

# Análisis del contenido de apps y videojuegos: implicaciones en procesos cognitivos en la lectura inicial

## Content analysis of apps and video games: Implications in cognitive processes in initial reading

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### RESUMEN

#### Palabras clave

Procesos cognitivos,  
lectura inicial,  
videojuegos, aplicación  
móvil

Este estudio reporta el análisis de los contenidos de veinte aplicaciones y videojuegos a fin de determinar si estos pueden favorecer el desarrollo de procesos cognitivos involucrados en la lectura inicial en español. El análisis pretende aportar, al ámbito educativo y clínico, información específica sobre el tipo de tareas incluidas en sus contenidos para coadyuvar al proceso de alfabetización en español. Los instrumentos de recolección de datos fueron la observación directa, el análisis de contenido en función de las tareas realizadas en los juegos y aplicaciones, así como la clasificación de estas tareas con base en la literatura en torno al tema. La observación estructurada determinó que la mayoría de las aplicaciones promueven aprendizajes para la lectura en diferentes niveles y solo cuatro de ellas contribuyen a la escritura; entre estas últimas, un videojuego de realidad virtual (Minecraft) favorece la lectura y la escritura durante la actividad en el juego. Los resultados muestran la pertinencia de efectuar análisis de las tareas implicadas en los videojuegos y aplicaciones con el propósito de determinar si pueden ser empleados como herramientas mediadoras de procesos cognitivos específicos en los ámbitos educativos formales, no formales y clínicos.

### ABSTRACT

#### Keywords

Cognitive processes,  
initial reading, video  
games, mobile app

*The present study reports on the analysis of the contents of 20 apps and video games, to determine if these can favor the development of cognitive processes involved in initial reading in Spanish. The analysis aims to provide, to the clinical and educational studies, specific information on the type of tasks covered in their contents, to assist in the process of literacy in Spanish. The instruments used for data collection were, direct observation, analysis of content based on the tasks performed in the games and applications, and the classification of these tasks based on the literature on the topic. Structured observation determined that most applications promote reading learning in different levels, and only 4 of them favor writing; among the latter, a game of virtual reality (Minecraft), promotes reading and writing during the activity in the game. The results show the relevance of the analysis of the tasks involved in video games and applications, to determine if they can be used as tools mediators of specific cognitive processes within the formal, non-formal educational environments, and clinical educational environments.*

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## INTRODUCTION

Videogames and applications (apps) for entertainment belong to information and communication technologies (ICTs) and are part of the daily activities not only of children and youngsters but also of people of all ages (Barnett & Coulson, 2010). Cox y Abbott (2004) have pointed out the positive effects of using ICTs on students' performance in all subjects of the British National Curriculum, and the most tangible evidence can be found in important educational subjects such as English, mathematics and sciences in all their key stages. Likewise, these authors have specified that the integration and the effective use of ICTs in the curriculum, in teaching processes and in learning environments, must be done based on certain pedagogical and didactic guidelines such as understanding more specifically the relation that exists between the resources ICTs offer and the theories, concepts and procedures of each subject area; know the potential ICTs offer to stimulate the users' intellectual capacity in formal or informal educational settings; expand their learning level besides developing communication and expression skills.

According to the arguments raised by Marín-Díaz and Martín-Párraga (2014), who have analyzed the curricular integration of video games as a central learning methodological tool at the early stages of development, a technology that would not have been designed based on an educational anagram, per se, that does not bear an educational label, could be used for those purposes by studying their possibilities as educational material. These authors sustain that video games can be of significant help in curricular formation processes. An adequate incorporation and utilization of ICTs in the educational and therapeutic settings may generate important changes in the different conceptions and practices of knowledge transmission such as a greater emphasis in the construction of knowledge in regard to the learning paces, attention to less-gifted students or users, assessment more focused on products and processes, better conditions for cooperative work, greater individual control in selecting learning contents and better possibilities of integrating verbal and visual communication (Poole, 1999).

Several types of apps and video games that were originally designed for leisure and entertainment are currently being used in a variety of educational and therapeutic areas. However, it remains unknown whether or not the activities performed during some free apps and video games enhance Spanish reading skills; neither have we observed studies that analyze those who can make use of games or apps according to the previous knowledge or skills that the user must have to make the most of the game, main aspects of this research.

In this context, the main objective of this study was to analyze the content of some apps and video games in Spanish to determine the cognitive

reading processes that may be enhanced while performing the activity and if the tasks presented in the video games and the apps can be used successfully or if they imply having prior specific information to ensure their optimal use.

The use of apps and video games has been reported in therapy sessions of patients with different ailments such as multiple sclerosis, cerebral palsy, psychotherapy, physiotherapy and occupational therapy. According to Annema et al. (2010), video games were used as distractors in managing pain, developing determined skills and motivating the patients. Other studies point out the benefits that the use of video games and apps play in the cognitive functions of different populations such as children with dyslexia (Franceschini et al., 2013; Rello, 2014; Osman, Wan & Che, 2015), and people with apraxia (Cogollor et al., 2012). Virtual reality games were used in physiotherapy to recover the functionality of the extremity damaged by a stroke; these patients saw not only their affected member benefited but also their gait and balance (Luque-Moreno et al., 2015).

In terms of the potential to alter the basic perceptual, attention and cognitive skills, the majority of researches have focused on the action the video games genre that have 3D complex scenarios, rapid movements and highly transitory objectives, high demand of periphery processing, the need to alternate between focused attention and distributed attention while rapid and accurate actions are being performed.

As observed, literature has framed the improvement in the performance of different tasks from experiencing with video games as a typical reflection of the transfer effect in which training in a tasks transmits an immediate response when facing another new task. Experiencing with video games, more than producing immediate benefits in specific activities, generates the user's ability to learn with greater efficiency and speed; hence, immediate benefits are felt in other tasks related to the perceptual and motor fields (Green & Bavelier, 2015). Therefore, ICTs, in the case of apps and video games, constitute a powerful change agent to redesign and innovate settings, conditions, methods and didactic materials, and have made possible the emergence of new pedagogical focuses in regard to the operation of academic and therapeutic institutions, curricular contents and treatments; the role of teachers and therapists, besides learning environments offered to student-user-patient.

#### GAMES AND APPLICATIONS: COGNITIVE PROCESSES PROMOTERS

During reading, several cognitive processes such as visual and auditory perceptions, visual movements, auditory recognition, work memory, speech and processing speed, among others, come into play (Etchepareborda & Habib, 2001). The use of ICTs in their different formats: games, apps and educational resources on the Internet, support regular and special education teachers in their teaching tasks.

Revisions to analyze the success in the classroom as well as those reported by teaching institutions offering specialized education for people with impairments have established that teaching reading and writing in their initial stages must be multisensorial and phonological (Thomson, 2010). These principles, obvious in many apps and video games, imply the simultaneous presentation of visual, auditory and kinesthetic information to enhance memory as well as learning (Thomson, 2010).

In 2012, a report on the analysis of some applications in the English language was made aiming at assisting people with dyslexia. In this study, the applications were grouped according to their objective such as lines, identification and use of letters, spelling, vocabulary, comprehension, grammar structure, initial reading, voice recognition, text creation, use of mathematical signs, brainstorming, memory, organizational skills and sequencing. This model of apps analysis served as a reference for our research (Coppin, 2012).

Regardless of the fact that, in general, the acquisition and initial reading processes are not dissociated in the writing processes literature, in this research, we will focus above all on reading since it was not possible to find in the apps and video games analyzed, a significant and equivalent number of applications aiming at fostering writing.

Next, we present, briefly and schematically, some contributions of our research in psycholinguistic in regard to the cognitive processes that include reading and that constitute the focal point of the analysis here expounded. Some of these cognitive processes are:

- Perception: these processes allow recognizing specific visual patterns, memory processes to store and decode reading and writing contents besides thought processes related to representation, comprehension and inference.
- Phonological and syllabic awareness: cognitive abilities associated with the acquisition of reading (González et al., 2013) that allow seeing and hearing that the language we hear as an endless thread is made up of words, syllables, phonemes and rhymes independent of one another. The development of phonologic awareness is a feature of the literacy period in which the awareness of phonemes as well as the development of the ability to use them in the reading and writing processes intervenes (Durand et al., 2014).
- Alphabetic knowledge: mentions the cognitive capacity used in the grapheme-phoneme conversion This manifests itself when we can distinguish the sounds that correspond to every letter of the alphabet in a written word and the capacity to recognize by their name the letters presented visually, process that requires both, knowing the letters and doing it rapidly.

- **Reading fluency:** the ability to read a text with accuracy and speed. This implies the automatic decoding and attention to the text message. Reading fluency implies recognizing and comprehending the words at the same time (Swartz, 2010), hence, little used or unknown words in a text will slow down the reader's fluency.
- **Vocabulary expansion:** Process related to fluency and comprehension. The more vocabulary a person acquires, the better is his reading comprehension and fluency; hence, a known word is read by visual route since it is the direct and fastest way to read.
- **Reading comprehension:** it involves the processes aforementioned since there are essential to learn how to read. The purpose of reading is to understand what is being read. Comprehension is the ability to understand the message conveyed in the text as well as remember and communicate its meaning. According to Swartz (2010), good readers monitor their comprehension to make sure they are interpreting the text.

All the processes depend on the functional and work memory since it implies the ability to retain or elaborate information while new information entering the system is being processed. This memory plays a crucial role in executing all the cognitive activities (Holmes et al., 2015).

Literacy implies retaining letters, words or phrases, depending on the level at which the subject proceeds the information while elaborating the next information. Lastly, the literacy processes also involve affective processes. Reading means constructing a meaning of the text or a mental image and this is achieved by prior knowledge, intentions, cognitive and affective expectations.

Since the main interest of our work is education and the impact of ICTs on the initial learning of reading, we have not found any studies regarding the characteristics of digital materials in Spanish presented as apps and video games on the free or access free platform, neither were there any analyses of the characteristics of their contents to foster cognitive processes linked to this specific field of learning. Thus, the primary objective of this research was to determine which cognitive reading skills in Spanish could be enhanced during this activity performed through free or access free version games and apps. Secondly, we attempted establishing if the apps characteristics required from the subject some type of prior knowledge for their optimal utilization or if said apps could be used by any user.

## BACKGROUND

This study is part of a more extensive research project on learning fostered by ICTs in children at educational level. In this regard, we present the results corresponding to the analysis of apps and video games and their specific impact on work memory processes (Jiménez-Porta & Diez-

Martínez, 2016). The results of this analysis showed that the activity in any of the games and apps involves work memory, since the user remains in the game only if he follows implicit rules, since in most cases, the instructions are not clear but the user discovers them throughout the activity.

Likewise, we observe that the user receives the visual information through drawings, photographs, forms or actions and that each of these visual stimuli is associated with a concept. These concepts belong to some semantic category since they are shown by means of animals, numbers, letters, transports or sounds that correspond to a specific action (verbs). Hence, any action in the games and apps also involves semantic memory.

Based on the results of the types of memory the games and apps benefited, we saw the need to determine which reading skills were enhanced while using games and apps since the presence of letters, syllables, words, numbers, images and photographs were recurrent in all of them.

Hence, the apps analysis was conducted to identify and classify the reading tasks at initial levels benefited during their use. Some of the tasks performed in the games and apps tally with the guided reading teaching pointers proposed by Swartz (2010), reason why we resorted to the author's proposal to classify these tasks.

## MATERIAL AND METHODS

The selected applications were the result of a search for technological resources that would meet the criteria of being in Spanish or that could be used in Spanish even when the titles or the indications were in English, and that would involve practicing tasks fostering reading or writing in Spanish even if these tasks were not indicated in their objectives, and be or have a free version that would comprise skills to foster reading and writing in Spanish. The search was conducted on three platforms: Windows 8.1, iOS and an Android version. In regard to the selection of video games and apps, we analyzed the activity benefited throughout the free version or open code, hence, openly accessible to everyone. From this search we selected twenty apps with the characteristics aforementioned. The activities carried out in the games and apps were initially registered in an observation guide created by means of a worksheet on which the type of learning activities carried out in the free version were entered. These tasks were categorized according to the cognitive processes privileged during the activity in the games and apps, and taking as basis the teaching pointers for guided reading proposed by Swartz (2010), which are detailed in the results section.



## RESULTS

The analysis of the apps and video games is shown in Tables 1 and 4. First, we made a registry with the name of the application, the versions, developers and platforms containing them (See Table 1).

**Table 1.** Applications analyzed and their generalities

Application	Versión	Desarrollador	iOS	Android	PC
Minecraft	13.1	Mojang AB	Yes	Yes	Yes
Busca las letras Lite/ Find the letters	2.1	EdNinja, Inc.	Yes		
Lee paso a paso	2.3	BQWare	Yes		
Palabras Domino	5.2	Nicolas Lehovetzki	Yes	Yes	
Visual Attention Therapy Lite	1.06	Tactus therapy solutions Ltd	Yes		
Lexico Cognition	2.7	Pappy GmbH	Yes		
Peak	2.8.1	Brainbow Limited	Yes	Yes	
Bubbles memory	1.1	Eduardo Mourey López Negrete	Yes	Yes	
Yo escribo	3	Islero SPA	Yes		
Memo 2 El Juego de memoria gratis	2.4	Clement Marty	Yes		
123 Zoo	2.0.1	Raúl Riera	Yes		
LEO Lite juego con los sonidos de las letras	1.0.110	Jaime C. Carriedo	Yes		
Sonidos de animales para los niños	2	Gaetano Consiglio	Yes		
Owlsmemo	1.1	Irina Schens	Yes		
Memory Crash	1.0.3	Jiaxin Wang	Yes		
Memory Training for Kids/Entrena tu memoria	1.2	Edujoy Entertainment S.L./ AppQuiz	Yes	Yes	
Memory Fitness Pro juego de parejas	1.1	Sharon Heller	Yes		
Piruletras /Dysegxia	4	Clara Bayarri	Yes		
Hyspherical	2	Game Analytics	Yes	Yes	
Aprender el alfabeto en español	1.6	Antonio Palos Cid-Fuentes	Yes	Yes	

Source: developed by the author.

Table 1 shows that eleven out of the twenty apps analyzed are independent developments and the remaining apps were produced by companies developing educational software. The fourth column shows the developers' preference for the iOS platform. We believe that this is related to economic and technical aspects, such as the extensive iOS penetration on the market, the graphic capacities and the stability of the iOS systems. This platform offers less fragmented systems unlike Android, which has a great variety of devices with different capacities, resolutions, processors and memory capacities.

Table 2 shows the description of applications according to the information provided by the developer and in function of other characteristics observed during the tasks that allow the user to follow-up on the activity being performed in the game; for example, if the game has certain levels of difficulty, if the achievement is reinforced, if the error is shown in the game, if there are progress bar charts, among others. We have noticed that during the game, commands such as Look for the Lite letters, Read step by step, Lexicon Cognition and LEO (I read) Lite, offer the user information through an auditory input that indicates the activity to perform in the game.

However, even when the user receives the instruction through this mean (auditory input), and if the user is illiterate, it will be difficult for him to display the instructions since these are heard only when the question mark is located and selected; information is usually acquired through schooling. Hence, even though the apps titles indicate ideas or concepts that support the reading and writing processes, the prerequisites involve understanding not only oral instructions but also decoding written signs. Those signs cannot be interpreted by illiterates or by adults that have loss certain decoding abilities due to cognitive alterations.



**Table 2.** Applications analyzed: *input* and feedback received by the user

	Instrucciones escritas	Instrucciones visuales	Instrucciones orales o auditivas	Instrucciones por medio de video	Opción de idioma: inglés y español	Tiene sonidos	Niveles de dificultad	Refuerza el logro	Indica el error cometido	Permite elegir el género del anfitrión	Registra los avances
Minecraft	*					*	*				*
Peak	*	*		*	*	*		*			*
Busca las letras Lite	*	*	*			*		*	*	*	*
Lee paso a paso	*	*	*		*	*			*		*
Palabras Domino	*				*	*		*			*
Visual Attention Therapy Lite	*					*		*	*		
Lexico Cognition	*	*	*					*			
Yo escribo	*										
123 Zoo						*					
Bubbles Memory	*					*	*				*
Memo 2	*				*			*	*		*
Animal Sound						*					
Dysegxia	*			*	*	*		*	*		
Owlsmemo	*					*	*	*			
Memory Crash						*	*	*	*		*
Memory Training		*				*		*	*		*
Memory Game						*	*	*			*
Hyspherical	*	*		*		*	*	*	*		*
LEO Lite	*	*	*	*		*		*	*		
Aprender el alfabeto en español						*					

Source: developed by the author.

Likewise, in LEO Lite, the illiterate user has the option of observing a video linked to an application which shows how to perform the activity. Using this application, although it is accompanied by oral instructions, requires the support of a literate who reads the instructions that indicate the existence of a support video.

In the same Table, column 2, we see that in fourteen of the twenty apps and games, the user information is presented in writing which facilitates the reading for literate users, or people with functions that have not been altered by disorders or diseases. This shows that reading is the main source of information despite the multimodality of resources used in applications. The foregoing tallies with Crescenzi-Lanna and Grané-Oró's report (2016), regarding the content analysis of multimedia materials of one hundred applications in which they observed that the text is a relevant and necessary element in 23% of the cases to be able to carry out the actions proposed in the applications.

Therefore, we observe that only the literate user makes optimal use of the application, even though the text is accompanied by visual and auditory resources, unlike what is presented in a traditional text. In column six, under the language option, five applications allow the user to choose the language in which he wishes the information to be presented; this also fosters the reading of words in other languages, mainly English. The option to modify the application language is once again offered to literate subjects who intend to learn commands and basic vocabulary in another language. Table 2, column nine shows the applications that reinforce the user's achievement after the right answer is given. Thirteen of the applications reinforce the user's achievement through a sound associated to an image immediately after giving the right answer. The immediate reinforcement of correct or incorrect answers has been described in literature as a fundamental aspect that encourages and consolidates learning besides increasing or, when applicable, reducing the emergence and quantity of answers (Coon, 2005, p. 298).

Users that do have precurent abilities to use apps and games to their fullest may benefit from any type of specific or associated learning proposed. This explains partly the motivation educators and therapists find in their practical experience when reporting that the subjects are motivated and attentive to the cognitive tasks applications and games involve (Franceschini et al., 2013; Kervin, 2016).

Table 3 shows the reading level apps and games present in their open code version. The reading level refers to the reading of isolated letters, syllables, phrases and sentences. The last column shows the specifications of those applications that promote print directionality. Reading letters and isolated words was the most recorded reading level in the applications selected. Three of them only show the users instructions through written phrases or sentences.

**Table 3.** Reading activities fostered by the applications

	Lectura de letras aisladas	Lectura de sílabas	Lectura de palabras	Lectura de frases	Lectura de oraciones	Direccionalidad en lectura
Minecraft	*		*	*	*	*
Peak			*			
Busca las letras Lite	*					
Lee paso a paso	*	*	*			
Palabras Domino	*	*	*			
Visual Attention Therapy	*			*		*
Lexico Cognition				*	*	
Yo escribo	*		*		*	
123 Zoo			*			
Bubbles Memory			*			
Memo 2			*			
Animal Sound						
Piruletras/ Dysegxia	*		*			*
Owlsmemo						
Memory Crash						
Memory Training						
Memory Game						
hyspherical						
LEO Lite	*	*	*			*
Aprender el alfabeto en español	*					

Source: developed by the author.

Some applications specify they were designed to learn how to read and write; such is the case of LEO Lite, a game that produces the sounds of the letters, Yo escribo [I write], Lee paso a paso [I read step by step], Palabras Domino [Domino words], and Aprender el alfabeto en español [Learn the Spanish alphabet]. Other applications such as Piruletras [Diseggxia], Visual Attention Therapy and Lexico cognition, even though they were designed for other specific purposes, contain, directly or indirectly, pointers that promote reading and writing.

Table 4 shows the content analysis of the activities presented in apps and video games in terms of cognitive processes required for the reading skills mentioned in the introduction.

**Table 4.** Games and applications: teaching pointers for reading

Guided Reading Teaching Pointers	Applications Offering Such Pointers
<b>1. Alphabet Principles</b>	
Letters recognition: Beginner Readers need to start by recognizing and draw letters.	<p>Busca las letras Lite [Search Lite Letters]</p> <p>Lee paso a paso [Read step by step]</p> <p>Palabras Domino [Domino Words]</p> <p>Visual Attention Therapy</p> <p>Yo escribo [I write]</p> <p>Piruletras/Dysegxia</p> <p>Minecraft</p> <p>LEO Lite [I read Lite]</p> <p>Aprender el alfabeto en español [Learn the Spanish Alphabet]</p>
Letter-name equivalence: This involves learning the names of the letters and identifying them with their sign.	<p>LEO Lite (vowels)</p> <p>Aprender el alfabeto en español [Learn the Spanish Alphabet]</p> <p>Lee paso a paso [Read step by step]</p>
Letter-sound equivalence: This involves hearing the sound of each letter and associating it with its sign.	<p>Aprender el alfabeto en español [Learn the Spanish Alphabet] (only with vowels)</p> <p>LEO Lite (vowels and consonants B, M, S, Ñ)</p>

<b>2. Phonological and Phonetic Awareness</b>	
Listen to sounds in words: The sounds in words (phonological awareness) must be associated to letters (Phonetics) throughout the instructions.	LEO Lite [I read Lite] Lee paso a paso [Read step by step]
Syllabic Division	Lee paso a paso [Read step by step]  Palabras Domino [Domino words]  LEO Lite [I read Lite]  Piruletras/Dyseggia
Assemble (codify) and disassemble (decodify) words	Piruletras/Dyseggia  Palabras Domino [Domino words]
Consonants and vowels	LEO Lite (vowels and consonants B, M, S, Ñ)  Aprender el alfabeto en español [Learn the Spanish Alphabet] (only with vowels)  Lee paso a paso [Read step by step]  Piruletras/Dyseggia
Spelling	Piruletras/Dyseggia
Divide words	Piruletras/ Dyseggia
<b>3. Language Structure</b>	
Using words	All the applications use written words to indicate the actions to be performed in the game
Vocabulary and word selection	Palabras Domino [Domino words]  Peak
Synonyms	Peak
<b>4. Reading Behaviors</b>	
Reading Direccionalidad: requires instructions	Minecraft  Visual Attention Therapy  Piruletras/Dyseggia  LEO Lite [I read Lite]

Source: developed by the author.

Next, we explain the cognitive processes to achieve the reading abilities proposed by Swartz (2010) which allow the comprehension of letters grouping shown in Table 4.

### Alphabet Principles

In this section, we group the applications that involve teaching pointers for the recognition of letters, letter-name and letter-sound equivalence. Nine of the applications we observed presented activities involving letter recognition. The letter-name equivalence is promoted in LEO Lite [I read Lite], Aprender el alfabeto [Learn the alphabet] and in Lee paso a paso [Read step by step]. Lastly, Aprender el alfabeto [Learning the alphabet] facilitates the letter-sound equivalence of vowels only, while LEO Lite [I read Lite] the equivalence is between vowels and consonants.

### Phonological and Phonetic Awareness

In this section, we concentrate on activities that comprise teaching pointers that involve listening to the sounds in words, syllabic division, codify and decodify words, spelling and divide or section words. LEO Lite [I read Lite] and Lee paso a paso [Read step by step] enhance listening to sounds in words. LEO Lite [I read Lite] is highlighted in the phonetic and phonological awareness of vowels and consonants b, m, s, y ñ, in the free version. The practice of the other consonants implies buying the application.

Aprender el alfabeto [Learn the alphabet] works on the phonetic and phonological awareness of vowels only, while the teaching pointers in Lee paso a paso [Read step by step] and Piruletras [Dyseggia] works on vowels and isolated consonants at the syllabic level. Piruletras [Dyseggia] presents phonological and phonetic awareness activities such as word coding and decoding. The benefit this type of tasks brings to reading-writing has been documented in the corresponding literature. However, in this application, the vocabulary is used to perform complex tasks that involve changing, removing and adding letters, and is based on using little known words in Mexican Spanish, such as eggplant, city council, room or ancient.

On the other hand, Lee paso a paso [Read step by step], Palabras Domino [Domino Words] and LEO Lite [I read Lite] promote the syllabic division; although there are tasks related to syllabic division in Piruletras [Dyseggia], these are really few in comparison to Palabras Domino [Domino Words], game that features the execution of this type of tasks throughout the application activity. Word coding and decoding was a recurrent task in Palabras Domino [Domino Words] and Piruletras [Dyseggia], application that shows different interspersed types of tasks as well as the use of bisyllabic words (football) and poly-syllabic words

(exercises) which involve the user having a higher literacy level or a more extensive vocabulary.

In regard to spelling, Piruletras [Dyseggia] is the only application that encourages this teaching pointer; however, according to our observations, there is no steady progress concerning difficulty or the possibility for the user to select a specific object such as learning the spelling rules of a specific letter. In Piruletras [Dyseggia], the syllabic structure is mixed with spelling rules and word coding, which makes the fluid execution of the task somewhat difficult and does not offer the user the option to choose the object to work on. The teaching pointer on sectioning words is offered by Piruletras [Dyseggia] only. However, we consider that this specific teaching pointer could be fostered with the use of compound words such as sacapuntas [pencil sharpener], pelirroja [red headed], among others, instead of words such as a partir [as of], in which the word division is not that obvious.

### Language Structure

In this section, we group application activities involving use of words, vocabulary, as well as a selection of words and synonyms. In regard to the use of words, we note that all the applications use words at different levels (isolated words, phrases, sentences) to indicate to the user which actions he needs to perform in the game. In Palabras Domino [Domino Words], the vocabulary is chosen among several semantic categories and words codification activities are carried out from which the user learns basic vocabulary such as cedro [cedar] in the tree category, up to a little used vocabulary such as baobab [baobab tree]. In Peak, the practice of activities enriches vocabulary such as the selection of two words with the same meaning. These tasks were located in the synonyms category.

### Reading Behavior

Reading directionability appears in the Visual Attention Therapy. This application focuses on literate users since the instructions on the upper part of the user interface are specified in writing. LEO Lite [I read Lite], on the contrary, focuses on illiterate users and the directionability appears in a white line on the left hand side of the interface. In Piruletras [Dyseggia], even though we haven't noticed a specific object, the directionability of the reading of words is promoted since these tasks require structuring the syllables which jump from left to right. Minecraft also promotes reading directionability since as the letters are pressed on the keyboard they appear on the screen under the conventional directionability.

The writing of letters, numbers, words and sentences was not considered within the teaching pointers of the guided reading proposed by Swartz (2010); however, it was fundamental to note that, besides reading, some applications such as Yo escribo [I write] and 123 Zoo, promote the writing



of isolated letters and numbers. In both applications, writing is done with the finger and these applications do not offer the user any auditory feedback of the letter being written. In Yo escribo [I write] we notice the presence of a graphic referent which is written with the letter being used as initial sound and the user is presented with the option of executing the drawing of bold or cursive letters. In this application, an arrow indicates the directionability to follow to draw a cursive letter, which promotes the appropriate execution of the letter. However, it does not offer any auditory feedback that would reinforce learning during the drawing or the positive corrective feedback.

Likewise, the drawing of letters in Aprender el alfabeto [Learn the alphabet] allows the user to receive auditory information of the sound of the vowels and numbers from one to five, provided the user presses the drawing representing an audio speaker. On the other hand, in Minecraft, writing is promoted by using a keyboard and the user can break down the writing according to his needs in the game. When writing in Yo escribo [I write] and 123 Zoo, no immediate feedback is provided to the user in regard to the drawing of numbers and letters.

Table 4 summarizes the fostered reading and writing skills. Nine of the twenty applications we analyzed teach the users alphabetic principles skills. Four of them teach phonetic and phonological skills, and within them, Piruletras/Dysegxia, Lee paso a paso [Read step by step] and Palabras Domino [Domino Words], comprise a greater variety of tasks of phonetic and phonological awareness for users. The aspects related to the structure of language are promoted in Palabras Domino [Domino Words] and Peak, since they promote the acquisition of an extensive vocabulary made up of different semantic fields; in Peak, the acquisition of vocabulary is done through synonyms selection activities.

The access to an extensive vocabulary repertoire occurs traditionally through reading a wide variety of texts through life experience or multimedia consultation material on different topics. Based on the foregoing, it is obvious that said applications of vocabulary increase benefit the user. Lastly, reading behaviors such as directionability, are promoted in LEO Lite [I read Lite] for early age children, while Minecraft, Piruletras [Dysegxia] and Visual Attention Therapy are directed to users with at least a basic literacy level in order to benefit from their use. It is obvious that using any game or app promotes the development of cross cutting skills (Sahagún, Ramírez & Monroy, 2016), as well as work memory, visual and semantic memory besides specific cognitive processes already mentioned for reading and writing.

## CONCLUSIONS AND RECOMMENDATIONS

In regard to the question initially raised about whether Spanish reading and writing skills are promoted during activities carried out in some free

apps and video games, we can assert that their use has an impact of the reading teaching pointers already mentioned besides an endless digital cross cutting learning (Inciarte, 2004). Likewise, it can also benefit any user with regular or special needs provided he can be supported by a literate user that helps him reach optimal use of video games or apps.

The multisensorial experience provided by the use of applications while learning to draw letters (Labat et al., 2014) may be very beneficial to children risking experiencing difficulties in acquiring the alphabetic principle and to adults with special educational needs. Hence, as we asserted, these children or adults need to have a sufficient literacy level or have the support of someone that helps them make optimal use of their contents. The ongoing presence of a text in the majority of applications, despite the multimodality that may be used in apps and video games, brings us to underline the importance of the use of reading and writing to access information. Technology and educational innovation developers should specify, in the description of the application, not only the objectives of said application but also the prior knowledge required from the users in order for them to reach its optimal use and, ideally incorporating support videos for their better use.

Educational innovation through using video games and apps must offer options according to the users' literacy level, the type of tasks or processes promoted by their use, and not only explain the age range that comprise different milestones of development due to their broad range and poor specification.

Likewise, developments must consider two options of multimodal input that allow the user to select the one that helps him make optimal use of its contents, individual record of the user's achievement level, record of the practice achievements, the incorporation of sound (auditory input) and vibration with the oral and visual instructions that may be used with illiterate children and users with auditory cognitive problems.

We recommend that technology and educational innovation developers include the writing of letters with information regarding the origin of the drawing of letters when these are bold and when a drawing is cursive, and present the visual information that guides the drawing, as we have observed in *Yo escribo* [I write]. Likewise, guiding the drawing of a letter and indicating through some sound or image if the users are doing it right or if they need to correct their mistake in order for them to rectify the drawing immediately, since the correction of an error while it is happening, helps the users to adjust their mental representation of that letter in particular and, thus, offer an individualized tutorial which benefits learning (Patchan & Puranik, 2016).

The data record presented could allow the creation of an app and game classification system according to the academic contents or learning

processes that are being promoted throughout their activities and, thus promote the creation of a content standardization system with the intention of achieving a classification system that would help the end user to choose an educational application catalogue that would adapt to his interests and individual needs.

The innovation and perfection of apps and video games implies the creation of multidisciplinary work teams that determine the practice of increasingly specific abilities. The data reported point to the need to continue deepening the types of cognitive processes that are promoted while using apps and video games and that integrate the knowledge that are currently available on the human cognitive functioning and the benefits brought by educational innovation to the teaching-learning processes (Mazzarella, 2008), more specifically those that promote reading and writing in Spanish at beginners levels since this educational level is the least studied in Mexico (Olivares et al.).

The analysis of the reading processes promoted or benefited by certain applications was conducted by considering traditional theoretical contributions. However, it is necessary that in subsequent and more advanced studies on the materials presented digitally to redefine the concept of reading through reading/browsing, since manipulating information on the screen requires managing certain competences that account for the interactivity digital interfaces proposed, as previously pointed out.

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