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ANALYSIS OF THE INITIAL ACCEPTANCE OF THE BEE-BOT ROBOT IN STUDENTS WITH AUTISM SPECTRUM DISORDER

Elena Pérez Vázquez, Gonzalo Lorenzo Lledó, Asunción Lledó Carreres, Alejandro Lorenzo Lledó, & Alba Gilabert Cerdá
Department of Developmental Psychology and Didactics, University of Alicante (Spain)

Abstract

Nowadays, pedagogical robotics is configured as a methodological trend in schools, conceptualized as a technology for learning and knowledge (TLK). Particularly, in the field of inclusive education, the use of CAT during the learning process of students with autism spectrum disorder (ASD) could imply a greater motivation towards the tasks by these students and, therefore, a greater focus of their efforts. Specifically, pedagogical robotics has a series of characteristics, such as predictability, high degree of control of the environment and sequencing, which are perfectly aligned with the educational needs of these students. Among them, the need for a controlled environment that favors error-free learning and decreases the high levels of frustration in the face of non-achievement of the task stands out. Thus, the purpose of the study is to analyze the initial acceptance, by students with ASD, of the Bee-Bot robot for teaching communication and social interaction skills. The proposed research presents a quantitative approach with a single-case quasi-experimental design. A non-probabilistic purposive sampling technique was used for the selection of participants. Thus, the sample of participants consisted of 11 students aged between 3 and 16 years old, attending specific communication and language units in schools in the city of Alicante (Spain). The instrument used is a field notebook designed *ad hoc* that evaluates the parameter called "initial acceptance". Regarding the procedure, an individual session with each participant lasted approximately 20 minutes. A descriptive data analysis for the calculation of frequencies and percentages was carried out with version 27 of the Statistical Package for Social Sciences (SPSS). The results indicated that more than 54.00% of the students indicated that they wanted to play with the robot, listened attentively to the explanations and pressed the robot's upper commands. Also, these results indicated that 90.91% approached the robot showing interest and 100.00% responded that they wanted to use the robot again. On the other hand, less than 28.00% of the students were frightened when the robot moved and covered their ears when the robot sounded. In conclusion, students with ASD accept the Bee-Bot robot, which makes it a potential tool for carrying out different activities.

Keywords: *Autism spectrum disorder, robot, Bee-Bot, initial acceptance.*

1. Introduction

Currently, Autism Spectrum Disorder (ASD) is understood as a neurodevelopmental disorder that manifests itself during the first years of life through difficulties in the areas of communication and social interaction and the presence of restrictive and repetitive behaviour patterns and behaviours (American Psychiatric Association [APA], 2013). From the perspective of inclusive philosophy, the teaching of students with ASD in such classrooms should be governed by a series of principles such as structuring, anticipation, visual support and error-free learning (García-Guzmán, 2021).

Rapid technological progress in the 21st century has made possible to extend the use of ICT to different areas, including schools (Kandel, 2022). Specifically, ICT is increasingly used as a tool to facilitate access, participation and learning for students with ASD (Nikolopoulou, 2022). Among the tools that could be adapted to these principles, pedagogical robotics can be distinguished as a space for dialogue between the disciplines of engineering, didactics and pedagogy that allows the analysis of the possibilities of robots as tools to support learning (Ghitis & Vásquez, 2014). Until now, different research has been carried out with robots and have demonstrated the advantages of its use in this field. These include attracting the attention of students with ASD (Boccanfuso et al., 2017), eliminating sensory overload (Robins et al., 2009) and allowing learning to be practised in a controlled situation (Nadel et al., 2022).

The present study brings as a novelty the use of a floor robot, called the Bee-Bot robot, to work with students with ASD on aspects related to the area of communication and social interaction. This robot had not previously been used with students with ASD for this purpose. The Bee-Bot robot is a bee-shaped robot whose design allows it to adapt to students of different ages and needs (Pérez-Vázquez et al., 2022). Due to the high cost of educational robots, this research proposes the Bee-Bort robot as a low-cost alternative accompanied by a task protocol for the development of communication and social interaction skills of students with ASD. This bee-shaped robot is programmed by means of simple commands to move through the boxes of the play maps used for each of the activities.

2. Objective

The present manuscript is part of a large-scale project whose main objective is to explore the application robotics to promote communication and social interaction skills in students with ASD. Specifically, this manuscript aims to answer the following research question derived from the main aim:

Do students with ASD show initial acceptance in the use of the Bee-Bot robot?

3. Method

This section refers to the research approach and design, the characteristics of the participants, as well as the instrument used, the intervention developed, the process and the data analysis.

3.1. Methodological approach and design

The research has been developed from a quantitative methodological approach because it uses data collection and analysis to answer the research question, relying on numerical measurement to establish patterns of behaviour (Maciejewski, 2020). Specifically, a quasi-experimental design (Maciejewski, 2020) was implemented, due to the fact that participants are selected to be part of the large-scale research project in two groups (control and experimental) to compare the efficacy of an intervention (Maciejewski, 2020). In this case, to test the efficacy of robotic-mediated interventions. A case study design is also implemented, because, as Ridder (2017) points out, this type of design allows for investigations in deep natural contexts. In this regard, this manuscript analyses the degree of acceptance of the robot experienced by students with ASD, belonging to the experimental group, in a pilot session developed in the classroom.

3.2. Participants

The present study was conducted with eleven participants who were chosen through the implementation of non-probability purposive sampling (Bueno, 2008). Following Bueno (2008) in this type of sampling, the sample is selected on the basis of criteria previously established by the researchers on the basis of the typical characteristics of what is to be investigated. In this regard, the criteria implemented for the selection of the sample are reflected in Table 1.

Table 1. Criteria for the selection of the sample.

- Diagnosis of ASD based on DSM-5 criteria (APA, 2013).
- Schooled in specific special education classrooms (communication and language classrooms).
- Schooled in pre-school, primary education or compulsory secondary education.
- Authorisation from legal guardians to carry out the experience.

Source: own elaboration

In particular, the group consisted of seven boys and four girls. The mean age of the participants was 7.00 years. Regarding the degree of ASD, 9.09 % were level 1, 72.73 % were level 2 and 18.18 % were level 3. In relation to the type of communication, four used oral language and seven used an augmentative alternative communication system (AACS) because they did not have verbal communication. As far as the level of curricular competence is concerned, two pupils had a pre-school level of education, and the remaining nine pupils had a primary level of education.

3.3. Instrument

In order to implement the intervention, a questionnaire was designed ad hoc with the aim of obtaining information on the behaviour of students with ASD participating in the use of the Bee-Bot robot for teaching communication and social interaction skills. The questionnaire is divided into two parts. The first part is intended to obtain demographic data (sex assigned at birth, age) and data from the socio-psychopedagogical report (level of ASD, type of communication, type of classroom, type of school,

current level of pupils' competence). The second part contains seven items that try to assess the parameter "initial acceptance of the Bee-Bot robot". These items are measured using a dichotomous response (yes, no) to try to reflect the presence or absence of the behaviours, i.e. the occurrence. The questionnaire was developed using the Google questionnaire tool for quick and easy application.

Table 2. Items used to measure the initial acceptance of the Bee-Bot robot.

1. Indicates that he/she wants to play with the robot.
2. Listens attentively to the explanations.
3. Approaches the robot showing interest in the activity.
4. Presses the robot's commands.
5. Gets scared when the robot moves.
6. Covers his/her ears when the robot sounds.
7. Responds that he/she wants to use the robot again when asked.

Source: own elaboration

3.4. Intervention

The present research was undertaken in one session. This session was developed in the regular classroom where they conduct their daily activities. Each of the participating pupils developed the session individually. When they entered the classroom, they could find, first of all, the story "El monstruo de los colores" by Anna Llenas, a play mat, the Bee-Bot robot and the A5 cards to help them with the programming commands. In this sense, the session can be divided into different blocks.

- Block 1. Introductions. In this first block, students were introduced to the activities they were going to carry out by means of a preview panel with pictograms. Thus, it was explained to them that we were going to play with the Bee-Bot robot during the session and they were exposed to it.

- Block 2. Reading the story. Next, we proceeded to the reading of the story "The colour monster" where emotions are explained. The story is adapted to the perceptual and comprehension characteristics of students with ASD. In this sense, an A2 size is used for the pictures of the story and the text is adapted with pictograms.

- Block 3. Explanation of the commands. The programming commands ("forward"; "backward", "turn", "pause", "delete") were explained to the students by means of the A5 help cards. At the same time as all the commands were explained, they were programmed. In addition, the students were asked to program them themselves.

- Block 4. Playing with the Bee-Bot robot. In this block, the pupils have to program the Bee-Bot robot from its initial position on the game carpet so that it reaches different points of the carpet, which will allow us to check whether the pupils have understood the contents of the story. Figure 1 shows one of the participants carrying out the activity.

Figure 1. Student working on the activities with the Bee-Bot robot.

In this sense, the researcher gives the following instructions to the student to do the activities: The researcher says: *What colour is the monster when he is happy?* (She will wait for him to answer orally or with the communication board) Then, she will say: *Take the Bee-Bot robot to the box with the yellow spot;* Secondly, the researcher will ask the student: *Where is the yellow monster?* Then she will say: *Take the Bee-Bot robot to the square with the yellow monster;* Thirdly, the researcher asks: *Where is the yellow jar?* Then she says: *Take the Bee-Bot robot to the box with the yellow jar;* Fourthly, she asks: *Where is the picture of the happy girl?* Then you say: *Take the Bee-Bot to the box with the picture of the*

happy girl; Finally, you say: *Where is the happy face?* Then say: *Take the Bee-Bot robot to the box with the happy face.* After questions have been taken, the session will be closed.

3.5. Process

For the development of the research project, contact was firstly made with the school through the institutional e-mails. Secondly, once this contact was established, a meeting was held with the centre's management team and the educational guidance team where a more detailed explanation of the project was given, specifying the work objectives and its structure. Then, thirdly, a new meeting was scheduled with the tutors of the centre's Special Education classrooms. At this meeting, they were provided with the authorisation and consent documents to be sent to the families of students with ASD who had expressed their interest in participating in the project. Thus, this documentation was approved by the Ethics Committee of the University of Alicante (UA-2021-09-06-1). Likewise, the day of the intervention was planned jointly, in order to introduce it into the dynamics of the class. Once permissions had been obtained, this pilot session was developed. The Special Education classroom teacher, the educator and the main researcher, who was in charge of interacting with the pupils, took part in the session. This session was developed individually with each student and lasted 20 minutes.

3.6. Data analysis

In the present study, a descriptive analysis of the data obtained through the ad hoc questionnaire was carried out. Specifically, firstly, the frequency was measured in order to obtain the number of students who presented each of the behaviours. Secondly, an analysis of the percentages was carried out in order to identify the proportion of students for each of the behaviours. Version 27 of the Stadistical Package for Social Sciences (SPSS) was used.

4. Results

The results of the study on the initial acceptance by students with ASD are presented below.

4.1. Results related to the acceptance of the robot *Bee-Bot*

The results indicated that more than 54.00% of the learners: wanted to play with the robot (item 1), listened attentively to the explanations (item 2) and pressed the robot's top commands (item 4). Also, the results indicated that 90.91% of the participants approached the robot showing interest (item 3) and 100.00% responded that they wanted to use the robot again (item 7). On the other hand, less than 28.00% of the participants were frightened when the robot moved (item 5) and covered their ears when the robot beeped (item 6). In table 3, Table 3 shows the detailed results of the descriptive analysis conducted.

Table 3. Results of the initial acceptance of the Bee-Bot robot.

ÍTEM		*f*		%	
		YES	NO	YES	NO
1.	Indicates that he/she wants to play with the robot.	8	3	72,73	27,27
2.	Listens attentively to the explanations.	6	5	54,55	45,45
3.	Approaches the robot showing interest in the activity.	10	1	90,91	9,09
4.	Presses the robot's commands.	7	4	63,64	36,36
5.	Gets scared when the robot moves.	2	9	18,18	81,82
6.	Covers his/her ears when the robot sounds.	3	8	27,27	72,73
7.	Responds that he/she wants to use the robot again when asked.	11	0	100,00	0,00

Source: own elaboration

5. Discussion

The main objective of this research has been to explore the initial acceptance by students with ASD of the use of the robot as a support tool in the learning process. In this sense, in reference to the results obtained, it can be observed that more than half of the participating students want to play with the robot, listen attentively to the explanations and press the commands on the top of the robot. These results may be due, as Silvera-Tawil et al. (2022) explains, to the fact that the robotic tools are predictable for

students with ASD, as they create a very structured environment that adapts very well to students with ASD. In this sense, these results may be due to the clear and simple instructions provided by the robots, which are perfectly aligned with the characteristics of students with ASD and allow them to follow the curricular guidelines. Regarding the results that indicate that most students with ASD approach the robot showing interest and respond that they want to use it again, these can be explained by the fact that, as Gudlin et al. (2022) point out, students with ASD find robots very attractive, due to their non-anthropomorphic structure and their mechanics (lights, sounds, movements). Finally, the results show that students with ASD do not express fear when they see the robot move, nor do they cover their ears when the robot sounds. These results could be related to the previous training carried out on a daily basis in Special Education classrooms to work on hypersensitivity, having developed previous sensory integration activities (Huerta, 2014).

6. Conclusions

In conclusion, students with ASD accept the Bee-Bot robot, which makes it a potential tool for conduct activities in the classroom context. Last but not least, the present research has different practical implications. In this sense, one of them is related to the fact that the activities designed for the Bee-Bot robot application could be used in a generalised way with other students with ASD, including other students with specific educational needs. Another practical implication could be to introduce the Bee-Bot robot into the regular classroom dynamics.

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