CJLT RCAT
Canadian Journal of Learning and Technology
La Revue canadienne de l'apprentissage et de la technologie

Volume 47 (3) Fall / Automne 2021

Shouting in the Kenyan Space: Can Spaceteam ESL Improve L2 Learners' Oral Reading Fluency in English?

Crier dans l'espace kenyan : Le jeu Spaceteam ESL peut-il améliorer la fluidité de la lecture orale en anglais des apprenants d'une L2 ?

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Abstract

This study examined the effects of Spaceteam ESL, a digital shouting game, on the development of oral reading fluency (ORF) among 71 English as a second language (ESL) students in three primary and secondary schools in Mombasa, Kenya. Following a mixed-methods approach for data collection and analysis, we pre-tested and post-tested the participants on their ability to read aloud efficiently (speed) and accurately (accuracy) in three tasks: (1) phrases extracted from the game; (2) phrases not related to the game; and (3) a short anecdote. Paired-samples *t*-tests results revealed that, as hypothesized, participants who played Spaceteam ESL improved their ORF on measures of speed on all tasks, possibly because of the fast-paced nature of the game. However, no significant differences were observed in terms of accuracy due to a ceiling effect: the participants had already mastered the intricacies of the letter-to-sound rules of English orthography. Overall, these findings corroborate our hypothesis that some of the affordances of Spaceteam ESL (e.g., focus on speed reading, multiple and varied opportunities for practice) could contribute to the development of some aspects of oral reading fluency.

Keywords: Spaceteam ESL; digital game; oral reading fluency; speed reading

Résumé

Cette étude a examiné les effets de Spaceteam ESL, un jeu numérique de cris, sur le développement de la fluidité de la lecture orale (FLO) chez 71 étudiants d'anglais langue seconde (ALS) dans trois écoles primaires et secondaires à Mombasa, au Kenya. Suivant une approche mixte pour la collecte et l'analyse des données, nous avons pré-testé et post-testé les participants sur leur capacité à lire à haute voix de manière efficace (vitesse) et précise (exactitude) dans trois tâches : (1) des phrases extraites du jeu ; (2) des phrases sans rapport au jeu ; et (3) une courte anecdote. Les résultats des tests t d'échantillons appariés ont révélé que, comme prévu, les participants qui ont joué à Spaceteam ESL ont amélioré leur FLO sur des mesures de la vitesse dans toutes les tâches, possiblement en raison de la nature rapide du jeu. Cependant, aucune différence significative n'a été observée en termes de précision en raison d'un effet plafond. Les participants avaient déjà maîtrisé les subtilités des règles de concordance entre les lettres et les sons de l'orthographe anglaise. Dans l'ensemble, ces résultats corroborent notre hypothèse selon laquelle certaines des possibilités offertes par Spaceteam ESL (par exemple, la priorité accordée à la lecture rapide, les opportunités multiples et variées pour la pratique) pourraient contribuer au développement de certains aspects de la fluidité de la lecture orale.

Mots-clés : Spaceteam ESL ; jeu numérique ; fluidité de la lecture orale ; lecture rapide

Introduction

Students benefit from using digital games in language education in several ways. Some of these benefits include students' increased motivation to learn (Ducate & Lomicka, 2009), enjoyment (Allen et al., 2014), and comfort (Liakin et al., 2017), which can all contribute to learning (Krashen, 1986; Kukulska-Hulme, 2016). In the context of second or foreign language (L2) education, the development of fluency is rarely explored (Grimshaw & Cardoso, 2018; Nation, 2008; Nation & Newton, 2008). Fluency involves real-time processing and "does not require a great deal of attention and effort from the learner" (Nation & Newton, 2008, p. 151). The reasons for the absence of fluency-development activities in the language classroom are often attributed to time constraints (Grimshaw & Cardoso, 2018; Nation, 2008), language learning anxiety (Gregersen & MacIntyre, 2014; Grimshaw & Cardoso, 2018), and/or low levels of willingness to communicate in learners (Horwitz et al., 1986), which consequently reduce opportunities for oral production (Gregersen & MacIntyre, 2014). There is, therefore, a need for activities that promote the development of fluency, particularly those that consume little or no class time, and motivate students to practice language.

For the development of reading fluency, Nation (2008) recommends that learners: (1) engage in proficiency appropriate "speed reading" activities (e.g., *paired reading*, requiring students to take turns reading aloud a text to each other); (2) feel motivated to read; (3) read intensively; and (4) engage in activities involving speaking and listening. However, these recommendations are often difficult to fulfill because of the constraints that affect the L2 classroom such as lack of time (Collins & Muñoz, 2016) and a focus on the teaching of new language features (Nation, 2008). One way of mitigating these

limitations is via out-of-class learning. Digital games such as Spaceteam ESL have the potential to address these constraints and simultaneously promote all of Nation's (2008) four recommendations.

Spaceteam ESL is a free multiplayer and team-building digital "shouting game" for mobile devices, where players simultaneously pilot a spaceship by controlling panels with knobs and dials listed with English words organized by levels (based on word frequency and pronunciation complexity). To keep the spaceship aloft, players must speak and listen to time-sensitive orders that require the manipulation of the knobs and dials on their screen. For example, the order "Activate space dogs" requires the team member with that label on their control panel to switch it on. Importantly, although Spaceteam ESL prompts the players to speak and listen, the game itself neither *speaks* nor *listens*. In other words, following Egbert and Shahrokni (2018) task structures for the design of technology-enhanced materials, all oral and aural interactions with the game happen "around" the game with other game-players, not "with" or "through" Spaceteam ESL. If players execute enough tasks successfully, each team continues to the next level of increasingly difficult gameplay. The game encourages the practice of read-aloud/oral reading fluency (Rasplica & Cummings, 2013).

Adopting a mixed-methods approach for data collection and analysis, the current study examined the affordances of Spaceteam ESL as a tool to promote this type of fluency among English as a second language (ESL) learners in a Kenyan context. We hypothesized that playing the game could contribute to the development of oral reading fluency and, accordingly, asked the following general research question: Can Spaceteam ESL contribute to the development of oral reading fluency in terms of speed and accuracy?

Background

Spaceteam ESL: Introduction and Previous Study

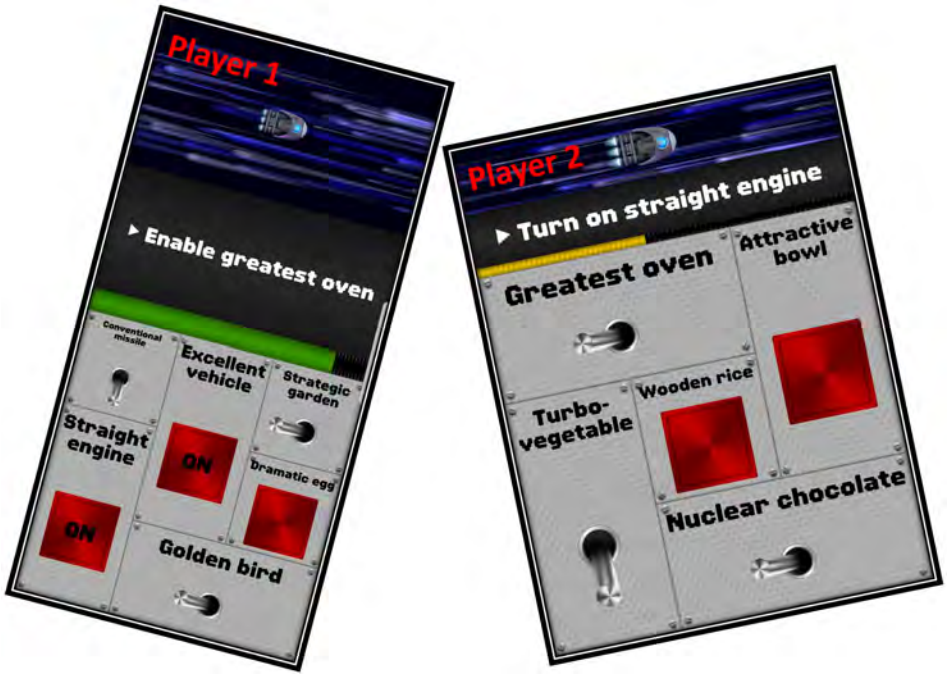
Spaceteam ESL is an educational game like no other. Unlike most mobile games in which players play alone, this one is a fun and chaotic "shouting game" in which several players in the same room work together using their mobile devices, e.g., tablets or smartphones, to pilot a spaceship. Players engage in reading, speaking, and listening activities: to keep the spaceship from crashing, players need to read and shout out sometimes non-sensical orders such as "Enable greatest oven!" to their peers, while at the same time listening to their teammates' shouting orders. If this communication challenge is successful, teams continue to the next level of increasingly difficult and frenetic gameplay.

Figure 1 illustrates Spaceteam ESL's interface using an Android smartphone (Player 1) and an Apple tablet (Player 2). While Player 1 is asked by Player 2 to "Turn on straight engine", Player 2 is simultaneously asking Player 1 to "Enable greatest oven". The challenging aspect of the game is to be both *accurate* (i.e., intelligible, faithful to the command displayed on their panels) and *fast* with the verbal instructions. This means that players need to read, speak, and listen accurately, e.g., intelligibly, and efficiently to complete the orders within the timeframe indicated by the timing bars below the instructions. If orders are not completed in time, the spaceship gets closer to destruction. The player

must also cope with humorous malfunctions such as knobs becoming blurry and slime covering the control panel while also occasionally being asked to simultaneously shake or flip their devices to avoid asteroids and wormholes.

Figure 1

Spaceteam ESL: The Interface Involving Two Players



Beyond the non-linguistic challenges built into Spaceteam ESL, the users can make gameplay more linguistically challenging. For instance, users can choose between five word-levels based on vocabulary, pronunciation complexity, and lexical frequency in the English language. Aligning with Nation's (2008) recommendations for promoting fluency, the game affords three speeds: normal, slow, and very slow. Since Spaceteam ESL requires some degree of reading proficiency, the game is recommended for intermediate to advanced students who have mastered some of the orthography-to-sound rules of the language. This is important because for fluency development, according to Nation & Newton (2008), students must use and practice what they already know, with the explicit purpose of speeding up production, e.g., speaking, and consequently lead to automaticity, an attribute of fluent language users.

Because Spaceteam ESL can become fast-paced, particularly as players advance in proficiency and speed levels, students need to become more intelligible, i.e., they must be able to convey and understand the message being read, which is an instantiation of accuracy (Munro & Derwing, 1995). One way to reach intelligibility and fluency is through practice (Linan-Thompson & Vaughn, 2007; Nation, 2008; Nation & Newton, 2008). Spaceteam ESL's practice feature (see Figure 2) allows students to listen to the words in each level by clicking on the speaker icon, record themselves pronouncing each word by clicking on the microphone icon, and then compare their oral recordings with the original one

by clicking on the recording icon. If teachers are constrained by time, noise, or students' fear of face-to-face interactions, teachers may ask students to practice their reading, speaking, and listening outside the space of the game using the practice feature.

Figure 2

Spaceteam ESL: Pronunciation Practice

Based on Spaceteam ESL's assumed potential for promoting fluency, Grimshaw and Cardoso (2018) examined the effects of the game on oral fluency development among ESL learners at a college in Quebec, Canada. While the experimental group played the game for 15 minutes as a classroom warm-up activity for a period of six weeks, the control group performed "traditional" classroom activities such as information gaps, story re-telling, and other interactive activities for the same period of time. Following a between-groups design, the data were collected via pre-tests, post-tests, and delayed post-tests, in which participants were recorded speaking about their summer vacations. The recordings were then analyzed for two measures of L2 fluency: syllables-per-minute calculations (i.e., the number of syllables accurately produced per minute of speech) and an overall assessment of speech recordings using a 6-item Likert scale by a panel of judges. The authors found that only the experimental game-playing group displayed a significant improvement from pre-test to delayed post-test according to the judges' ratings of fluency. However, results showed no significant difference between the treatment and control groups, and between the pre- and post-tests on syllables-per-minute calculations, the most commonly adopted measure for rating oral fluency (Blake, 2009; Hird & Kirsner, 2010; Derwing et al., 2009) – the one also adopted in the current study. One explanation for the unexpected results may be that the tests adopted did not accurately measure what they were supposed to measure, indicating an

issue of test validity (Douglas, 2001). The effects of gameplay in Grimshaw and Cardoso (2018) could not carry over into a completely different task setting because, while gameplay involved the reading aloud of prefabricated sentences produced by Spaceteam ESL, the speech analyzed in the study derived from spontaneous narrations. Another important difference between the treatment (using Spaceteam ESL) and the test (using narrations) is that the texts used in these activities did not correspond to the same genre in form, style, or subject matter. Whereas Spaceteam ESL utilizes a "genre" consisting of disconnected, sometimes non-sensical sentences, the tests consisted of sentences derived from "last summer vacation" narratives.

The current study addresses these limitations by focusing on one of the main affordances of Spaceteam ESL: the game's ability to promote oral reading fluency as found in read-aloud activities.

Oral Reading Fluency: Speed and Accuracy

Oral reading fluency (ORF) is a complex, multifaceted process that involves the coordination of many processes and sub-skills involved in reading (Lipka et al., 2016; Wolf & Katzir-Cohen, 2001). According to Rasplica and Cummings (2013), ORF refers to one's ability to read aloud connected text *quickly* and *accurately* without the concerted cognitive effort compared to speaking. ORF involves real-time processing that "does not require a great deal of attention and effort from the learner" (Nation & Newton, 2008, p. 151). A similar view is shared by Wolf and Katzir-Cohen (2001) and Hudson et al. (2008), who characterize the phenomenon as the by-product of the development of accuracy and automaticity in word and connected-text reading, including phonological and orthographic processes at the letter and word levels, automatic access to knowledge of orthographic rules (phonograms), as well as semantic and syntactic processes at the text/discourse level. This research suggests that ORF is comprised of at least two dimensions: speed and accuracy.

In this study, speed is operationalized as a simple calculation of the rate (measured in seconds) of accurately read words. As such, speed has direct connections with the rationale behind Rapid Automatized Naming tasks (Lipka et al., 2016), which measure how quickly individuals can name aloud the symbols seen in orthography, i.e., letters or digits. This ability has been consistently related to fluency of reading in English (Cardoso-Martins & Pennington, 2004) and other languages such as Finnish (Koponen et al., 2013) and Italian (Lipka et al., 2016; Tobia & Marzocchi, 2014). Interestingly, scores on such tests are consistently correlated with reading ability (Swanson et al., 2003).

Accuracy, on the other hand, refers to the extent to which an L2 learner's reading aloud performance deviates from a norm in the form of errors, as produced by a native or non-native fluent speaker (Pallotti, 2009). In the context of this study, a typical example of an inaccurate reading aloud production would be for an English learner to pronounce the word "knee" incorrectly as [kni] rather than [ni], as a fluent or native speaker would pronounce it. In this study, accuracy is operationalized in its narrowest sense, as defined above, without considering the complexities associated with the term such as appropriateness and acceptability (Housen et al., 2012), and possibly intelligibility in its generic sense, defined as "the extent to which a speaker's message is actually understood" (Munro & Derwing, 1995, p. 76).

We hypothesize that when L2 learners have a considerable amount of practice at reading aloud via Spaceteam ESL, the orthography-to-sound decoding process becomes gradually easier to the point in which reading aloud becomes automatic; that is, the text is decoded with ease, speed, and accuracy (Rasinski et al., 2012).

Current Study

This study is part of a larger project financed by the Social Sciences and Humanities Research Council of Canada (SSHRC), which aims to improve teaching and learning through educational technology in sub-Saharan Africa. The larger project examines several aspects of Spaceteam ESL as a pedagogical tool, including students' and teachers' perspectives as well as the game's ability to contribute to the learning of vocabulary and pronunciation, and to the reduction learning anxiety. In this study, we specifically examined one aspect of language development: oral reading fluency (ORF), an ability that has been shown to be the most common, reliable, and efficient indicator of one's overall reading skills, as indicated in the meta-analysis and literature synthesis reported in Reschly et al. (2009) and Wayman et al. (2007), respectively. We hypothesized that Spaceteam ESL could contribute to the development of ORF in both speed and accuracy, and in quantitative and qualitative methods of analysis. The research was guided by the following general research question:

- Can Spaceteam ESL contribute to the development of oral reading fluency in terms of speed and accuracy in both quantitative and qualitative measures?

Method

To investigate participants' improvement in oral reading fluency in terms of *speed* and *accuracy*, a mixed-methods quasi-experimental design was adopted to measure oral fluency development, consisting of both quantitative (using a pre-/post-test design to examine participants' ORF development) and qualitative data (via focus group discussions).

Participants and Location

Seventy-one pre-adolescent and adolescent intermediate-level English learners from three public schools (School A: n = 30; School B: n = 18; School C: n = 23) in Mombasa, Kenya were recruited to participate in the study by receiving the same Spaceteam ESL treatment over a three-week period. The participants included 40 females and 31 males between the ages of 10 and 17 years (M = 13.50, SD = 2.20). The breakdown of age and gender for each school was as follows: School A (16 females/14 males, range = 10-12 years, M_{age} = 11.18, SD_{age} = 0.72), School B (12 females/6 males, range = 14-17 years, M_{age} = 15.22, SD_{age} = 1.00), School C (12 females/11 males, range = 13-17 years, M_{age} = 15.05, SD_{age} = 1.29). According to the sociodemographic survey, Kiswahili was the native language of the largest number of students, followed by Kigiriama, Luhya, Rabai, and other less-spoken languages and regional varieties. When asked how often they used English outside of the classroom, the participants reported using the language "sometimes" (M = 2.6, on a 5-point scale ranging from "never" to "very often").

Instruments

Participants were pre- and post-tested on their ability to efficiently (speed) and accurately (accuracy) read aloud the following three tasks: (1) ten phrases extracted from the game (n = 38 morphemes, including free and bound forms), (2) ten equivalent phrases not related to the game (n = 112 morphemes), with words compiled from the 1,000-4,000 most frequently used words in English (Nation, 2016), and (3) one 128-word anecdote (n = 157 morphemes). See the Appendix for the phrases and anecdotes used in the three tasks. The rationale behind the adoption of these tasks was to address one of the limitations of a related study (Grimshaw & Cardoso, 2018) that assumed that gains resulting from Spaceteam ESL gameplay would transfer to other text genres or styles, i.e., spontaneous speech, and subject matters i.e., "summer vacation" narratives. In addition, the adopted three tasks assess ORF development using speech derived exclusively from reading-aloud tasks, thus emulating the type of oral output that results from gameplay (Grimshaw & Cardoso, 2018). Finally, the second and third tasks allow us to verify whether the gains learned in gameplay would extend to other genres, e.g., sentences not related to Spaceteam ESL, and subject matters, e.g., an anecdote about a parrot, not sentences about piloting a spaceship.

Procedures

At the outset of the experiment, participants filled out a demographic questionnaire about their age, gender, proficiency in English, knowledge of other languages, frequency of English use outside of the classroom, etc. In two to three weekly sessions over a period of three weeks, they were asked to play Spaceteam ESL for approximately 45 minutes as an after-class activity. Each participant received an Amazon Fire 7 Tablet pre-installed with the game, with the difficulty level initially set to "beginner" mode (word level: 1, game speed: very low), and were asked to form two-member groups to play the game. To reduce the possibility of technical connection problems due to faulty wi-fi networks, a local "non-internet" wi-fi network was created for the participants to interact with their peers' devices. To make their gameplay experience more challenging, the participants were asked to increase the number of members in their groups and to modify the original word level as well as game speed configurations whenever they felt comfortable with the speed, the game's words, phrases, and their associated pronunciation.

The participants' ORF knowledge, i.e., their ability to read aloud English phrases efficiently and accurately in three tasks, were assessed quantitatively on two instances: once at the outset of the experimentation (pre-test) and once again after three weeks of gameplay (after approximately six to eight playing sessions; post-test). For the tests, each participant was individually audio-recorded using the built-in microphone of a hand-held Sony ICD-UX560 Digital Audio Recorder. To avoid testing effects, the order of items in the sentence-reading tasks were randomized in both tasks.

At the end of the study, students were invited to participate in focus groups consisting of six to eight students, which aimed to probe their perceptions of the experience on several topics covered by the project. The topics included learnability, intelligibility, motivation, anxiety, willingness to communicate, etc. Although the initial intent was to recruit a small number of discussants, all 71 participants

volunteered to contribute to these discussions. In this study, due to its focus on ORF development, our analysis focused on the answers to the following related four questions and follow-up discussions from the focus groups:

- Did Spaceteam ESL change how you feel about your English?
- Do you think Spaceteam ESL helped you improve your English? How?
- What did you learn about English?
- How do you think Spaceteam ESL helps students improve their English?

All data collected through the quantitative and qualitative instruments were transcribed for further analysis.

Analysis

The participants' performance on each test was audio-recorded and acoustically analyzed for speed measured in seconds, using Audacity, which is a popular open-source audio editor, and following a quantifiable approach similar to Lennon's (1990) "speech rate" calculation, which computes the number of words per phrase or utterance (Segalowitz, 2010). This measure for speech rate is largely concerned with the temporal aspects of speech, which includes speed and, indirectly, pause length (Derwing et al., 2009). In the current study, since the phrases and anecdote were the same for all participants and consequently of comparable length and content, we computed the total duration of each participant's target sentence or anecdote in the three tasks, in seconds. These values were later aggregated according to time of testing (pre-test, post-test) and task (phrases extracted from the game, equivalent phrases not related to the game, and one anecdote, as explained earlier). To compare improvements in speed over time and to calculate means, standard deviations and significance levels, paired-samples *t*-tests were employed.

Accuracy, on the other hand, was measured via a computation of the correct *morphemes* read aloud in each task (task 1: n = 38 morphemes, task 2: n = 112 morphemes, task 3: n = 157). All tasks included words compiled from the 1,000-4,000 most frequently used words in English (Nation, 2016). Morphemes are the smallest units in a language and can be free, e.g., animal, or bound, e.g., the suffix -s in animals – in this case an inflectional affix. The main advantage of considering morphemes to measure accuracy in oral reading tasks is that they constitute more precise units for the assessment of a user's knowledge of the target language's spelling-to-sound rules, which are part of morphophonological awareness (Apel et al., 2013). In our study, for instance, if a participant pronounced the target word "animals" as "animal", that output received a 1 out of 2 rating for accuracy. Variations in pronunciation, on the other hand, were ignored. For example, if a participant pronounced the plural marker /z/ in "animals" as a voiceless [s], that "deviation" was considered correct. As was the case for speed, paired-samples *t*-tests were used to compare improvements in oral reading accuracy over time and to calculate means, standard deviations, and statistical significance.

Finally, for the qualitative analysis, based on the four aforementioned questions, the transcripts of the focus group discussions were coded by two researchers using a deductive thematic coding (Saldaña, 2011), with the codes based upon the two categories subsumed under ORF: speed and accuracy. These categories were further analyzed to determine whether the pedagogical use of Spaceteam ESL contributed to the participants' perceptions of improvement in the two measures of ORF. To confirm the consistency of how the codes were applied, discrepancies between coders were discussed until there was a consensus. In cases where no agreement was achieved, the problematic passage was discarded from the analysis.

Results

Quantitative Results: Speed and Accuracy

Using paired-samples *t*-tests, the 71 participants' performance in oral reading speed and accuracy before and after playing Spaceteam ESL were analyzed for the three tasks: ten phrases extracted from the game (Task 1), ten equivalent phrases similar in length, complexity, and frequency not related to the game (Task 2), and one anecdote (Task 3). The results are summarized in Table 1. Lower values indicate improvements in fluency. For accuracy, the higher the value, the better the improvement.

Table 1

Oral Reading Fluency: Speed and Accuracy Rates by Task

	Speed (In Seconds)					Accuracy (Morpheme)				
	Pre-test		Post-test			Pre-test		Post-test		
Task	M	SD	M	SD	*p*<	M	SD	M	SD	*p*=
1	19.46	3.66	17.14	3.52	.001	36.31/38	1.72	36.62/38	1.65	.101
2	44.03	9.18	40.17	10.21	.001	106.54/112	5.38	106.27/112	6.41	.525
3	60.96	11.34	54.92	11.06	.001	153.34/157	3.86	155.55/157	4.30	.670

To protect from Type I Error, a Bonferroni correction was conducted. Because each participant completed three tasks, the desired alpha level ($p <. 05$) was divided by the number of comparisons (3), arriving at the p-value for determining significance: .05/3 = .0167 (or $p <. 017$). To determine if any of the comparisons are statistically significant, the p-value for this study was set at $p <. 017$.

In terms of *speed*, participants read aloud Task 1 at a faster speed after playing Spaceteam ESL ($M = 17.14$, $SD = 3.52$) as opposed to before playing the game ($M = 19.46$, $SD = 3.66$). This difference, 2.32, BCa 95% CI [1.55, 3.08], was significant, $t(70) = 6.03$, $p < .001$, and represented an effect of $d = 0.65$. Relatively similar results were observed for Task 2, wherein participants read the target phrases at

a faster speed after playing Spaceteam ESL (M = 40.17, SD = 10.21) than on the pre-test (M = 44.03, SD = 9.18). This difference, 3.85, BCa 95% CI [2.51, 5.20], was once again significant, $t(70) = 5.73$, $p < .001$, and represented an effect of $d = 0.40$. Finally, for Task 3, participants also read the 157-word passage at a faster speed after playing Spaceteam ESL (M = 54.92, SD = 11.06) than what was observed on the pre-test (M = 60.96, SD = 11.34). This difference, 6.05, BCa 95% CI [4.25, 7.85], was significant, $t(70) = 6.69$, $p < .001$, and represented an effect of $d = 0.54$. Overall, these results indicate that participants improved their speed in all tasks after the treatment period.

Regarding *accuracy*, paired-samples *t*-tests showed no significance differences from pre- to post-test in any of the tasks: $t(70) = -1.66$, $p = .101$ for Task 1; $t(70) = 0.64$, $p = .525$ for Task 2; and $t(70) = -0.43$, $p = .670$ for Task 3. These results suggest that the proposed game-based pedagogy had no effect on improving the participants' ORF performance in terms of accuracy.

To summarize, the quantitative analysis of the data collected for this study revealed that the pedagogical use of Spaceteam ESL contributed to the development of only one of the components of ORF: speed.

Qualitative Results: Speed and Accuracy

The quantitative findings reported above for speed can be corroborated by the participants' statements during the focus group discussions, in which they reported that playing Spaceteam ESL helped improve their oral fluency in terms of speech rate. To illustrate, consider the following verbatim quotes in which the participants clearly vocalize their perceptions that gameplay improved made them more efficient, faster performers:

- "it makes your brain to be faster, it makes you speak faster, it makes you read more fast than usual"
- "[it helped me] getting quick in English and reading"
- "when it was going faster and it was improving me in how to read faster"
- "It helps to speak more fluently and more faster than […] how you usually speak English"
- "[the game] makes us very active, it makes us to be very fast"
- "[it gave] me more instruction of getting quick in English and reading"

A thematic analysis of the qualitative data did not yield any obvious statements reflecting the game's potential to improve oral reading accuracy, i.e., the participants' ability to perform in read-aloud, grapheme-to-phoneme tasks, thus validating the quantitative results. Most of the statements related to improvements referred to the learning of the following:

- Vocabulary, e.g., "you learn something like new words"; "I learned words and the spelling of some words"
- Pronunciation, e.g., "I learned how to pronounce words, and other things"; "I can […] now pronounce words that were challenging me"; it helps me pronounce the words properly

- Orthography, e.g., “it helps me to improve in spellings”; “it helped me […] to write spellings and grammar” and
- general English, e.g., “I think that my English has changed, improved”; “it helped me out in English”.

These findings indicate that the participants’ perceptions of Spaceteam ESL’s potential to improve ORF was only articulated for one of the categories considered in the study: oral reading speed.

Discussion

The goal of this study was to examine the effects of Spaceteam ESL on the development of two important measures of reading oral fluency: speed and accuracy (Rasinski et al., 2012; Rasplica & Cummings, 2013). Our quantitative and qualitative findings suggest that while speed was significantly affected by gameplay, accuracy was not.

As hypothesized, the improvements observed in speed can be attributed to one of the affordances of Spaceteam ESL, a game that capitalizes on efficiency for successful gameplay. Interestingly, efficiency is the dominant feature in Nation’s (2008) recommendations for fluency development. According to Nation, to achieve fluency, L2 students should be involved in activities such as speed-reading practice, repeated reading (in which students are asked to read aloud short passages until they reach a criterion level of success), and paired reading (when students take turns reading aloud a text to each other). They should also read a lot and feel motivated to read. We believe that Spaceteam ESL accomplishes all these goals, mutatis mutandis. As such, our findings corroborate recommendations by second-language acquisition researchers that practicing what students already know via Spaceteam ESL may lead learners to automaticity and speed (Linan-Thompson & Vaughn, 2007; Nation, 2008; Nation & Newton, 2008), at least in tasks that involve reading aloud. Interestingly, speed has been shown to be correlated with fluent reading ability (Swanson et al., 2003), as attested in tasks that require the rapid naming of written words (Cardoso-Martins & Pennington, 2004; Koponen et al., 2013; Lipka et al., 2016; and Tobia & Marzocchi, 2014).

The non-significant results involving accuracy can be explained by our assumption that for fluency development, students should engage with “material that is very familiar and contains no unknown language features” (Nation, 2008, p.8). Because students already knew the intricacies of the grapheme-to-phoneme rules of English orthography, their level of reading accuracy was already highly developed. This is confirmed by the high values observed on the pre-test in all accuracy tasks (36.1/38 for Task 1, 106.54/112 for Task 2, and 153.34/157 for Task 3), indicating a ceiling effect. Overall, these findings indicate that a language learner’s ability to accurately match orthography to sound is a requirement for oral fluency that should precede the practice for speed, as recommended by Nation (2008) and Millett (2017a, 2017b).

An important finding and contribution of the current study is that it addresses a limitation reported in Grimshaw and Cardoso (2018) by examining a stricter version of fluency (oral reading

fluency) in order to enhance test validity and consequently measure the intended types of interactions promoted by Spaceteam ESL, specifically oral reading fluency. The test adopted by Grimshaw and Cardoso (2018) to examine fluency development consisted of spontaneous narratives, an oral task that is incompatible with the affordances of Spaceteam ESL in both style and text genre. As attested in the sociolinguistic and variationist literature, differences in style and genre lead to differences in performance in both L2 acquisition (Donaldson, 2017; Major, 2004) and in language use in general (Eckert & Rickford, 2009; Labov, 2009).

Our findings also revealed that Spaceteam ESL gameplayers were able to extend their newly acquired oral reading fluency to other tasks, if they remained within the realm of oral reading, regardless of topic. One possible explanation for these results may be because, although the topics and genre differed across the three tasks, the tasks remained cognitively similar and exclusively involved oral reading. These results appear to corroborate studies by Pae (2018), Reinders (2010), and Schneider et al. (1998) who argue that varying processing requirements in tasks and experiments affect acquisition. This is because tasks that place a greater cognitive demand on learners, e.g., the narration of one's summer vacation, lead to slower learning in comparison with those that do not, e.g., the oral reading of texts.

Conclusion

This study examined the effects of the pedagogical use of a digital shouting game, Spaceteam ESL, on the development of oral reading fluency among a group of ESL students in Mombasa, Kenya. The study addressed a limitation of a previous study (Grimshaw & Cardoso, 2018) by utilizing a stricter operationalization for fluency that is more compatible with the affordances of Spaceteam ESL: oral reading fluency (Hudson et al., 2008; Rasplica & Cummings, 2013). Our results indicate that, as hypothesized, participants who played Spaceteam ESL improved their oral reading ability on measures of speed, possibly because of the fast-paced nature of the game, which promoted efficiency for successful gameplaying. Interestingly, learners were also able to extend their newly acquired ability to other tasks, including those that differed in text genre. On the other hand, no significant differences were observed in terms of accuracy due to a ceiling effect, likely since the target L2 learners had already mastered the grapheme-to-phoneme rules of the English spelling system.

Despite these encouraging results and the contributions of the study regarding the adoption of a stricter operationalization for measuring oral fluency, and its methodological implications disfavouring the mixture of incompatible and stylistically different tasks to measure language development, there are many limitations that need to be acknowledged and addressed in further investigation. The most serious one is the lack of a control group to be used as a benchmark to reliably measure the effects of gameplay on ORF development. Although the participating ESL students did improve their ability to read orally efficiently, it remains inconclusive whether this improvement was a mere consequence of time, or even a result of testing effects. Another important limitation was the sampling of our participants, which included only highly proficient ESL learners. Had we included speakers of lower English proficiency, it is possible that we would observe and assess the development of accuracy, one of the features of oral

reading fluency. Finally, we would like to acknowledge that the duration of the experiment was short for logistical reasons including the duration of one of the researcher's stay in Kenya, costs, and the participants' availability including constraints such as exam periods and the end of the school year. Ideally, the treatment period should last the duration of a school session, preferably within a "language learning beyond the classroom" approach to L2 education (Nunan & Richard, 2015). In sum, a replication of the current study in a more controllable environment is necessary to further understand the relationship between Spaceteam ESL and oral fluency development. This would not only allow us to confirm some of the groundwork findings reported in this study, but it would also uncover the generalizability of these results in other contexts such as those reported in Grimshaw and Cardoso (2018), which took place in a post-secondary setting in Québec, Canada. Other suggestions include using other technological platforms and even different digital games that encourage players to use the language efficiently and accurately (or intelligibly).

Overall, the results corroborate our hypothesis that some of the affordances of Spaceteam ESL such as the focus on speed reading as well as multiple and varied opportunities for practice, contribute to the development of one aspect of ORF: speed. Importantly, it can be used as a tool to extend the reach of the classroom and, consequently, mitigate some of the limitations that afflict the language setting: time to practice (Collins & Muñoz, 2016) and lack of opportunities for the development of fluency (Nation, 2008).

Acknowledgements

A preliminary version of this study was presented at the EuroCALL Conference (2019, Louvain-la-Neuve, Belgium) and published as a four-page paper in its proceedings. We would like to thank our Kenyan collaborators, particularly Ms. Rose Iminza and Ms. Rosemary Waga, as well as the principals and students of three schools in Mombasa: Aga Khan Academy, Changamwe, and Sacred Heart for their invaluable support. *Asante sana!* Finally, we would like to acknowledge funding from the Social Sciences and Humanities Research Council of Canada (SSHRC).

References

Allen, L., Crossley, S., Snow, E., & McNamara, D. (2014). L2 writing practice: Game enjoyment as a key to engagement. *Language Learning & Technology, 18*(2), 124–150. http://dx.doi.org/10125/44373

Apel, K., Diehm, E., & Apel, L. (2013). Using multiple measures of morphological awareness to assess its relation to reading. *Topics in Language Disorders, 33*(1), 42–56. https://doi.org/10.1097/TLD.0b013e318280f57b

Blake, C. (2009). Potential of text-based internet chats for improving oral fluency in a second language. *The Modern Language Journal, 93*(2), 227-240. https://doi.org/10.1111/j.1540-4781.2009.00858.x

Cardoso-Martins, C., & Pennington, B. F. (2004). The relationship between phoneme awareness and rapid serial naming skills and literacy acquisition: The role of developmental period and reading ability. *Scientific Studies of Reading, 8*, 27–52. https://doi.org/10.1207/s1532799xssr0801_3

Collins, L., & Muñoz, C. (2016). The foreign language classroom: Current perspectives and future considerations. *The Modern Language Journal, 100*, 133-147. https://doi.org/10.1111/modl.12305

Derwing, T. M., Munro, M. J., Thomson, R. I., & Rossiter, M. J. (2009). The relationship between L1 fluency and L2 fluency development. *Studies in Second Language Acquisition, 31*(4), 533-557. https://doi.org/10.1017/S0272263109990015

Donaldson, B. (2017). Negation in near-native French: Variation and sociolinguistic competence. *Language Learning, 67*(1), 141–170. https://doi.org/10.1111/lang.12201

Douglas, D. (2001). Performance consistency in second language acquisition and language testing research: a conceptual gap. *Second Language Research, 17*(4), 442-456. https://doi.org/10.1177/026765830101700408

Ducate, L., & Lomicka, L. (2009). Podcasting: An effective tool for honing language students' pronunciation? *Language Learning & Technology, 13*(3), 66–86. http://dx.doi.org/10125/44192

Eckert, P., & Rickford, J. (Eds.). (2009). *Style and sociolinguistic variation*. Cambridge University Press. https://doi.org/10.1017/CBO9780511613258

Egbert, J., & Shahrokni, S. (2018). *CALL principles and practices*. Open educational resources (OER). https://opentext.wsu.edu/call

Gregersen, T., & MacIntyre, P. D. (2014). The motion of emotion: Idiodynamic case studies of learners' foreign language anxiety. *The Modern Language Journal, 98*(2), 574-588. https://doi.org/10.1111/modl.12084

Grimshaw, J., & Cardoso, W. (2018). Activate space rats! Fluency development in a mobile game-assisted environment. *Language Learning & Technology, 22*(3), 159–175. https://doi.org/10125/44662

Hird, K., & Kirsner, K. (2010). Objective measurement of fluency in natural language production: A dynamic systems approach. *Journal of Neurolinguistics, 23*(5), 518-530. https://doi.org/10.1016/j.jneuroling.2010.03.001

Horwitz, E. K., Horwitz M. B., & Cope, J. (1986). Foreign language classroom anxiety. *The Modern Language Journal, 70*(2), 125–132. https://doi.org/10.2307/327317

Housen, A., Kuiken, F., & Vedder, I. (2012). Complexity, accuracy and fluency: Definitions, measurement and research. In A. Housen, F. Kuiken, & I. Vedder (eds.), *Dimensions of L2 performance and proficiency complexity, accuracy and fluency in SLA* (pp. 1-20). John Benjamins. https://doi.org/10.1075/lllt.32

Hudson, R. F., Pullen, P. C., Lane, H. B., & Torgesen, J. K. (2008). The complex nature of reading fluency: A multidimensional view. *Reading & Writing Quarterly, 25*(1), 4–32. https://doi.org/10.1080/10573560802491208

Koponen, T., Salmi, P., Eklund, K., & Aro, T. (2013). Counting and RAN: Predictors of arithmetic calculation and reading fluency. *Journal of Educational Psychology, 105*(1), 162–175. https://doi.org/10.1037/a0029285

Krashen, S. D. (1986). *Principles and practice in second language acquisition*. Pergamon Press.

Kukulska-Hulme, A. (2016). *Personalization of language learning through mobile technologies*. Cambridge University Press.

Labov, W. (2009). The anatomy of style shifting. Stylistic variation in language. In P. Eckert & J. Rickford (Eds), *Style and sociolinguistic variation* (pp. 85-108). Cambridge University Press. https://doi.org/10.1017/CBO9780511613258

Lennon, P. (1990). Investigating fluency in EFL: A quantitative approach. *Language Learning, 40*, 387–417. https://doi.org/10.1111/j.1467-1770.1990.tb00669.x

Liakin, D., Cardoso, W., & Liakina, N. (2017). Mobilizing instruction in a second-language context: Learners' perceptions of two speech technologies. *Languages, 2*, 1-21. https://doi.org/10.3390/languages2030011

Linan-Thompson, S., & Vaughn, S. (2007). *Research-based methods of reading instruction for English Language Learners*. Association for Supervision and Curriculum Development.

Lipka, O., Katzir, T., & Shaul, S. (2016). The basis of reading fluency in first grade of Hebrew speaking children. In A. Khateb & I. Bar-Kochva (Eds), *Reading fluency current insights from neurocognitive research and intervention studies*. Springer. https://doi.org/10.1007/978-3-319-30478-6_6

Major, R. (2004). Gender and stylistic variation in second language phonology. *Language Variation and Change, 16*, 169–188. https://doi.org/10.1017/S0954394504163059

Millett, S. (2017a). *Speed readings for ESL learners: 3000 BNC*. English Language Institute Occasional Publication 26. Victoria University of Wellington.

Millett, S. (2017b). *Speed readings for ESL learners: 4000 BNC*. English Language Institute Occasional Publication 27. Victoria University of Wellington.

Munro, M. J., & Derwing, T. M. (1995). Foreign accent, comprehensibility, and intelligibility in the speech of second language learners. *Language Learning, 45*(1), 73-97. https://doi.org/10.1111/j.1467-1770.1995.tb00963.x

Nation, I.S.P. (2008). *Teaching ESL/EFL reading and writing*. Routledge. https://doi.org/10.4324/9780203891643

Nation, I.S.P. (2016). *Making and using word lists for language learning and testing*. John Benjamins. https://doi.org/10.1075/z.208

Nation, I.S.P., & Newton, J. (2008). *Teaching ESL/EFL listening and speaking*. Routledge. https://doi.org/10.4324/9780203891704

Nunan, D., & Richards, J. (2015). Preface. In D. Nunan & J. Richards (eds.), *Language learning beyond the classroom* (pp. xi–xvi). Routledge. https://doi.org/10.4324/9781315883472

Pae, T.-I. (2018). Effects of task type and L2 proficiency on the relationship between L1 and L2 in reading and writing: An SEM approach. *Studies in Second Language Acquisition, 40*(1), 63–90. https://doi.org/10.1017/S0272263116000462

Pallotti, G. (2009). CAF: Defining, refining and differentiating constructs. *Applied Linguistics, 30*(4), 590–601. https://doi.org/10.1093/applin/amp045

Rasinski, T., Blachowicz, C., & Lems, K. (2012). *Fluency instruction: Research-based practices*. The Guilford Press.

Rasplica, C., & Cummings, K. (2013). *Oral reading fluency*. Council for Learning Disabilities. https://council-for-learning-disabilities.org/what-is-oral-reading-fluency-verbal-reading-proficiency

Reinders, H. (2010). *The effects of task type and instructions on second language acquisition*. Cambridge Scholars.

Reschly, A., Busch, T., Betts, J., Deno, S., & Long, J. (2009). Curriculum-based measurement oral reading as an indicator of reading achievement: A meta-analysis of the correlational evidence. *Journal of School Psychology, 47*, 427-269. https://doi.org/10.1016/j.jsp.2009.07.001

Saldaña, J. (2011). *Fundamentals of Qualitative Research*. Oxford University Press.

Schneider, V. I., Healy, A. F., & Bourne, L. E. (1998). Contextual interference effects in foreign language vocabulary acquisition and retention. In A. F. Healy & L. E. Bourne, Jr. (Eds.), *Foreign language learning: Psycholinguistic studies on training and retention* (p. 77–90). Lawrence Erlbaum. https://doi.org/10.4324/9780203774670

Segalowitz, N. (2010). *Cognitive bases of second language fluency*. Routledge. https://doi.org/10.4324/9780203851357

Spaceteam ESL. (2022). *Spaceteam ESL*. http://spaceteamesl.ca/

Swanson, H. L., Trainin, G., Necoechea, D. M., & Hammill, D. D. (2003). Rapid naming, phonological awareness, and reading: A meta-analysis of the correlation evidence. *Review of Educational Research, 73*(4), 407–440. https://doi.org/10.3102/00346543073004407

Tobia, V., & Marzocchi, G. M. (2014). Predictors of reading fluency in Italian orthography: Evidence from a cross-sectional study of primary school students. *Child Neuropsychology, 20*(4), 449–469. https://doi.org/10.1080/09297049.2013.814768

Wayman, M., Wallace, T., Wiley, H., Tichá, R., & Espin, A. (2007). Literature synthesis on curriculum-based measurement in reading. *The Journal of Special Education, 41*(2), 85-120. https://doi.org/10.1177/00224669070410020401

Wolf, M., & Katzir-Cohen, T. (2001). Reading fluency and its intervention. *Scientific Studies of Reading, 5*(3), 211–239. https://doi.org/10.1207/S1532799XSSR0503_2

Appendix

Oral reading tasks

1. Spaceteam-ESL Words (to control for genre)

1. Activate big tree
2. Turn off green phone
3. Start space-animals
4. Enable blue mountain
5. Turn on powerful fruit
6. Fly away from little planet
7. Switch on brown deer
8. Turn on crazy meal
9. Activate mechanical park
10. Turn off technological blade

2. "Other contexts" words*

1. I want to become an actor when I'm older.
2. You keep throwing the ball to me if you can.
3. I have a gift to give my friend on her birthday.
4. Rabbits and ducks don't have beards.
5. There was a funny cat on the chair in the kitchen.
6. The radio signal is weak in the park.
7. The pilot learned to fly aircrafts at the academy.
8. The journalist's sense of humor made me laugh.
9. The soccer player faked an ankle injury in the stadium.
10. In the case of volcanos and hurricanes, people must evacuate to avoid casualties.

* The sentences under "other contexts" utilize words from the 1,000-4,000 most frequently used English words, based on Nation's (2016) rationale for making and using word list for language learning and testing.

3. Anecdote using 1k-4k words**

Last year, Jimmy received the best present: it was a parrot. After a few days, the parrot started to speak. Jimmy was very happy! Soon, however, Jimmy heard the parrot say some very bad words. Jimmy was so frustrated that he decided to punish the bird. He carried his parrot into the kitchen and put it in the

freezer. For a few minutes the bird screamed bad words and was very loud. When Jimmy opened the door, he was surprised at the change in the bird's personality. He did not know why the parrot stopped saying bad words after only a few minutes in the freezer. Then, however, the parrot pointed inside the freezer to the frozen chicken and said, "May I ask what the chicken did wrong?"

** The anecdote contains words from the 1,000-2,000 most frequently used English words, based on Nation's (2016) rationale for making and using word list for language learning and testing. Frequency distribution: 81.25% from 1,000 frequency band (in blue below), 5.47% from 2,000 frequency band (in green), and 13.28% representing the off-list words (in red, consisting of "unusual" words such as Jimmy, parrot, and freezer). The following table illustrates the colour-coded distribution of these word frequencies – analysis conducted using lextutor.ca's Vocab Profiler: *Compleat Web VP*):

Current profile	
%	Cumul.
81.25	81.25
5.47	86.72
0.00	86.72
13.28	100.00

last year jimmy received the best present it was a parrot after a few days the parrot started to speak jimmy was very happy soon however jimmy heard the parrot say some very bad words jimmy was so frustrated that he decided to punish the bird he carried his parrot into the kitchen and put it in the freezer for a few minutes the bird screamed bad words and was very loud when jimmy opened the door he was surprised at the change in the bird personality he did not know why the parrot stopped saying bad words after only a few minutes in the freezer then however the parrot pointed inside the freezer to the frozen chicken and said may i ask what the chicken did wrong

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