TEARA: Educational Treatment of Children with ASD, mediated through augmented reality.

Mónica. R. Romero[1], Ivana Harari[1], Javier Diaz[1], Estela Macas[2]

[1]National University of La Plata, Faculty of Informatics, Research Laboratory in New Information Technologies (LINTI).
Calle 50 y 120, 1900 La Plata. Buenos Aires.

[2] International Ibero-American University - UNINI MX. Mexico

[1]monica.romerop@info.unlp.edu.ar, [1]iharari@info.unlp.edu.ar, [1]jdiaz@info.unlp.edu.ar, [2]estela.macas@doctorado.unini.edu.mxc

Orcid ID:https://orcid.org/0000-0002-6099-7039
Orcid ID: https://orcid.org/0000-0001-6350-7739
Orcid ID:https://orcid.org/0000-0002-4225-3829
Orcid ID:https://orcid.org/0000-0002-1237-1154

Abstract. The treatments that used since the 1960 as educational proposals for children with autism spectrum disorder (ASD) are becoming obsolete over time. This research proposes an educational treatment for children with autism mediated through augmented reality called (TEARA), as a response to the challenges and constant change of a globalized world, which requires the establishment of new methods, strategies and treatments that allow improve the quality of life of these children with autism. The methodology was approached through a mixed, exploratory, descriptive, and purposeful study where a multidisciplinary team participated, we developed a training system called Hope, which reinforces and promotes teaching-learning processes, finally after several cycles of intervention, deep observation and the compilation of results, it was established that TEARA can be used by professionals, parents and people who accompany children with ASD.

Keywords: *ASD, Treatment, Education, Hoope, Augmented Reality, TEARA*.

1 Introduction

Autism spectrum disorder onwards ASD is a neurological disorder that is complex[1], has no cure, in addition to being considered one of the enigmas that even medicine does not fully understand[two]. Autism spectrum disorder becomes one of the most complex to treat[3]–[5], although over time specialists have managed to diagnose this disorder at a younger age, which allows an early intervention plan to be drawn up[5],[6].

Regarding ASD and strategies in the educational field, various investigations have been planted where information and communication technologies have been used for

two decades to reinforce certain areas in children.[8], [9]and they manifest themselves in different ways such as: software and hardware. Experience tells us that the projects that were raised individually and methodically, although it is true, strengthen certain areas and provide assertive results.[10], [11] . It is no less true that those projects that are worked on from multidisciplinary groups and with a prolonged duration achieve greater benefits.[12]–[14].

In recent years we have seen how emerging technologies make their way into our society, virtual, augmented and mixed reality are present as an innovative element in education[15], [16], and even more in children with special educational needs (NEE)[17],[18]; That is why when we started this research in 2017 we planned to use augmented reality (AR) in teaching-learning processes.[18],[19], however in the development and conceptualization we rely on different strategies such as: Design thinking general conceptualization of the product[twenty-one], User Experience (UX), we use a user-centered design (UDC)[22]that allowed us to develop the training system called Hope.

Once these processes have completed, we seek to maximize their results, we elaborate a pedagogical technological intervention plan where we design the TEARA program. This study structured as follows: Section 2 explains the materials and methods that used, for data collection several techniques such as surveys, interviews and deep observation were conducted. Section 3 presents the results of the study, finally Section 4 presents a critical reflection on the proposal and future challenges of the TEARA program.

2   Material and method

This research presents a mixed approach since it uses a qualitative and quantitative method.[23]. The scope of this work is exploratory because programs that include the integration of innovative technologies, specifically augmented reality, to support children with ASD have not yet defined. This research is descriptive because it seeks to know in detail about the benefits of including TEARA in the treatment of children with ASD and purposeful since this research defines an Educational Treatment of Children with ASD, mediated through TEARA augmented reality.

This research focuses on two modalities such as documentary and experimental, this is because the experimentation was carried out through the Hope application, it is closely related to the deductive method because it bases its development on evaluating TEARA on children with ASD. , allowing to identify if this program is proactive for interventions where it is intended to use emerging technologies, especially augmented reality.

The field work of this research conducted in the city of Quito at the Ludic Place Therapeutic Center, the population made up of the group of children with ASD who used the Hope training system (5 children), and professionals who accompanied this experience, medical, academic (5) and information and communication technology (5) personnel.

The children who participated are 5 children, three of the male gender and 2 of the female gender, keeping the privacy of the data defined from now on by a capital letter: Eidan (E), Matias (M), Santiago (S), Valeria (V) and Ana (A). The children have a confirmed diagnosis of moderate and severe ASD respectively, the children regularly attend the Ludic Place Therapy Center 2-4 times per week. Their legal representatives previously signed an informed consent agreement.

2.1 Educational Treatment of Children with ASD, mediated through augmented reality TEARA

TEARA designed to strengthen teaching and learning processes for children with ASD, mild, moderate, and severe, it can used by children from 4 years old to 12. TEARA uses a training system called Hope that teaches through dance, that is, configured so that the child learns to dance and progressively seeks to include new learning, showing greater complexity as time goes by, it can used in academic centers, therapy centers, or at home.

TEARA proposes the use of Hope software, which developed through a friendly interface, in a playful space, allowing children and their caregivers to interact through emerging technology, specifically augmented reality. This system has activities and teaches dance steps. This system allows the child with ASD mobility of options to configure the environment by adding or removing options for use.

2.2 What do I need to apply TEARA

4 main aspects have defined that will help the use of TEARA to be successful.
- People: The people involved in TEARA are children, parents, or legal guardians, academic or medical staff of a child with ASD.
- Place and adaptations: To work with TEARA it is essential to define a place where the activities will take place, this can be a meeting room, a classroom, the living room of a house, the important thing is that you have a place of 4 square meters so that the proposed activities can be conducted.
- Training system: The necessary instruments for the application of the treatment are of distinct types: Hope software, free version; hardware: television or laptop, Kinect. The following figure 1 shows the training system.

Fig.1. Training system, on the left software and hardware for operation, on the right Hope main menu.

- Intervention plan: To apply TEARA it is necessary to start from a correct planning followed by an intervention plan that in turn defines phases: socialization, diagnosis, intervention, monitoring, evaluation.

2.2 TEARA phases.

Planning Phase: This phase allows sessions to devoted to the proper planning of the intervention. In this phase, important actions defined, such as the Therapy Center where TEARA will used, communication with managers, sessions to explain this process to participating teachers or medical personnel., which is the place where we will conduct the sessions, the necessary materials. This phase made up of 9 sessions that indicated below:

Sessions with academic staff, doctors, parents.

- Socialization sessions (1): it is important to explain what TEARA for what it is for, the work methodology and what aspects of the children will be reinforced through its use. Parents participate in the socialization meetings and decide whether to give your informed consent for the use of TEARA in your clients.
- Sessions to define work team (1): in this session what sought is to integrate a preferably multidisciplinary work team that will be responsible for the execution of TEARA.
- Adaptation sessions (1): In these sessions the work team will look for the right place to use the training system, define the place and install the Hope software, check that the Kinect works correctly, in addition to checking the connection of the laptop or television necessary for the execution of the sessions.
- Test and training sessions (2): The people who are part of the work team have to start the tests of the training system, when the tests have a favorable result, the training can begin, the intention is that the teacher who will participate with the child with ASD must be proficient in the use of the Hope system because he will be the one to guide the child in the first sessions.
- Participant Identification Sessions (1): This session identifies child participants with ASDs who will use TEARA.

- Sessions to define curricular intervention plan (2): The curricular plan must be thought and worked for each of the participants according to their needs, in the curricular plan objectives of different types are generally identified: cognitive, communications or procedural the intention is to define a path to follow according to the strengths or weaknesses that each child with ASD presents.
- Sessions to define the form of evaluation (1): once the intervention with TEARA has conducted, the progress of the children must evaluated in accordance with the curricular plan drawn up to know to what extent the use of TEARA was favorable or not, to reinforce certain teaching-learning processes or skills in children with ASD who have participated

Execution Phase: This phase allows TEARA to run the training system through the Hoope software. This phase is up of 25 sessions that indicated below: Sessions with children with ASD:

- Initial diagnosis sessions: it is essential that prior to using the system an initial diagnosis of the participant conducted, this evaluation done to determine the current state of processes such as imitation, perception, gross motor skills and fine motor skills, in this section the professionals They must make a record of the data obtained.
- Hope training system sessions: these sessions serve to reinforce teaching-learning processes, imitation, fine and gross motor skills, perception, visual-motor coordination. These sessions last 22 minutes and held 3 times a week. The number of TEARA sessions defined in the intervention plan; however, it recommended that the number of sessions be 25 sessions to have more assertive results.
The first sessions the child accompanied by the teacher or therapist in charge so that in a coordinated process they can gradually use the TEARA system individually.

Review Phase: This phase allows evaluating the TEARA process, that is, the use of the training system through the Hope software. This phase consists of 2 sessions that indicated below:

- Sessions to conduct the evaluation (1): This session allows the work team to conduct an evaluation of the progress obtained after the application of TEARA, the same form of evaluation that used in the diagnostic session used and it verified if any of the teaching-learning processes improved after the intervention.
- Feedback sessions (1): this session allows evaluating whether the objectives of the intervention plan met and if opportunities for improvement are evident, it conducted in a meeting where it discussed with those interested in the process. The following Figure 2 below shows the phases of TEARA as a summary.
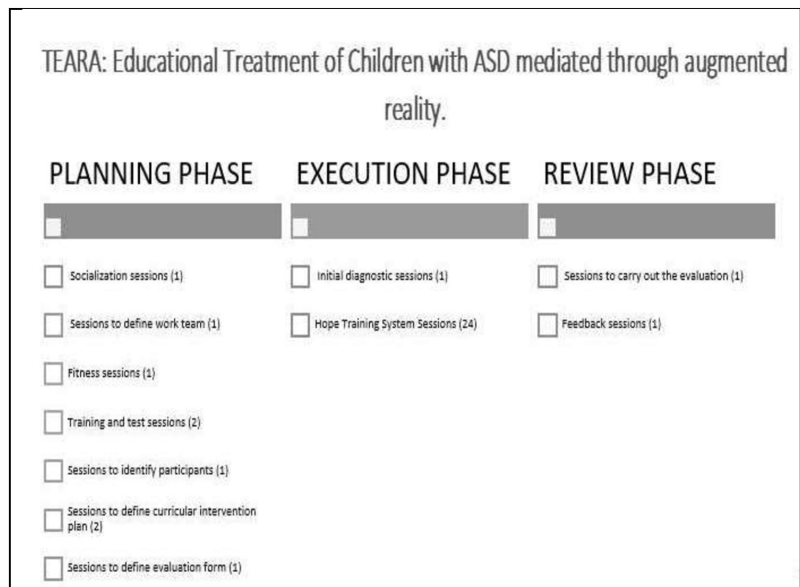
Fig.2. Phases of the Educational Treatment of Children with ASD mediated through augmented reality TEARA.

2 Results

TEARA used in a group of children with ASD and with the support of a multidisciplinary team, in this process each of the phases defined in its methodology considered, TEARA used for three months, through 9 sessions of the phase planning, 25 sessions of the execution phase and finally 2 sessions of the review or evaluation phase. For each session, actions conducted so that children with ASD use the system and through it learn dance steps, using their body, each option of the system allows children to reinforce the processes defined in advance in the pedagogical intervention plan, TEARA allowed strengthen imitation, perception, gross and fine motor skills, visual coordination, motor movement.
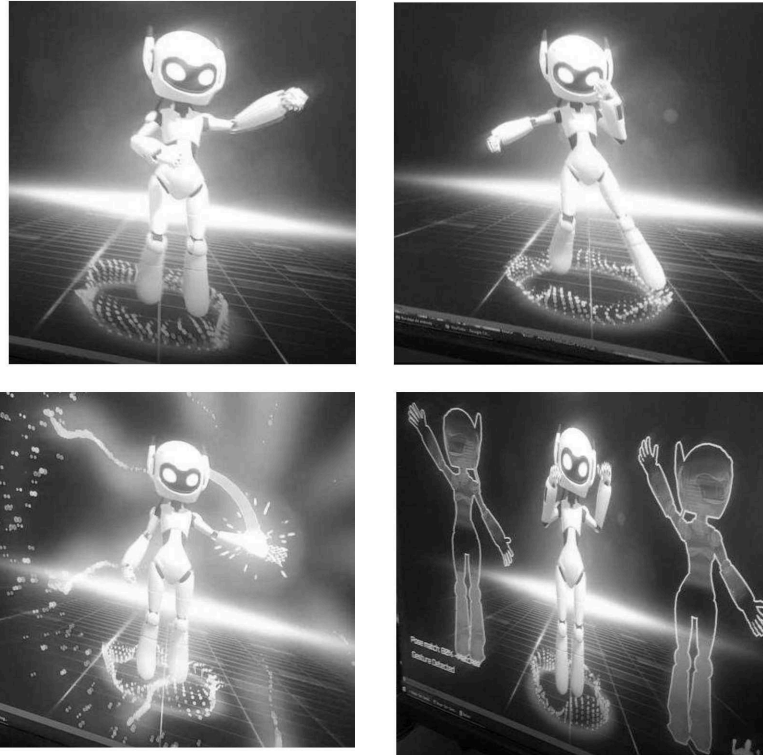
Fig3. Images of the Hope software training system shown.

The multidisciplinary team assigned for this project conducted the diagnostic sessions, keeping a record of the evaluation obtained from the processes before the use of TEARA, a scale of 1-5 used, where 1 means that the process is incomplete and 5 means that the process is incomplete dominated and compared with the evaluation sessions at the end of the intervention, the following results were obtained after the application of TEARA in the participants, Figure 4 presents the results grouped by process in the graphs each participant is shown evaluating in the diagnostic session before TEARA and after use.
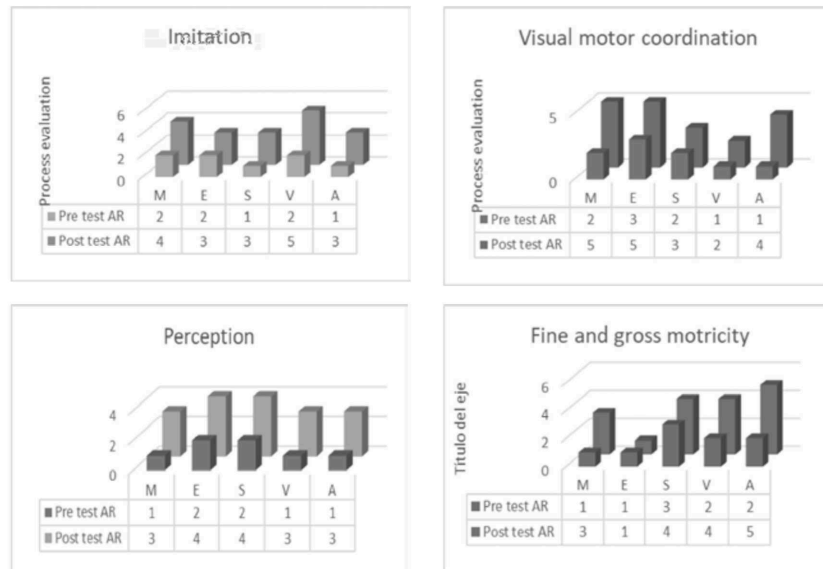
Fig.4. Results obtained in the diagnostic session of children with ASD contrasted with the results obtained after the use of TEARA.

3   Discussion and conclusion

The advancement of science and technology is increasing, the teaching-learning processes are being renewed and strengthened over the years, there is also evidence that Information and Communication Technologies (ICT) are assertive in treatments in children with ASD, because they cause a special motivation for their use, they have been used for about a decade[24].

However, from a review of the literature it was possible to show that the interventions of children with ASD are maintained over the years, these treatments that have been widely disseminated have been maintained over the years, without a change, updates or innovation for decades, we analyze its limitations and after reviewing that new technologies have strengthened various motor, cognitive and communication areas, we conducted this research defining a new Educational Treatment mediated through augmented reality that we call TEARA as a disruptive way and innovative way of strengthening teaching-learning processes in children with ASD.

TEARA was developed as a doctoral research, carried out in the LINTI New Computer Technologies Research Laboratory of the National University of La Plata, Argentina, the time allocated to its analysis, design and implementation was

approximately five years, during this time work was carried out taking into account the needs of children with ASD and with the opinion of experts who are part of their immediate context, we refer to the team of medical professionals, academics and parents who share their day-to-day lives, which have allowed through their knowledge and experience to develop a training system called Software Hope that, from a playful proposal, supports cognitive and communicational areas of ASD children.

In this investigation, the phases on which TEARA is based are indicated, which are well defined, being 3: planning, execution and review, the treatment is based on the execution of 36 sessions where 09 of them are destined for a planning stage, 25 of them have the intention of intervening directly with the child with ASD and the final 2 sessions try to carry out an evaluation and feedback on the usefulness of this treatment.

TEARA can used in both therapy centers and primary settings, or in the homes of children with ADS. It designed to reinforce certain teaching-learning processes such as imitation, visual coordination, perception, motor skills, however, it has shown that in addition to these processes it helps children with ASD by promoting verbal and non-verbal communication.

The training system that is a fundamental part of this proposal has been continuously improved by adding better options, the software is very easy to use and very intuitive, it is designed so that in a first stage the therapists or teachers accompany the child with ASD and that in subsequent sessions as the child gets used to its use, the child can use it alone.

The intention behind TEARA is the definition of a methodology for the inclusion of new technologies as a teaching-learning strategy, which broadly encompasses the considerations that must be taken into account before, during and after their use; the intention is not only the use of a software created for children with ASD, but also a comprehensive intervention proposal that is structured in a complete way, that is, in the planning phase several actions are carried out and it is essential to allocate time to the elaboration of an intervention plan that defines objectives in a particular way for each child, the diagnostic sessions and subsequent evaluation allowed us to verify that TEARA was effective in strengthening the teaching-learning processes.

TEARA had a very positive impact on the children who used it, the processes for the most part improve remarkably, when reviewing the records of the diagnostic sessions and the evaluation sessions an increase is evident, the children showed particular interest in the use of the Hope system , and according to the clinical observation, the children finished the therapy with a better mood predisposition, their behavior favored the activities that were carried out after the intervention. Figure 5 shows a child using TEARA.

Fig5.TEARA envisioned a child with ASD participating through the training system using Hope Software.

The limitations that we find when using TEARA can be defined in two central points; On the one hand, there is a certain fear on the part of the teachers and therapists of the use of new strategies, at the beginning the professionals presented resistance to a change in the way of imparting the therapy, the same one that is always carried out in the same way, on the other On the other hand, the limitation is that to use TEARA, the center must have a laptop or a television in addition to acquiring a Kinect device whose market value is not high but can be considered a budgetary limitation. As future work, we encourage the use of TEARA in children with mild ASD as the participants diagnosed with moderate and severe ASD.

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