**Abstract**

The S.L. (Sign Language) is the mother tongue of people with H.D. (hearing disability), this language is their main way of communication which supports them to developing and learning new languages. Nevertheless, this communication process is limited because the S.L. is unknown in society and also changes its vocabulary according to geographic, ethnic and other factors. That fact segregates the S.L. users from the rest of the people.

On the other hand, according to Kožuh (2016) and Marschark (2009), the W.L. (Written language) represents a fundamental tool for communication on the environment because it is quite diffused and the majority of the information is expressed through it. Therefore, the W.L. is a second language for people with H.D. and learning it is very important for them, in spite of the learning process could be difficult and slow. These learning problems are often caused because of the inadequate methodologies taught at the special education centers for H.D. students.

This investigation arises from the idea of implementing teaching methods of foreign languages on literacy learning for deaf people. Starting with not-traditional methods that present information on it context, without grammatical rules and decontextualized words. Also, it uses games for supporting the students and increasing their interest, attention and motivation. ICT (Information and Communications Technology) tools were used for streamline the reader process with a broad visual content that improves the scholar activities of H.D students.

In this article, we studied the performance of a prototype teaching tool (game), made of a mixture of methodologies and games, where students with H.D. interacted face to face with a virtual group interface and across many activities (Character selection, Stories creation, reviews, competitions and points), they studied literacy information. This process was realized through a case of study in a modality of convenience displaying, divided in three phases. On the first one, the students were asked to read a short text, select related images, write a short text from similar images and answer some questions. On the second phase, six sessions of learning were accomplished with the developed tool, and on the third phase, similar activities to the first phase were done; later results would be compared in order to perceive the effects of the tool on learning students. The performances of each participant were evaluated based on the criteria used by H. Fernandez (2016) and A. Kida (2010), on their studies of the reading and writing evaluation.

Keywords: Hearing disability, Learning Literacy, Teaching methods of foreign language, Games, Virtual Interface, Design.

**1 INTRODUCTION**

Hearing Disability (H.D.) has major implications in a person's life, including lack of access to spoken language, which often has serious consequences on their interpersonal relationships and development in society (Cardin et al., 2016). As a communication alternative, the sign language (S.L.) being the mother tongue of the majority of people with H.D. (B. Lekova-Dimitrova, 2016); (Cardin et al., 2016); (Russell & Lapenda, 2012), allows them to have an approach to language development at an early age (Rincón et al., 2015) (Enns & Lafond, 2007). In this sense, it is extremely important, rich in terms of forms of expression and facilitator of learning new languages (Necla & Uğurlu, 2017); (Stone et al.); (Héloïr, 2008). Being a strong predictor of success that will later be in the domain of Written Language (W.L) (Domagala-Zyśk, 2015).

However, S.L. has two fundamental weaknesses, which make harder the communication of deaf people. The first one, is ignorance of S.L. in society, which excludes its users (Martins, et al., 2015), creating a distance between hearing people and deaf people (Kožuh et al., 2016). The second, is the fundamental change in its vocabulary, depending on several social factors such as gender, age,
ethnicity and place of origin (Bayley, et al., 2015); (Marschark, et al., 2012), creating barriers even with people with H.D. that belong to other contexts.

On the other hand, written language (W.L.) represents a fundamental tool for effective communication in the surroundings and for social inclusion (Kožuh et al., 2016), because it is quite diffused and the most of the context information is showed in that way (Marschark, et al., 2009), without any translation to S.L. (Martins, et al., 2015). For that reason, literacy learning is very important (Cano et al., 2015) to improve the communication, and the life quality of deaf people. Nevertheless, learning literacy for people with H.D.; Has been and continues to be a challenge (Marschark, et al., 2009), which, despite advances in technology and its applications in education, has not been able to be solved in an integral way (Welter et al., 2015).

According to Ruiz (cited by Cano et al., 2015) and Marschark et al (2009), students with H.D. Present difficulties in the acquisition of W.L., both in reading comprehension and in written expression. They often have a reduced vocabulary and learning difficulties compared to their hearing peers (Kyle et al., 2016) (Kožuh et al., 2016) (Cormier et al., 2012). This problem with regards to learning, is due to several factors. Among them, the absence of phonological awareness or relationship between phoneme and grapheme, since according to Hirshorn (2015), citing Stahl and Murray (1994), there is a link between the visual and phonological information that allows decoding and printing spoken words already known in character and meaning. Another factor is the condition of parents, who are mostly listeners (Depowski et al., 2015), do not allow the development of a spontaneous communication model in their children (Rincón et al., 2015), who could present Greater complications in learning (Marschark et al., 2009); (Hirshorn et al, 2015).

The main factor to be taken into account in this study, is the current teaching method which do not accord with the learning needs of students with H.D (Rusell & Lapenda, 2012), where written Spanish is introduced as if it were their mothers tongue, whereas according to Rincón et al. (2015) and Lederberg & Spencer (quoted by Kožun et al., 2016) it should be taken as a second language. In addition, these methodologies seek to teach through the use of grammar, unknown words, fragmented information or speculative ways of information storage in a stable way, which is only achieved by machines, not by humans (Gunter et al., 2016).

Based on the above, the idea arises of implementing other types of teaching methods, in this case, foreign language methodologies, where, taking the S.L. as their mother tongue, and to W.L. as a second language (Welter et al., 2015); (Rusell & Lapenda, 2012), we seek to support the learning process. In addition, tools such as ICT have been taken into account, which stimulate the reader's interest and motivation (Gunter et al., 2016) (Plonsky & Ziegler, 2016).

1.1 Methodologies of foreign language teaching:

According to Neuner (cited by Alcalde, 2011), two categories differ: traditional or grammatical methods, and direct or natural methods. In the first category, the objective is to know the words and grammatical rules of the new language, so that the student can both understand sentences and build them. The problem that such methodologies often have is the intention to teach loose and decontextualized words (Silva et al. Al., 2015) which can be predictable and even boring (B. Lekova-Dimitrova, 2016). On the other hand, the second category or "direct" or "natural" methods is born out of the attempt to disassociate itself from the methodology used for classical languages, and thus to develop a new procedure more in line with the spoken “live” language developed in everyday life. (Alcalde, 2011).

This project is mainly based on methodologies of the direct or natural type. These methodologies seek to expose the elements of the new language in its own context, starting from the reading comprehension, and through textual information of histories, that explain the grammatical structure and vocabulary in an indirect form (Alcalde, 2011). This allows the comprehension and reflection on the content, word learning and combination of words, to later express themselves through writing.

The methodologies used were the intermediate method, which proposes the active participation of students, exposing the information in the context, implicit grammatical rules and content reviews. The audio-visual method suggests a high content of images for the association with the content and later memorization. The communicative method proposes playing activities and games to strengthen group learning (Alcalde, 2011). The immediate physical reaction method presents understanding as the basis of learning and its confirmation from commandos (Ochoa et al., 2014). The learning method
formulates activities through tasks as an opportunity for communication (Ellis, 2009). The method from short stories proposes an entertaining and playful environment for the study of stories that teach structure and vocabulary (Lekova - Dimitrova, 2016). Finally the glottodidactics method involves the student’s personality who creates the information he wants to learn (Domagała-Zyśk, 2015).

1.2 The role of games in learning

Games are an important element for the cognitive and imaginative development of students. Its interactive and competitive nature encourages interest and motivation to win, while contributing to language development (Gunter et al., 2016); (Mugnier, 2006). According to Mackey & Goo (quoted by Plonsky & Ziegler, 2016), games based on interaction and communication are more effective for language learning. These games are used for the introduction of new topics, review of what has been learned, supplementary instruction or appropriation of learning tools for daily life. (Gunter et al., 2016).

Motivation to learn is an important factor, which promotes the self-confidence and mentality necessary to acquire knowledge and be put into practice (Belous, 2015) (Kontra & Csizér & Piniel, 2015). According to Caprara (Quoted by Siddiq & Gochyyev, 2017), personal beliefs significantly affect academic achievement.

In this Project, referents from several existing games were taken into account, for the creation of one constructed by several activities.

1.3 Technological tools for learning

The use of ICTs provides multiple and interactive tools which adapt to the learning process of deaf people, based on other senses and making visual, special and temporal material available (Rincón et al., 2015). The integration of visual-spatial or visual-constructional aspects facilitates the understanding of graphic information, which allows students to improve their school activities (DeWitt et al., 2015), in order to have a more playful and participative learning that increases their performance in literacy and communication efficiently with their environment.

Several studies, such as the ones from De Nooijer et al. (2014); Fischer and Zwaan (2008); Tellier (2008), cited by Van Berkel-Van Hoff et al (2016), demonstrate that textual or linguistic information is best retained if it is presented to the student in more than one modality. Therefore, the visual material in the acquisition of literacy, awakens the attention and curiosity of the person with H.D., facilitating learning (Padden, 2015). In this sense, it is necessary to take into account web accessibility, which seeks to make the interface clear and concise (Martins et al., 2015), so that visual information, which may include texts, photographs, gifs, or videos, can fulfil the purpose in the best way.

In addition, such technologies have the ability to provide a large amount of visual content and attractive information which makes them a good option to promote bilingualism in academic, cognitive and linguistic spaces (Rincón et al., 2015). Taking into account the fact that students are more active and attentive to the processes developed in the classroom when involving ICT (DeWitt et al., 2015).

2 METHODOLOGY

The research, was developed from the creation of a game virtual tool (DiaPlay), raised from the design methods of IDEO and INTI, an addition with methodologies as the participatory design and codesign. The project has based on some activities of teaching methodologies of foreign language, mentioned on the introduction of this paper, and uses of ICT. There was a participation of 12 deaf students, in fifth and sixth year of basic education, who were between 10 and 13 years old. Also, 3 hearing students who were 5, 7 and 8 years old, and one S.L. Interpreter.

The aim was to evaluate performance of the use and effectiveness, of a created tool, taken into account some factors like the use frequency, intensity and influence that they could have at results.

The experiment was carried out at the facilities of the National Institute of Hearing and Language (INAL), in Quito, Ecuador. Where the researcher, performed the tests, and kept a record of the field work. Participants were divided into two groups of 6 students each, the group 1, was integrated for fifth year students, who were between 10 and 12 years old. And the group 2 was made up of sixth year students, who were between 10 and 13 years old. The hearing participants were tested separately.

Initially, all participants accomplished a written test, where they were asked to perform the activities of Table 1, in a period of approximately 20 minutes, during the morning time. The test was evaluated

3230
taking into account the reading and writing assessment scales presented by Kida et al (2010), and the rubric to evaluate written productions of deaf students by Herrera et al. (2016).

<table>
<thead>
<tr>
<th>Table 1. Activities of the written test.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task</strong></td>
</tr>
<tr>
<td>One</td>
</tr>
<tr>
<td>Two</td>
</tr>
<tr>
<td>Three</td>
</tr>
<tr>
<td>Four</td>
</tr>
<tr>
<td>Five</td>
</tr>
</tbody>
</table>

For the evaluation were considerate, the number of successes and errors, whether they answered naturally or with interpreter help (Kyle et al., 2016), also the amount of ideas and its coherence in relation with the text (Kida et al., 2010), and the written expression from the rubric of Herrera et al (2016), which has the following criteria:

(1) Adaptation to the communicative situation, (2) Coherence, (3) Cohesion, (4) Textual structure, (5) Grammar, (6) Spelling and (7) punctuation. Which was evaluated with scores from 0 to 3, where “0” represents that it is not possible to evaluate due to the little extension or non-compliance of the criterion. “1”, that the criterion is not fulfilled or is achieved with difficulty, “2”, the criterion is fulfilled despite the difficulties or lack of aspects to be evaluated, and “3”, the criterion is fully met.

After the initial written test, the only one test for the hearing participants. 3 sessions of literacy teaching were carried out with group 1, and 6 sessions with group 2. The sessions of group 2 were performance with the double of frequency and intensity than the sessions of group 1. In both cases, the sessions tacked an approximate duration of 30 minutes using the prototype teaching tool, elaborated from Methodologies of foreign language teaching, ICT and Games. The tool consisted of 13 activities explained in table 2.

<table>
<thead>
<tr>
<th>Table 2. Teaching Tool Activities.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task Group</strong></td>
</tr>
<tr>
<td>One</td>
</tr>
<tr>
<td>Two</td>
</tr>
<tr>
<td>Three</td>
</tr>
</tbody>
</table>

Finally, the same initial test was performed to the participants of both groups, in order to compare the results between state A and B of each one, and the results of hearing participants. In addition to elucidating the effect that could have the differences in the frequency and intensity worked in both groups.

3 RESULTS

Two analysis stages of results were done. The first one has as main objective to know the student's performance when they develop DiaPlay’s activities in successive meetings. The second one compared the written tests from all participants in order to understand the potential effect resulting while using the tool.
3.1 Participants Performance While Using the Tool

According to records in the field diary, during the activity, 67% of students were very attentive, 23% were attentive and 10% moderately inattentive. The whole of the participants reacted to their turns in every season, which shows that using random turns is an effective way to keep the participants interested and attentive. In the same way, the presence of characters and identifiers elements managed that all players were focused in the activity and be aware about their playmate’s turns.

During the activity of generation of information in the form of story (Task 5), the time needed progressively decreased in successive meetings with an average of 46.2 seconds and standard deviation of 13.8. Time significantly reduces when meetings are done more frequently because of the participants know the activity and they are more confident talking in front of their playmates when they increase their practice. On the other hand, 98.1% of the ideas expressed were related with the image that was selected, but 53.3% were related with the ideas that were expressed by their playmates, trying together to create a story. In addition, at a higher frequency developing the activity, the relation of the participants’ ideas was lower.

The average time taken by the interpreter in order to do the review of the contents was of 2min47s. However, better results were obtained when the duration of the explication was of 4min10s during which, on top of doing the review using tactile sign language, the participants wrote the sentences in their books as suggested by the interpreter. During the review of the information by way of written sentences and images, the students paid particular attention. However, when it came to realising the activities which required remembering this information, there was 18.2% of failure in which the participants didn’t recognise nor express what had been reviewed.

The group making in order to carry out the competition and review activities was 90.2% successful. The remaining 9.8% was faced with complications because some of the participants refused to work together in the same group.

Overall, the completion of the competition and review activities were achieved with a success rate of 81.8%. This is shown in table 3 in which A represents the activity success percentage, B representing the failure percentage, C the average time invested (in minutes), and D the standard time difference.

<table>
<thead>
<tr>
<th>Task</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>One</td>
<td>Do a drawing representing a particular word or sentence which the classmates should try to identify</td>
</tr>
<tr>
<td>Two</td>
<td>Do the sign of a word or sentence which the classmates should try to identify</td>
</tr>
<tr>
<td>Three</td>
<td>Select the word corresponding to the picture</td>
</tr>
<tr>
<td>Four</td>
<td>Arrange the words of the jigsaw sentence</td>
</tr>
<tr>
<td>Five</td>
<td>Write a sentence based on a picture</td>
</tr>
</tbody>
</table>

The duration of activity 1 reduced constantly throughout the sessions. The participant in charge of drawing understood the word or sentence with a rate of 94.9%, whereas the other participants managed to understand the drawing with a rate of 83.3%, due to the quality of the drawings it reduced proportionally to the time invested.

In activity 2, there was a better success percentage compared to activities 1 and 3. This is due to the fact that the participants managed to remember the word – image connection much better than the word – sign connection with no support image.

Despite the higher success percentage of activity 2, the time used in activity 3 increased progressively. This is due to a greater intensity and frequency in the game participation. The students should remember a greater amount of information in less time. The activities which presented the most difficulties for them were the 4 and 5. In the 4th, there was proof of the influence of frequency, which when lowest produced an increase in the success of the activity. The 5th was the activity with
the highest percentage of help requested, considering that 62.2% of the students made questions and asked for help in order to remember the written words.

### 3.2 Effects on Learning

In general way, the performance of all participants in the first written test, increased 11.5% in the second test. The success percentage in the activities of the first test was 66.3%, and the second test was 77.8%. The increase of group 1, was 10.6%, and the increase of group 2, was 12.4%.

#### Table 4. Participants performance in the tasks of written tests.

<table>
<thead>
<tr>
<th></th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Task 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1T1</td>
<td>50%</td>
<td>91%</td>
<td>78%</td>
<td>78%</td>
<td>26.2%</td>
</tr>
<tr>
<td>G1T2</td>
<td>83.3%</td>
<td>88%</td>
<td>89%</td>
<td>83.3%</td>
<td>32.5%</td>
</tr>
<tr>
<td>Difference</td>
<td>33.3%</td>
<td>-3%</td>
<td>11%</td>
<td>5.3%</td>
<td>6%</td>
</tr>
<tr>
<td>G2T1</td>
<td>75%</td>
<td>87.4%</td>
<td>66.2%</td>
<td>72.2%</td>
<td>38.8%</td>
</tr>
<tr>
<td>G2T2</td>
<td>83%</td>
<td>95.6%</td>
<td>83.3%</td>
<td>88.8%</td>
<td>50.7%</td>
</tr>
<tr>
<td>Difference</td>
<td>8%</td>
<td>8.2%</td>
<td>17.1%</td>
<td>16.6%</td>
<td>12%</td>
</tr>
</tbody>
</table>

In the table 4, the letter “G”, represents the group, and the letter “T” represents the first or second test. The task 1, obtained the largest increase from the first to the second test. This activity presents an improvement of 33% in the group 1, and 8% in the group 2. The time used for deaf participants decreased in 34%, and the time used for one of hearing students, was 68% less than the average of time used for the students with H.D.

The task with the smallest increment of success, was the number 2, where the group 1, got a negative result, and the group 2, obtained an increase of 8%. Participants of group 1, presented an error percentage of 9% in the first test, due to omission errors. However, in the second test, the same group obtained a largest error percentage with a majority of action errors.

The intensity of the learning sessions performance, influenced the written test results, because, with greater intensity, better results were obtained. The above, is verifiable with the results of reading comprehension of the task 3, where the coherence of the expressed ideas, in relation with the text, increasing significantly in the group 2, compared with the group 1. In the same way, the positive results of the activity number 4, growing 5.3% in the group 1, and 16.5% in the group 2.

The written expression activity, or task 5, also showed a greater increase in performance of group 2, whose percentage doubled to increase of group 1. Nevertheless, both teams presented similar behaviours with respect to evaluation criteria of Herrera et al (2016), where spelling obtained the highest rating, and punctuation and grammar, the lowest rating. However, the criterion with the best increase from the first test to the second test, was grammar in both cases.

For its part, the hearing participants who are 7 and 8 years old, presented a high performance developing the written test. Where the student of 8 years, was the only one with a good rating in punctuation and obtained an efficiency of 90.44%. The hearing participant with 7 years old, got an 80.92% of success, due to punctuation and grammar problems, even worse than the grammar problems of deaf participants. On the other hand, the hearing participant who are 5 years old, obtained 26.8% in his performance, similar result as students with H.D. in the first written test.

The time token for developing all the tests, had a constant decrease, from the first to the second test. Partially, because participants got acquainted with the test.

### 4 CONCLUSIONS

#### 4.1 Participants Performance While Using the Tool

The students had a great interest in the game, especially the kids of the fifth grade, who often asked to play again. However, with a lot of frequency in carrying out the activity, the students became tired and they diminished attention. Therefore, it is recommendable reduce the frequency, from 5 to 2 or 3 times.
per week, to maintain interest in the game and the learning of the students. The presence of characters, identifying objects and equipment definition, contributed to the game's immersive factor, which increase the learning (Gunter et al., 2016).

Initially the participants with H.D. showed difficulty in saying sentences related to the corresponding image in S.L. because they expressed discomfort when they have to speak in front of their classmates. But as the sessions increased, the confidence grew and the time spent for each student declined. For this reason, the public speaking encourages participants' confidence and improves their communication skills in S.L. However, there was a constant difficult in interlacing his ideas with those of his classmates and for creating a group history, which in part is due of the absence in connectors of S.L. And to the differences presented with W.L. (Welter et al., 2015), which are reflected in the form of expression of participants and their ability to organize the elements of a sentence, or produce it.

The explanation of the content and the review, made by the interpreter of S.L, play a very important role in a help that strengthen the knowledge of the words and phrases of the students. In this sense, requires an exposition in the meaning of each word in S.L, in addition to the interaction of the participants in writing each sentence using the manual alphabet and written text. To reinforce the learning through repetition (Gunter et al., 2016), for approach the audiovisual method (Alcalde, 2011), and express the information in more than one modality (Van Berkel-Van Hoff et al., 2016).

The teamwork, a tool used by the communicative method (Alcalde, 2011), and the learning method through tasks (Ellis, 2009). It contributes to the improvement of the interpersonal relations in the participants, because they are committed to working with a common purpose and thus obtain the best possible results, in the case of “Dia play”, they obtain a greater number of points. These points should be striking and get the protagonism of the scene, both to inform the team that won them, and the opponent and thus attract attention, interest and motivation to win on both teams.

The activity that took the most time, was that included drawing, because the participants tried to make quality drawings, but as the frequency increased, they sought to be more competitive by reducing the time spent, but also reducing the quality of the drawings, reaching to the point of not being understandable by the other participants and therefore, to diminish the success obtained in that task.

People with D.A, process information in the visual-manual channel, which can be positively complemented by the use of figures and visual material (van Berkel-van Hoof et al., 2016). This is evidenced by the fact that activity number two, by not having images in the first instance, presents the lowest percentage of success among activities involving word and sentence recognition.

According to Mayer & Moreno (cited by Van Berkel-Van Hoff et al., 2016), teachers should be so careful and evite the saturation of contents in the student because the excess of information could cause learning difficulties. Thus, the game intensity should be reduced, so that the students, can internalize the contents without confusions, as observed in the task 3, of competence and review task group.

### 4.2 Effects on Learning

Changes in teaching methodologies and introduction of new tools, has enriches learning process of deaf students (Rusell, 2012), which is evidenced with increase in performance of all participants with H.D., obtained inside second test , after applying of built tool when comparing.

Test results of participants with H.D. From 10 to 13 years, with hearing students of 7 and 8, it is observed if despite being minors and having a lower level of schooling, the results of hearing participants are much higher. However, the results of five-year hearing participant are similar to those of deaf students. In this paper, we present the findings of a study by Martinez et al. (2009), Kyle et al. (2016), Kožuh et al. (2016), Cormier et al., 2012, among many other authors that assure difficulty and learning Slowly presented deaf students, in relation to their hearing peers. However, spelling results obtained by students with H.D. exceed those of the seven-year-old listener, who being in the literacy stage according to their age, and because of phonological awareness, confuses the sound Of the letters "b" and "v", "s", "c" and "z", or "g" and "j", elaborating texts with severe orthographic problems.

Spite of the improvements presented in activity of providing personal data, there are still 16.6% of cases, where participants had problems in writing their name and age. Sometimes they didn't pay attention to the question and confused age-by-date statement, which is absent in the test, is a common statement in their school evaluations. On the other hand, listening participants correctly wrote
their data in a much shorter period of time. This behavior is justified by who says that getting attention of deaf people is more difficult than hearing people (Depowski et al., 2015).

When they relate the image to the written word, students expressed doubts and insecurity to select answers, often asked for help and asked the sign language interpreter to ascertain the purpose of the exercise. It was also shown a greater difficulty to identify conjugated verbs in continuous present and words with greater number of letters, according to Stone, 2015, is due to limitations of access of S.L. To W.L.

Repetition of content encourages development of memory, and thus of literacy learning (B. Lekova-Dimitrova, 2016), therefore, when performing studio sessions with greater intensity will obtain better results both in reading comprehension As in written expression.

On the other hand, the results obtained in written expression, evidenced that their learning presents greater difficulties than one of reading comprehension (Rusell and Lapenda, 2012). However, high spelling scores were obtained because students remembered the correct way to spell words. Grammar and punctuation continued to be the most serious problem in the productions evaluated, due to the absence of verbal conjugations, articles, connectors and punctuation marks (Welter et al., 2015).

Finally, it is concluded that the tool created, used less frequently but with greater intensity, could bring important improvements in the learning of deaf students in the long term. However, it is necessary to make corrections and strengthen the prototype, in terms of programming, organization of the activity and feedback, to be faster, most efficiently and be open to receive new information in a simple way (Parton, 2014).

REFERENCES


