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# Multi-sensory storytelling to support learning for people with intellectual disability: an exploratory didactic study

Andreia Matos[a], Tânia Rocha[ab], Luciana Cabral[a]*, Maximino Bessa[ab]

*[a]Universidade de Trás os Montes e Alto Douro, Vila Real, Portugal*
*[b]INESC TEC,Oporto, Portugal*
*\*CITCEM, Flup, Oporto, Portugal*

**Abstract**

In this paper we present a study about multi-sensory content within the context of learning activities aimed at people with intellectual disability. A story was prepared together with traditional stimulus (audio and visual) and multisensory (audio, video, tactile and smell). Knowing that people with intellectual disability, due to their cognitive limitation, have multiple learning difficulties, namely in areas such as: communication, reading/writing and attention [1], it is really important to create innovative and pedagogically effective solutions that may motivate them and assist their learning process. Therefore, this study presents Preliminary results showing an overall improvement regarding the participant's memory when using the very multi-sensory contents.

## 1. Introduction

Disability is generally defined by CIF (International Classification of Functioning, Disability and Health), as "problems in the function or structure of the body, such as a significant deviation or loss" [1]. Intellectual disability, in particular, affects cognitive functions and its development over time, leading therefore to major learning difficulties which is one of its most recognized and prominent characteristics. Its origin may result from genetic

factors, environmental conditions, disease and injury during childhood, circumstances occurring during and after pregnancy as well as during the first years after birth [2]. Furthermore, this group of disability is closely associated with several pathologies in the intellectual development, dementia and mental and intellectual retardation [3].

As regards the teaching and learning contexts, there are in general, several tools thought of to support teaching. Some of its examples are provided by the area of information and communication technologies (ICT), such as PowerPoints, digital books, virtual schools, movies, and videos, among others. However, for people with intellectual disability this number tends to decrease. [4] In fact, attention and memory are cognitive functions that are affected by intellectual disability. Therefore, not only people with this disability tend to not pay attention to an activity but they also show not recalling what was previously done or practiced. From a didactic point of view, such learning limitations call for an adequate response so that people with intellectual disability may be provided with proper methodologies that allow them to experience higher levels of interest and motivation in a given activity and consequently lead them to better learning results.

To overcome this tendency we explore a didactic solution by means of very innovative multi-sensory contents to enhance learning. Therefore, if we add new sensory stimuli (such as smell and tactile) to the learning process we strongly believe we can increase memory, and consequently learning, as it is claimed by different studies, such as Brug *et al.* (2012) and *Young et al.* (2011). Indeed, according to these authors the stimulation of different senses help in retention of information and learning process.

In this paper we study how multisensory contents assist memory and help developing motivation skills within the learning process for people with this disability, register difficulties observed and results obtained.

This paper is structured by the background, where the main concepts (intellectual disability and multi-sensory contents) are exposed, followed by the case study and its description (methods, participants, experimental design, apparatus, procedures, results and discussion). Finally, it is presented the conclusions and future work.

## 2. Background

According to  Alfassi & Hefziba (2009), the learning process is the same for both people without disability and people with intellectual disability [6]. The traditional didactic approaches and activities, such as reading and writing tasks in textbooks, movies, powerpoints presentations, oral and gestural exposition, acetates, among others, are the common methods used within the learning process [7]. These methods have been used throughout the years and because of the continuous practice of these methods, students in schools have increasingly shown discouragement [8]. Typically, only two senses are in fact stimulated: audio and visual. However, when it comes to effective learning, it's crucial to stimulate others [9].

The objective of multi-sensory content is to make users feel their own presence, stimulating all their senses with different purposes [10]. Thus, we have five senses: taste, audio, visual, smell and touch. These stimuli produce different reactions in each person, and this is because several factors influence these same reactions. In the group of people with intellectual disability, the cognitive skills are affected and reactions obtained before inserting stimulus become even more diversified [11].

In education, there have been efforts to incorporate the multi-sensory contents in storytelling. Storytelling can be a way to convey knowledge, entertainment and provides a social environment. In the United Kingdom, for example, storytelling began to be used, in schools, to develop social interaction of children [12].

An upgrade of Storytelling is Multi-sensory storytelling and it´s being much used and practiced. Indeed, not only it is widely used in United Kingdom, but it has also been recently introduced in Netherlands and Belgium. Despite this success, there is little research on its content and efficacy [13]. Multi-sensory storytelling involves stories with the multi-sensory and oral text. The content and presentation should be created taking into consideration the (in) capacities of the group. During the presentation, it is normal to deliver an object (adding the tactile stimulus) to attract people's attention and motivate them to explore. Also, stories must be planned in order to facilitate the comprehension of people with intellectual disability. This multi-sensory content allows controlling the environment and provides the "feeling" that something will happen, letting people to get involved and attempt to anticipate the story. Consequently, it is very important to choose the stimuli presented and correctly prepare the local (room) where the story will be told so that nothing interferes with the experience. Several topics can be addressed in these multi-sensory activities depending on the purpose and the more are repeated the easier it is for people to understand and retain the information. This type of activity can raise participant's motivation. For people with intellectual

disabilities, the experiences may have different results for each person, depending on their sensory abilities, tastes and cognitive development [12].

Due to the area of our project, we chose two studies that are directly related to this theme to be analysed. Therefore, Brug et al. (2012) present a multi-sensory book where each page has a stimulus. The study included forty eight people with profound intellectual and multiple disabilities. Stimuli were tested according to the age of people, rather than story's content. The content was based on the activities of daily life and some elements of fantasy. Tactile and auditory were the most frequently stimuli. The stimulus was firstly presented and then given to the public so they could experience it. The experience was done twice a week. The sensory stimuli used were: auditory, visual, tactile, olfactory, taste and balance. As a result, it can be concluded that the choice of stimuli differed greatly according to the age. Thus, the content should be as appropriate as possible for each age. The experiences were performed in different countries and with different instructors, which may have influenced the results. The results show that there is a fairly good relationship between the use of visual and olfactory stimuli. A stimulus may complement the other. Thus, the use of a visual stimulus may be a good choice in this type of experiments. An olfactory stimulus looks more as an alternative to a tactile stimulus. Knowing the person with intellectual disability is essential for obtaining good results [13].

Young et al. (2011) presented a study that consisted of a multisensory book, in which each page had a phrase. Every phrase had a sensory stimulus. The objects associated to the stimuli were attached to A3 sheets. Eight individuals with profound intellectual disabilities (five men and three women) with ages between four and nineteen years old participated in this study. They had limited and non-verbal communication. Stories were told by mothers or teachers and one was told by the occupational therapist. In order to draw conclusions from the experience, the sessions were filmed and interviews were conducted by storytellers. As a result, six participants spent most of the time looking at the pages, one was seen touching the pages, and the other person had no reaction. The experience allowed six participants to better deal with the themes developed in the stories. When stimuli were increased, participants did not pay much attention to the storyteller. Instead, they paid more attention to the book (where the stimuli is presented). It was concluded that multi-sensory storytelling based on the daily topics can be used to address complicated issues [12].

### 3. Pilot Case Study

The main goal of this pilot study is to try to understand if people with intellectual disability can take advantage of such didactic approach consisting of multisensory storytelling contents in their learning activities. We want to determine how they react to multisensory storytelling and how this motivates them to learn.

#### 3.1. Methods

In this research, the case study is associated to ethnography to overcome the difficulties in communication as found in the group with intellectual disability. The methods of data collection used are directly related to the research methods adopted: logbooks (very common in case studies), document analysis, interviews, direct observation and video (used in the case study and ethnography).

#### 3.2. Participants

All participants are members of the Centre of Occupational Activities, from the Nuclisol- Piaget institution. The group that took part in the case study consists of eighteen individuals with intellectual disabilities with ages ranging between twenty-two and forty-four years old. The individuals, eight women and ten men (CAO – Nuclisol Piaget students), present different kinds of intellectual disability, namely: Down Syndrome, ADDH - Attention Deficit Disorder with Hyperactivity, fetal alcohol syndrome, dyslexia, dysgraphia and others still undiagnosed. Specifically, only one participant has Down syndrome; the remaining nineteen are not associated to a defined pathology, but a group of pathologies (for example, fetal alcohol syndrome with dysgraphia). According to DSM – IV, these pathologies can be classified according to severity levels, between light to mild. Regarding the participants, only one of them presented a high level of disability (DSM-V 2013). Within the group, twelve individuals have normal vision, six have corrected to normal vision and two individuals have some specific visual disabilities (strabismus).

At a literacy level, there has been a variation between kindergarten and primary school education, more specifically, fifteen individuals went no further than kindergarten and five between the 1st and 2nd years of the first cycle basic school.

### 3.3. Experimental design

First, we prepared the story (called "fruits story") whose purpose was teaching the group about fruits. The selected story's content (fruits) is an item also addressed in the school program (corresponding to the 1$^{st}$ grade of the first cycle basic school). Then, it was chosen the stimuli to be presented. The fruits presented were: green apple, orange and peach. Also, we presented the fruits and taught the users the features of each referred fruit (such as colour, taste, other similar fruits and vitamins). The story started with a green apple presenting its friends (orange and peach), and then each fruit presented their features. In the end, the story recommends its readers to eat several fruits every day because it is healthy. The Powerpoint presentation was designed according to the theme of stories and the stimuli we wanted to present to the audience.

We created two versions of this story: the audio-visual (with only these two stimuli) and the multisensory experience (including all stimuli: audio, video, smells, tactile).



Fig.1 - First slide from the Powerpoint presentation



Fig. 2 – Tutorial video of an orange juice recipe.

As regards as the presentation of aromas, it was used the smell machine, and they were used in the following order: green apple, orange and peach (in this order).



Fig. 3 - Sell machine used in the activity.

The video audio track and the voice of the storyteller worked as audio stimulus. The fruits were used for the touch stimulus (green apple, orange, a peach and a nectarine).

In the audio-visual experience, the audio and visual were the only two stimulated stimuli.

Finally, twenty four hours after the activities, an interview was performed in order to understand what information the users were able to retain. In this questionnaire, we first asked the participants what they recalled (without the support of any sort of leads, to assess global information retained) and then we asked objective questions (to assess recalled details). The objective questions that subjects were asked are the following:

1. How many fruits does the story talk about?
2. Do the lime, lemon and tangerine belong to the same fruit group?
3. The orange is very rich in vitamin. Which vitamin is this?
4. What can we find inside of a peach?
5. There was a difference in the skin of the peaches featured. What was it?
6. Did you like the story?
7. Do you wish to repeat?

### *3.4. Apparatus*

The following material resources were used in audio-visual environment: for the visual stimulus, a computer (Acer Aspire E1 Series), a multimedia projector (Epson EB-450Wi); and for the audio stimulus, speakers. In the multisensory environment: we used the same visual and audio stimulus; a scent machine (Daleair vortex machine) was used to deliver the orange, green apple and peach aromas; and for the touch stimulus, real fruits (orange, green apple and peach). It was chosen the least intrusive equipment due to the possible mental or psycho disturbs (strokes and other mental anomalies).

### *3.5. Procedures*

The group performed one activity in one of the two environments presented: in audio-visual environment and in mu8497-8*-ltisensory environment (visual, audio, tactile, and smell). The activities were practiced in separate rooms. This division was intended not to constrain the activities, i.e. the smells stimulus of multisensory experience could not remain in the audio-visual experience. The participants were assigned randomly to each environment. The activities were conducted in groups of two elements so that it was possible to control the interaction and the stimuli presented and reduce distractions.

In the multi-sensory activity they sit in front of a smell machine and the PowerPoint presentation. To start we explained the activity and presented the fruits. Fruits were touched by the participants so that they could experience the touch stimulus, followed meanwhile by the smell emission (smell stimulus). During the presentation it was shown several fruit images (visual stimulus) as well as a video revealing how to make orange juice (visual and audio stimuli).

In audio-visual activity they saw the same PowerPoint presentation and they listened to the storyteller. It was presented the same visual and audio stimuli in both activities.

At the end of the story some questions were made concerning the contents thought of check whether the information was understood or not. Once they completed the activities, they returned to their normal activities. After twenty four hours, we went back to the Institute to proceed with the interviews.

## 4. Results and Discussion

Globally, the participants' interaction was positive. During the multi-sensory experience, most of the participants showed signs that they were aware of the smell stimulus and provided positive feedback. Only one participant from the multisensory experience made a comment when he detected the smell. Given their reaction, it is possible to confirm that the majority of participants detected the smell but did not make any comment. However, we are not sure if the other participants that didn't show any signs that they had detected the smell did in fact feel it or not. We believe that its location may have influenced the results. The tactile stimulus alert attention and interaction, especially when there were different textures, as with the peaches.

During the audio-visual experience, the attention of individuals increased when audio and visual stimuli were presented and these types of stimuli have produced a greater reaction (they laughed or talked about the issue).

After 24 hours, being the activity already completed, we carried out the analysis of the interviews. Through the interviews it was possible to check the amount of detail that users recalled from the story. Each interview was reviewed and classified. In table 1, we can see the results as obtained by the participants.

Table 1. Percentage of correct answers and the respective average of the groups.

| Id | Multi-sensory (%) | Id | Audio-visual (%) |
|----|-------------------|----|------------------|
| 7  | 80                | 1  | 50               |
| 8  | 100               | 2  | 67               |
| 9  | 7                 | 3  | 50               |
| 10 | 0                 | 4  | 7                |
| 11 | 93                | 5  | 53               |
| 12 | 100               | 6  | 7                |
| 17 | 97                | 13 | 0                |
| 18 | 73                | 14 | 90               |
| -  | -                 | 15 | 97               |
| -  | -                 | 16 | 70               |

It should be noticed that there were two interviews with no correct answer. This happened because each of them correspond to two individuals who have limited communication capacities, and did not answer to any question from the interview. Also, two participants who were included in the multi-sensory experience of the group were absent and consequently failed to answer the interview.

Figure 4 shows the average of correct answers regarding the two environments.
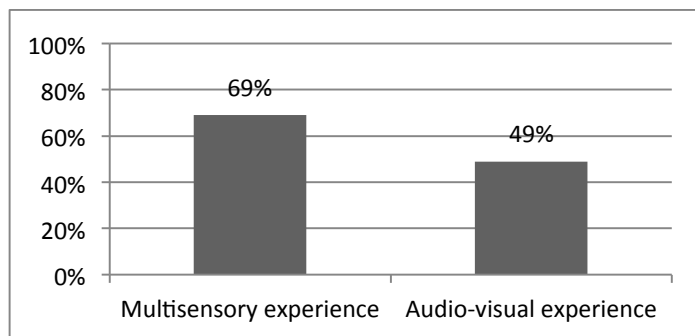


Figure 4: Average of correct answers of the two environments.

Users had a better performance in the multi-sensory environments, with an average of correct answers of 69%, when compared to the audio-visual environments (49%). This result may indicate that from a didactic perspective, as tested, the multisensory experience is more effective regarding memory.

When comparing the global and specific information retained (according to the interviews results) we observed that subjects recalled more details of the story when presented by the multisensory experience.

Concerning the stimuli presented in the multi-sensory storytelling, the tactile stimulus had more impact. In the interview, the group immediately recalled the tactile stimulus. The olfactory stimulus, however, was not referred once, during the interview by any participant of the activity. This could be due to the fact that participants were conversant with these stimuli. When these stimuli were similar to a familiar object, the number of comments and the interaction increased. It is worth mentioning that this group has different intellectual pathologies as distinct personalities, and due to this fact we obtained different reactions to the same situation (some laughed, others spoke, others did not move).

Two participants showed more resistance when it came to perform the experience because they had to be removed from the activities that they were carrying out and which they were enjoying. This aspect was therefore a factor that inhibited the interaction, participation and decreased the desire to repeat the experience.

## 5.   Conclusions and Future Work

The main objective of this study was to observe and analyse how this particular audience reacted when presented with a multi-sensory environment as regards as specific learning purposes.

The preliminary results indicate that multi-sensory content may achieve better results (both in experiments and in direct observation). Participants made more comments and their interaction with the researchers was higher. One can say that in this story the multi-sensory content contributed more positively to the retention of learning contents, consisting on the topic of fruits, than the other environment.

As the results seems promising we intent to run a full study on how multi-sensory storytelling can help this group of people in their learning activities. Another possible and further study may be the test of each particular stimulus. This way we can observe in more detail the reactions to a given stimulus. Also, we think it is important to experiment different stories with different complexity to see to what extent multisensory works.

### Acknoledgements

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