swedish, not in Persian.

The participants' parents were native Persian speakers. The children spoke Persian as a minority language. They mainly spoke Persian at home and participated in Persian mother tongue classes at schools (about one hour each week). All participants were required to have been in the Swedish school system for a minimum of three years in order to participate in the project. The three-year criteria was used in order to ensure that the participants had had sufficient time to acquire basic knowledge of their L2 (Swedish) and would be able to perform the tasks. Their schools used Swedish as a medium of instruction, meaning that all courses, except language courses such as English, German and French, were in Swedish. Therefore, children were surrounded by input in the national language (Swedish). Two participants in year 7 had been diagnosed with dyslexia and were therefore excluded from the study. Also, one participant in year 4 was not included in this study as he wrote about another topic than the assigned topic. Thus, the analysis in this study includes 23 participants (see Table 1). These 23 children had lived in Sweden for an average of 8.5 years and had attended Swedish schools for at least 5.6 years at the time of the assessment.

Those who were interested in this project received an information letter and a letter of consent in both languages and were asked to complete the letter of consent in the language in which they were most comfortable. Questionnaires collected on the children's background, language and literacy use and practices at home (Johansson, 2022) demonstrated that the participants mainly spoke Persian with their parents and spoke both Persian and Swedish with their siblings. The questionnaires also demonstrated that they read more often in Swedish at home. An examination of their writing tasks and screening tests (Johansson & Lindgren, 2021) showed that they had higher writing fluency, measures of productivity and fluency, and lexical retrieval, assessed in terms of phonological and semantic fluency, in Swedish compared to Persian. They were more exposed to Swedish, the national language, (L2) than to Persian, the minority language, (L1) at school and in society. They were also more used to reading and writing in Swedish as most of the tasks and assignments they performed at home, as well as lessons at school, were in Swedish (Johansson, 2022).

Table 1. Distribution of participants across years

Years (M age)	N
Year 4 (10)	6
Year 5 (11)	4
Year 6 (12)	2
Year 7 (13)	5
Year 8 (14)	3
Year 9 (15)	3

4.2 Materials and procedures

4.2.1 Reading, linguistic and cognitive test materials

The test materials used in this study were standardised in Persian and Swedish, respectively.

Word reading. The Persian WR test consisted of three categories of words, with regard to frequency: high frequency, medium frequency and low frequency. All the words were without diacritics. There was a total of three cards with 40 words on each card. The participants were given two minutes to read as many words as they could correctly on each card. The reliability index (Cronbach's alpha) for this test reported 0.98 (Kormi-Nouri & Moradi, 2007).

The Swedish WR test included 36 words for participants in years 4–5 and 46 words for participants in years 6–9. The participants saw each word on a computer screen for 200 milliseconds and were required to read each word. The reliability scores provided in the manual were 0.90 for year 4 and 0.93 for year 8. In addition, the validity scores reported 0.89 (year 4) and 0.79 (year 8) $p = <.001$ (Høien, 2007).

Working memory. WISC IV working memory tasks were used in Persian (Abedi et al., 2016) and Swedish (Wechsler, 2007). The first author read a series of digits to the participants. They were required to repeat them in reverse order. The level of difficulty of the task increased in proportion to the number of digits the participants were required to remember and repeat in reverse order.

Vocabulary knowledge. The Persian test contained 30 multiple-choice questions. The participants listened to the questions and responses and were asked to identify and choose the correct response. The Cronbach's alpha for this test was 0.87 (Kormi-Nouri & Moradi, 2007). The Swedish test contained 40 multiple-choice questions for years 4–6 and 34 multiple-choice questions for years 7–9. Similarly, the participants listened to the questions and responses and were asked to identify and mark the correct answer. The reliability scores provided in the manual are 0.88 for year 4, 0.91 for years 5 and 6, 0.78 for years 7 and 8 and 0.80 for year 9. There were no time limits for the VK tests in either Persian or Swedish.

4.2.2 *Writing tasks*

Each participant wrote four texts, a descriptive and a narrative text, in both Persian and Swedish. For the descriptive writing tasks, the participants wrote about their dream house in Persian and their dream present in Swedish. For the narrative tasks, two similar frog stories were chosen; they wrote about *Frog Where Are You?* (Mayer, 1969) in Persian and about *A Boy, a Dog and a Frog* (Mayer, 1967) in Swedish. Seven main images were chosen from each story and the participants were asked to write down what was happening in the images. A pilot study helped us determine the approximate amount of time required to complete each writing task. The participants had 15 minutes to finish each descriptive text and 30 minutes to finish each narrative text. All participants completed their writing tasks within the time provided.

The participants, together with their parents, chose the time and place of our meetings. They were asked to choose the time that was most convenient for them, as well as a quiet location in order to avoid distractions, for example, meeting rooms, classrooms, home and libraries. Most participants completed all the tasks in the larger project during two to three sessions. However, a few of the older participants only had the opportunity to meet with the first author once. So, the first author asked them to choose a day when they were free and had no school activities or classes. We believe that by adjusting to participants' needs and preferences, we enabled them to perform the tests and writing tasks to the best of their ability. The order of tests, writing tasks and languages was counterbalanced.

4.2.3 *Instruments and measures of fluency*

Children who attend Persian mother tongue classes are generally used to writing by hand. They are not accustomed to the Persian keyboard and are unfamiliar with its various features. Thus, we used the Eye and Pen tool (Alamargot et al., 2006) to collect and analyse the writing tasks, such as retracting the total writing time. In a recent study, two indicators were defined for writing fluency: productivity (number of written elements produced) and fluency (process: number of written elements per second). Each indicator was operationalised for three text units: characters, words and clauses. For each level we counted the number in the participants' texts for productivity, and the number per second for fluency (for further information, see Johansson & Lindgren, 2021).

The resulting dataset contained composite scores of measures of productivity and fluency on three units, across two genres and languages.

5. ANALYSIS

5.1 Preliminary analyses

For all analyses, we applied an alpha level of $p < .10$, suggested by the small sample size. This left us with a somewhat larger chance of type I errors. However, as long as we were aware that this could happen, in an exploratory analysis we would prefer not to miss the relationship between variables.

5.1.1 Analyses of outliers

An inspection of the distribution of scores revealed that for some variables, the skewness and kurtosis indicators indicated a non-normal distribution. Subsequent outlier analyses indicated that one case disturbed the normal distribution of WR Swedish scores, and another case disrupted the normal distribution of all fluency scores. We have not included these cases in the analysis of these variables.

5.1.2 Relationship between the explanatory variables

We first inspected the relationship between the reading, linguistic and cognitive scores across languages. As expected, the scores for the cognitive skill, WM, correlated significantly ($r = .61, p = .002$), indicating that this measure is to some extent language independent. In other words, it points to a working memory construct that does not rely on language factors. However, we found no correlation for language and reading, VK and WR scores (respectively $r = -.12, p = .59; r = .08, p = .88$).

We then inspected the relationship between the three variables within the languages (Table 2). Within both languages, WM and VK were positively associated. The pattern for WR appears to be language specific. In Persian, the two reading and linguistic scores were positively associated – WR and VK – while in Swedish, WR was associated with WM. This latter finding may indicate that WR in Swedish relies on WM, while in Persian it does not.

Table 2. Correlations (p -values within brackets) between reading, linguistic and cognitive skills in the two languages: Word Reading (WR), Working Memory (WM) and Vocabulary Knowledge (VK). (p value $< .10$ are underlined.)

	Persian	Swedish
WR-WM	.21 (.92)	<u>.38</u> (.08)
WR-VK	<u>.59</u> (.003)	.23 (.30)
WM-VK	<u>.36</u> (.09)	<u>.44</u> (.04)

5.1.3 *Relationship between dependent variables within languages*

For fluency and productivity, the three units – characters, words, clauses – correlated strongly (varying from .78 to .98), all at $p < .001$) within both languages and both genres. While we found a strong correlation for the three units for fluency and productivity in the languages, we calculated the compound scores for fluency and productivity: the average scores for the three units, per genre and per language, resulted in four scores for the productivity and four scores for the fluency variables (two languages*two genres). These scores allowed us to check for correlations across genres within languages. For Swedish, the productivity scores for both genres correlate .47, the fluency scores .77; for Persian, these correlations were .84 and .95, respectively, indicating a somewhat stronger differentiation in Swedish than in Persian, in which almost no differentiation was observed. For the purpose of generalisation, we combined the scores for the two genres per language, resulting in four scores for writing fluency, for fluency and productivity, in both Persian and Swedish.

5.2 *Analysis strategy*

In order to answer the first research question about the effects of genres on writing fluency in both languages, we ran correlation analyses between the indicators of writing fluency and applied paired t-tests within (genre effects) and across languages. To answer the second question about the associations between reading, linguistic, cognitive skills and writing fluency, within and across languages, we ran correlation analyses.

6. RESULTS

This section presents the results of the effects of genre and languages on writing fluency. We also analysed the relationship between reading, linguistic and cognitive skills and writing fluency in both languages and genres.

Table 3 presents the descriptive data for the two dependent variables of fluency and productivity, across two genres in two languages, based on 23 cases (for the fluency variables, one outlier was removed; $n = 22$).

6.1 Effects of genre on writing fluency

Table 3. Descriptive statistics across different types of text

Genre	Language	Fluency		Productivity	
		M	SD	M	SD
Narrative	Swedish	0.37	0.11	181.15	64.03
	Persian	0.16	0.09	104.16	47.21
Descriptive	Swedish	0.35	0.12	167.19	70.14
	Persian	0.14	0.07	84.35	40.19

Note: n = 23; For the Fluency variable, one outlier was removed from the data analysis.

6.1.1 Effect of genre in Swedish and Persian

The genre effect was statistically significant for Persian (fluency $t(21) = 2.5, p = .01, ES = 0.54$; productivity $t(22) = 3.71, p < .001, ES = 0.77$) but not for Swedish (respectively, $t(22)=1.16, p= .26, ES=0.24$; $t(22) = 0.97, p = .34, ES = 0.20$). The genre effect in Persian indicated that descriptive texts were shorter and written at a slower speed than narrative texts. Such a genre effect was not observed in Swedish. The difference in effect was possibly due to the smaller variation in scores in Persian compared to Swedish.

6.1.2 The effect of language within genres

Within both genres, the Swedish texts were longer and written at a higher speed. The narrative texts were considerably longer ($t(22) = 7.47, p < .001, ES = 1.56$) and written at a higher speed ($t(21) = 11.35, p < .001, ES = 1.55$). The same applied to the descriptive texts (productivity: $t(22)=6.04, p < .001, ES= 1.26$; Fluency $t(21) = 9.92, p < .001, ES = 1.33$). All were large effects.

The correlations for productivity between genres were both statistically significant. There was a correlation in Swedish $.62 (p < .001)$ and in Persian $.39 (p = .06)$ between production in narrative and descriptive texts. No significant correlations were observed for fluency (narrative texts $r = .33, p = .13$, descriptive texts $r = .33, p = .14$) in Persian and in Swedish.

6.2 Reading, linguistic and cognitive skills that explain the variance in productivity and fluency in two languages

In this section we explored the relationship between reading, linguistic and cognitive skills and the indicators of writing fluency in Persian and Swedish.

6.3 Relationship between reading, linguistic and cognitive skills and writing fluency across two genres

Table 4 presents all correlations between the three measures (WR, VK, WM) assessed in both languages, and the two writing fluency indicators, for both genres, in both languages.

Table 4. Correlations between WR, VK, WM and writing fluency across two languages and genres (*r*: correlation; *p*: *p*-value). Correlations with *p*-value of $< .10$ are underlined.

		Swedish				Persian			
		Productivity		Fluency		Productivity		Fluency	
		Narr	Desc	Narr	Desc	Narr	Desc	Narr	Desc
WR_SWE	<i>r</i>	<u>.49</u>	.34	.22	<u>.42</u>	<u>.45</u>	.29	-.06	.14
	<i>p</i>	.02	.12	.35	.06	.04	.19	.79	.52
VK_SWE	<i>r</i>	.13	-.02	-.10	-.01	-.06	-.08	<u>-.43</u>	<u>-.36</u>
	<i>p</i>	.55	.94	.67	.97	.76	.73	.04	.10
WM_SWE	<i>r</i>	.31	.13	.01	.11	.15	-.02	-.01	-.02
	<i>p</i>	.16	.55	.98	.59	.49	.94	.98	.92
WR_PER	<i>r</i>	<u>.36</u>	.12	.09	.21	<u>.67</u>	<u>.62</u>	<u>.60</u>	<u>.65</u>
	<i>p</i>	.10	.60	.70	.34	.001	.002	.002	.001
VK_PER	<i>r</i>	.15	<u>.39</u>	.20	.28	<u>.36</u>	<u>.47</u>	<u>.40</u>	<u>.37</u>
	<i>p</i>	.51	.07	.36	.20	.09	.02	.06	.08
WM_PER	<i>r</i>	-.07	.06	-.11	.01	.05	.11	.14	.15
	<i>p</i>	.75	.79	.60	.96	.82	.61	.51	.51

Note: Correlations were based on 23 cases. Correlations that include WR Swedish and/or Fluency were based on 22 cases. Narr = Narrative; Desc = Descriptive genre.

WR correlated with writing fluency measures in both languages, but more consistently in Persian – in productivity and fluency in both genres—compared to Swedish—with productivity in narrative and fluency in the descriptive texts.

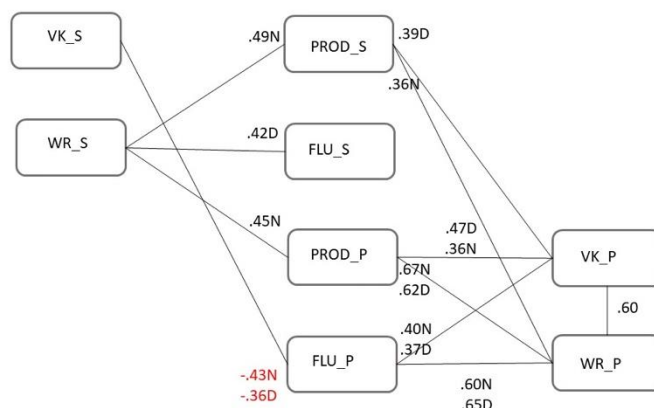
VK in Swedish did not correlate with any of the four writing fluency measures in Swedish. However, Persian VK positively correlated with all four writing fluency measures in Persian.

WM scores did not correlate with the writing fluency scores in either of the languages.

Overall, the pattern in Persian appeared to be more consistent with linguistic and reading—VK and WR correlated with all four Persian writing fluency measures.

This pattern of correlation is visualised in Figure 1, which presents an overview of the raw correlations ($p > .10$).

Figure 1. Graphic overview of the raw correlations ($p < .10$) taken from Table 4 between two individual characteristics (Word Reading [WR] and Vocabulary knowledge [VK]) per genre (N: Narrative; D: Descriptive). Left panel: VK and WR Swedish; right panel: Persian. Negative correlations: in red.



6.4 Relationship between reading, linguistic and cognitive skills and writing fluency in two languages

Table 5 presents the relationship between WR, VK, WM and writing fluency indicators in two languages, abstracting from the two genres. Figure 2 provides a graphic overview of the relevant correlations from Table 5 ($p > .10$).

Table 5. Correlations between WR, VK, WM and writing fluency in two languages generalised across two genres (*r*: correlation; *p*: *p*-value). Correlations with a *p*-value of $< .10$ are underlined.

		Prod_SWE	Prod_PER	Fluency_SWE	Fluency_PER
WR_SWE	r	<u>.45</u>	.36	.36	.04
	p	.04	.11	.11	.86
VK_SWE	r	.06	-.07	-.05	<u>-.40</u>
	p	.78	.74	.82	.06
WM_SWE	r	.25	.08	.07	-.01
	p	.25	.72	.75	.95
WR_PER	r	.27	<u>.67**</u>	.16	<u>.63**</u>
	p	.22	<.001	.46	.001
VK_PER	r	.32	<u>.43*</u>	.26	<u>.39</u>
	p	.14	.04	.24	.07
WM_PER	r	-.003	.08	-.05	.15
	p	.99	.71	.82	.51

Note: Correlations were based on 23 cases. Correlations in which WR Swedish and/or Fluency were based on 22 cases. Narr= Narrative; Desc=Descriptive genre.

Figure 2. Graphic overview of the raw correlations ($p < .10$) between reading and linguistic skills (Word Reading: WR) and (Vocabulary Knowledge: VK) and writing fluency (Productivity, Fluency) generalised across two genres. Left panel: VK and WR Swedish; right panel VK and WR Persian.

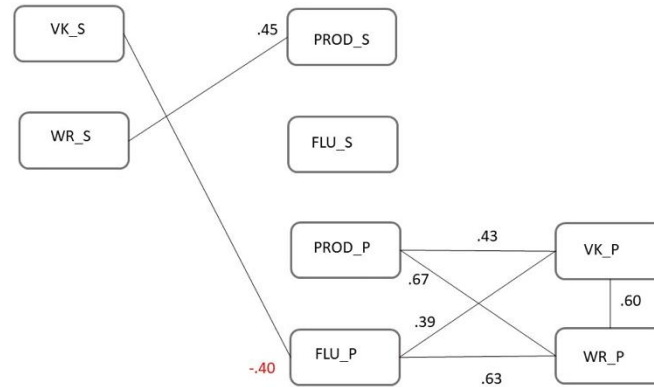


Figure 2 shows a regular pattern for Persian that strongly contrasts with the pattern in Swedish. For writing fluency in Persian, a consistent pattern was observed between WR and VK. Both reading and linguistic skills contributed positively to both writing fluency indicators. No such pattern was observed in Swedish. In Swedish, only WR positively correlated with writing productivity. A cross-language negative correlation was found between VK in Swedish and fluency in Persian.

No reading and linguistic skills measured in Persian contributed to writing fluency in Swedish.

7. DISCUSSION

The main aim of the study was to investigate the cognitive factors that could influence writing fluency, and the extent that the relations depend on genres and scripts. We explored whether the relationship between cognitive, linguistic and reading skills and writing fluency was different for the two languages in biscriptal Persian-Swedish children. We selected three explanatory variables that were expected to reduce the cognitive load, thereby positively influencing writing fluency: WM as a cognitive skill and WR and VK as reading and linguistic skills.

7.1 The construct of writing fluency

Our first research question asked about the effect of L1 vs. L2 on writing fluency—in terms of productivity and fluency—and whether the effects can be generalised

across genres. The answers to this question can tell us more about the generalisability of the construct of writing fluency.

This study highlights the construct of writing fluency using two measures: productivity and fluency. The scores on the three text units indicated productivity and fluency: signs (characters), semantics (words) and syntactic (clauses) units. We found that the productivity and fluency scores across genres correlated more strongly in Persian compared to Swedish, indicating that the construct of writing fluency is somewhat more differentiated in Swedish, while in Persian, the differentiation between these two indicators is almost absent. We therefore conclude that there are indications that productivity and fluency are language-dependent constructs, in this sample, including participants with different expertise in L1 and L2. Cummins (2005) states that oral language fluency is language dependent in bilinguals' L1 and L2. The current study appears to indicate that writing fluency could also be language dependent in bilinguals' languages. Other studies may dive deeper in this issue and try to find more participants with varying language practice and experience in different scripts.

7.1.1 Effects of language and genre on productivity and fluency

We observed a language effect on both productivity and fluency as both Swedish texts were longer and more rapidly processed than the Persian texts. We also observed a genre effect on productivity and fluency in Persian as the descriptive texts were shorter and processed at a slower speed. However, we did not observe this effect in Swedish. The results showed that the participants were more fluent writers in Swedish (L2). Thus, the genre effect was only found in the language in which they were less fluent writers, suggesting that it was probably more challenging and time-consuming for them to write descriptive texts compared to narrative texts in Persian. Narrative texts can require less effort and be less cognitively demanding to produce than descriptive texts (Kellogg et al., 1991). An alternative explanation for this effect is the task format. For example, for the narrative tasks, the participants were provided with images and were asked to describe what was happening in the images. However, during the descriptive tasks, they had no access to any of the images and had to use their own imagination to produce their texts. Another explanation is the time set for each task. The pilot study showed that the students needed more time to write narrative texts than descriptive texts. Therefore, the descriptive task was set at 15 minutes and the narrative task at 30 minutes, which obviously creates more writing time. However, these two task factors were similar in Persian and Swedish. Thus, they do not explain the differences in genre effects between Persian and Swedish. As this genre effect was only observed in the language in which the participants were less fluent writers, it could suggest that using their imagination to create a text, generating ideas, accessing the linguistic skills that are presumably stored in their LTM, was more challenging in their L1 than in their L2.

The results of this study are not in line with previous studies on bilingual children (Miller et al., 2008; Schoonen et al., 2009) and adults (Chenoweth & Hayes, 2001), which found that they were more fluent writers in their L1 rather than their L2. In the previous research (e.g., Miller et al., 2008), the language situation was different, the participants' L1 was both the school language and the language that students used at home, and the L2 was the foreign language acquired at school. This difference means that the participants those studies had received more education and practice in L1 compared to L2. The limited literacy practice and formal L1 instruction the participants received in our study, may have restricted their opportunity to develop their reading and linguistic skills in L1. All school subjects at the participants' schools in the present study, except for languages subjects, were taught in Swedish (L2). Therefore, they had a wealth of opportunities to read and write in L2 across different genres, presumably resulting in even higher reading and linguistic skills in L2 compared to L1. Gathercole and Thomas (2009) have shown that the acquisition of the dominant language could be unproblematic for bilinguals whereas the acquisition of minority language maybe hampered with limited input. The results of this study support this notion as the children had higher writing fluency in their school language, L2, rather than their mother tongue, L1. So, their limited mother tongue instruction and the limited literacy practice at home have possibly led to reduced input in Persian writing and resulted in lower writing fluency in this language.

7.2 The effects of reading, linguistic and cognitive skills on fluency in two languages

Our second research question was about the relationship between three resources—Working Memory (WM), Word Reading (WR), Vocabulary Knowledge (VK) and writing fluency.

The results suggest that there are both similarities and differences regarding the role of these skills in understanding writing fluency in L1 and L2. The examination of the relationship between WM as a cognitive skill and writing fluency provided similar patterns across languages. WM did not correlate with productivity or fluency in any of the languages or genres. This was rather surprising as WM capacity can put a strain on children's writing during writing processes, such as translating and transcribing, which could influence their writing fluency (Chenoweth & Hayes, 2003; Olive, 2004). In a study of monolingual English children, Adams and colleagues (2015) found a significant relationship between verbal WM, measured by digits and writing fluency in year 1, but not in year 3. They concluded that the association between WM and writing fluency can change with children's age and as children automate their low-level transcription skills, more WM capacity become available for high-level transcription, such as proposing more complex text structure and language construction. This could partly explain the absence of a relationship between WM and writing fluency in L2 (in the present study, the language in which they are most fluent). However, it could be assumed that such relationships could have been found

between WM and writing fluency in the language in which the writers are less fluent (L1). Future studies could include more participants and investigate these relationships between children's L1 and L2 across different years.

Considering reading, WR and writing fluency appear to be related in both languages, which could further support the idea of a reciprocal relationship between reading and writing (Brand & Brand, 2006; Clay, 2001). The intertwined nature of the relationship between reading and writing can possibly be attributable to some common underlying linguistic text knowledge and cognitive skills that are involved in reading and writing processes (Shanahan et al., 2006). However, the results suggest that WR is more strongly and significantly related to both the writing process and the productivity of children's L1 compared to their L2. Drawing on the orthographic depth hypothesis (Katz & Frost, 1992), the level of orthographic depth between L1 and L2 could explain some of these differences across languages. For example, in Persian, there is a consistent correspondence between graphemes and phonemes in reading. However, the reader is not able to access all phonological representations of a word as short vowels are not written in Persian. In contrast, in Persian writing there is an inconsistent relationship between graphemes and phonemes. Also, the writer is not accustomed to writing short vowels. Persian orthography is considered to be opaque when these phonological representations in reading are absent (Rahbari & Sénéchal, 2009). It can be assumed that these orthographic characteristics i.e. lack of phonological representations and inconsistency between graphemes and phonemes, could slow down the process as the writer pauses to think about spelling and, in some cases, decide whether a specific phoneme is a short or a long vowel. Spelling uncertainty can also lead to a reluctance to produce more words (longer texts). A cross-linguistic analysis by Seymour et al. (2003) of 13 European languages showed that reading acquisition can be faster in transparent orthographies (e.g., Spanish) compared to semi-transparent (e.g., Swedish) and opaque orthographies (e.g., English). Thus, it could be concluded that orthographic characteristics are important and that they could prevent some children from becoming more fluent writers, particularly when they have received limited mother tongue instruction, which could supposedly result in them having limited writing practice in their L1.

The results suggest that linguistic skills can play different roles in understanding writing fluency in L1 and L2. Strong and significant relationships were observed between the participants' VK and writing fluency (both fluency and productivity) in their L1, but not in their L2. These relationships were observed in the language in which the writers were less fluent. The participants were chosen from cities with large Persian communities, so they had the opportunity to practice, hear and speak Persian in the society. However, this practice was mostly restricted to all-day issues while these students acquired Swedish also as an academic language so they could expand their sentence structure, abstract words, world knowledge and vocabulary. Furthermore, they only received limited mother tongue instruction. All these factors could have led to limited linguistic skills including VK in children's L1. In this case, it

probably takes more time for children to access and/or find the right words, which are presumably stored in their LTM. This could influence process writing fluency. It could also result in the production of shorter texts as they struggle to find words to convey their message and they may feel inclined to produce shorter texts. The results of this study are in line with a previous study on the same group of participants in which a significant relationship was found between lexical retrieval and writing fluency in children's L1, but not in their L2 (Johansson & Lindgren, 2021). Johansson and Lindgren (2021) described how the participants' writing in L1 appeared to function more like an L2 and was more consistent with findings from L2 studies. For example, Grewal and William (2018) found a significant correlation between the lexical retrieval and writing fluency of bilingual children in L2.

In general, among both adults and children, L2 can be considered to be the language in which writers are usually less proficient and in which it is more cognitively demanding to write fluently compared to L1 (Chenoweth & Hayes, 2001; Miller et al., 2008). Very few studies have investigated the relationship between bilingual children's VK and writing fluency in both L1 and L2. However, the results of the present study and previous research could suggest that knowledge of words and being able to retrieve such words could be more important in the language in which children are less fluent and that these relationships might decrease as linguistic proficiency and reading and writing experience increase. This could explain the lack of any significant relationship between VK and writing fluency in children's L2, which was the language in which it was probably less demanding for them to write.

Some cross-language effects were also found between the participants' writing fluency and their reading and linguistic skills across L1 and L2. For example, WR and VK in Persian would appear to be somehow important to the length of texts that the participants produced in Swedish. Furthermore, WR in Swedish seems to be rather important in the length of narrative texts participants produced in Persian. Thus, the participants were possibly able to share some knowledge related to their writing productivity from L1 to L2, and vice versa. Also, all fluency and productivity writing measures significantly and strongly correlated in both languages and genres. Previous studies have used the multicompetence perspective (Cook, 2002; Kobayashi & Rinnert, 2013) to explain how bi/multilingual children (Lindgren & Stevenson, 2013; Lindgren et al., 2017) and adults (Kobayashi & Rinnert, 2012) could benefit from their writing-related knowledge across their L1 and L2. The present study provides some evidence in this respect, when taking into account these cross-language effects in relation to the participants' writing fluency. However, a different pattern emerged when examining the cross-language effects on the writing process because a negative correlation was found between VK in Swedish and the fluency of the writing process in Persian. This negative correlation could suggest that as the writers' VK increased in their L2, they wrote more slowly in Persian. This may suggest that higher linguistic proficiency including VK in one language does not impact the speed at which children can produce a text in another language.

Overall, the results could suggest that reading and writing in L1 supported the children's reading and writing in L2 (Bialystok, 2001). Similar results were found when the participants' oral and reading exposure in L1 outside school correlated with their writing fluency in their L2 (Johansson & Lindgren, 2021).

We are fully aware of the exploratory nature of this study, considering the small sample size and large age range of the participants, and that we must avoid making broad conclusions. We tried to find test materials that were as similar as possible in both languages. However, they were not identical because they were designed in two different countries. Thus, the minor differences between them may have impacted the results.

However, our finding that in L1, Persian—the participants' least developed language for writing—the differentiation across genres has not been established and that writing fluency can be predicted in both genres from reading and linguistic variables, although not in Swedish, appears to indicate that writing fluency becomes independent of these skills once a certain level of education has been reached. Future studies may include social, such as motivation, and cognitive factors, such as the linguistic and cognitive abilities, to present a broader picture of both social and cognitive elements that could influence bilingual children's writing fluency.

We are also aware of the fact that this study does not disentangle the effect of language and script. Such a study requires a different research design, for example with the option that children write in the L1 in two scripts, if possible.

8. CONCLUSIONS AND IMPLICATIONS FOR EDUCATIONAL POLICY

In conclusion, the results suggest that reading and linguistic resources are important in both productivity and fluency in the language that children struggle with the most (L1). These resources need to be utilised so that children can translate and transcribe ideas into written text rapidly and produce longer chunks of texts more fluently. Children also need to exercise the written language, differentiating between their oral language and written language proficiency.

In the Swedish context, bilingual children's minority language is recognized, and the children are provided with one hour mother tongue instruction. However, the results suggest that the mother tongue instruction could be increased as it does not provide sufficient time for children to improve their writing fluency and possibly reading and linguistics skills in their L1 and does not lead to full literacy bilingualism.

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