A Humanoid Robot (NAO)
as a Child Management Tool
in a Kindergarten Classroom

ABSTRACT

Whether it is Bee-Boot or Thymio, education professionals need to be pedagogically creative in order to reinvent their learning strategies to best fit their context. Several studies have shown that these robots are potential educational tools, especially for students with learning difficulties. Among these robots, there are humanoid robots that can induce a different learning experience, moving from an object to be manipulated to the emergence of social situations and interactions with psycho-affective valence.

As part of our reflections on the integration of digital technology in schools, we have chosen to introduce the humanoid robot Nao in several kindergarten classes in order to propose an unusual pedagogical use of the robot.

Keywords: humanoid robot, preschool class, classroom management

1. Introduction

1.1. The humanoid robot NAO

This robot is a social robot with the characteristics of a human figure. It is artificially intelligent, capable of interaction and equipped with a certain physicality. It is equipped with visual sensors, speakers and microphones that allow it to produce and hear sounds while in motion.

Initially created to be a home assistant, it was soon used in schools for its positive impact on the behaviour of pupils. Primarily used with children on

the autism spectrum for its ability to foster interaction and develop social and communication skills, it is beginning to find a place in compulsory education classrooms.

Although it can be used as a learning tool for programming, we have experimented with it more as a classroom management tool.

2. Methodology

2.1. NAO teacher support tool

2.1.1. Why this public?

In kindergarten, classroom management is not easy insofar as getting learners to work independently remains difficult. The teacher must therefore set up a specific organisation such as group work in order to facilitate his or her pedagogical intervention and to develop the autonomy of his or her pupils. During group work, the teacher takes charge of one workshop while the others are self-managed. However, the pupil remains very dependent. The teacher can be called upon for many tasks that children of this age are not capable of carrying out on their own: reading the instructions, organising and supervising the distribution of the task to be carried out, encouraging, providing feedback, etc. To cope with these demands in a preschool classroom, we hypothesise that the humanoid robot Nao could provide support during learning.

2.1.2. Context of the integration of the Nao robot

The integration of the robot took place in three kindergarten classes in French-speaking Belgium. Fourty-six pupils from 3 to 5 years old carried out the different activities planned in our pedagogical scenario.

The objective of the proposed activities is to approach the comprehension of inferential information through the reading aloud of stories from children's literature enriched by questioning about them. This work is carried out in workshops. In this context, Nao is "responsible" for the "Let's understand the stories" workshop.

2.1.3. Workshop process and help from Nao

The students are grouped in threes or fours and follow each other in the different workshops planned by the teacher. The groups are made up of learners with a heterogeneous level of mastery of the skill, i.e., they are made up of a weaker

student, an average student and a student with a facility for understanding the text. In the end, eleven groups were formed.

When they arrived at the "Let's understand the stories" workshop, several Naomarks (examples can be seen below) were available for the pupils to carry out the proposed activity and to interact with the NAO robot (Figure 1).
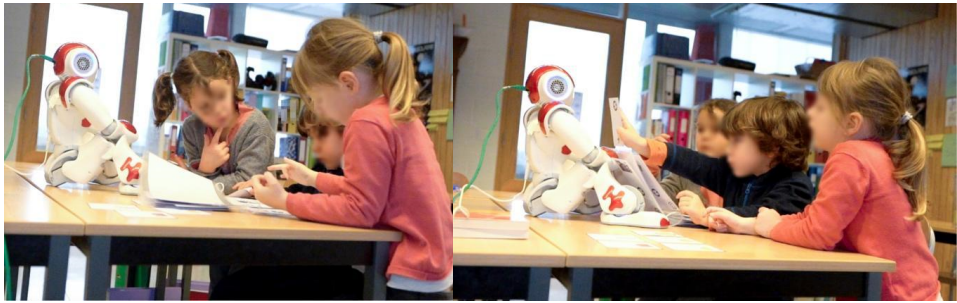

Figure 1. Students interacting with the NAO robot.
Source: Kumps, Temperman, De Lièvre (UMONS)

These Naomarks can handle different categories of interactions (Table 1) with the help of images that symbolise them for ease of use. Before working autonomously with Nao, the students had first manipulated the different Naomarks so that they could understand their usefulness and functioning.

Table 1. The different categories of Naomark.

Instructions	Nao gives the instructions	"You are asking me to explain what to do. Listen carefully to the text I am going to tell you and answer the questions by choosing the picture that corresponds to your answer".
Reading	Nao reads the story	Reading the book page by page.
Objectives	Nao gives the objectives	"You ask me what the activities are for. You are going to learn to understand in groups a text that you are going to listen to and to find information contained in this text".
Questions	Nao asks the literal and inferential comprehension questions	"Now that you have listened to the story, try to answer the questions I am going to ask you. Here is the first question: ...."

| Procedures	Nao recalls the procedure for validating the answer	"You are asking me to explain how you should validate your answer. Take the image that corresponds to the answer and put it in front of my eyes. I will tell you if you have found the right answer or if you have to continue discussing together to choose another one."
Organisation	Nao reminds us of the time remaining before moving on to another workshop	"You ask me how much time you have left to finish your activity. You have... minutes left".
Feedback	Nao gives specific feed-back – validates or not the answer	"You have just shown me an answer. Congratulations, you have found the right answer. (answer to the question). You can move on to the next question. Unfortunately, the answer is not correct. I suggest that you discuss it among yourselves and choose another one. You can also listen to the story again."

Source: Kumps, Temperman, De Lièvre (UMONS)
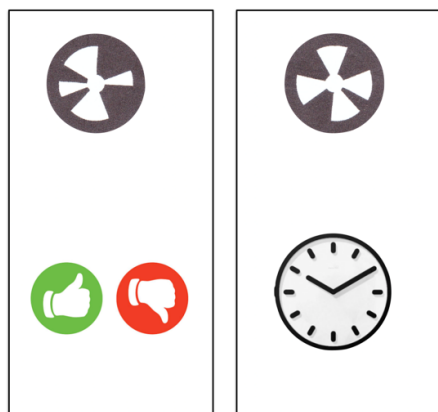
Figure 2. Examples of Naomark "feedback" and "organisation".

Source: Kumps, Temperman, De Lièvre (UMONS)

The students scan the first Naomark to get the instructions for the workshop (Figure 2). Then they ask NAO to read the story they have planned. The book is at their disposal to follow the story read by the robot.

The pupils have the different Naomarks arranged in pockets in order to give a structure to the workshop. A "Beginning of the activity" pocket (reading, objectives, instructions), a pocket with questions about the story heard and a "I ned help" pocket: procedures, organisation, feedback.

Each workshop offers ten different questions of progressive difficulty: five explicit questions and five implicit questions. Pupils took part in three "Let's understand the story" workshops (with three different books) over a period of three weeks, one workshop per week.
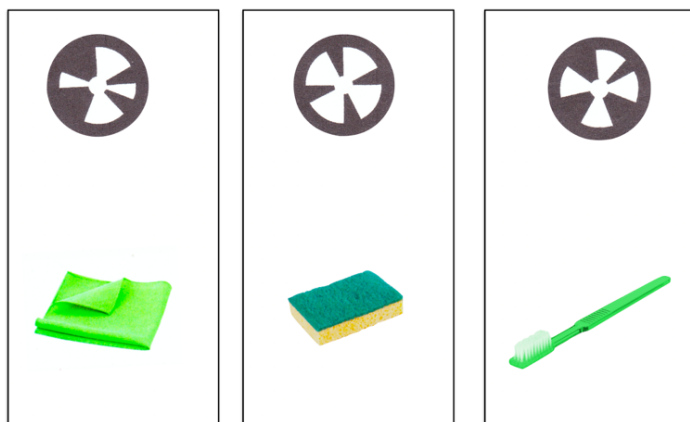

Figure 3. Example of an explicit question asked: What does the little monster use to wash the tap?

Source: Workshop "Comprenons l'histoire: Au lit petit monstre" (Ramos, 1996)

3. Results

3.1. How do the pupils use Nao?

During these different workshops, we counted the frequency of use of Nao-mark by the pupils. Our results show a significant but disparate use according to the different categories of intervention provided by the robot. This descriptive analysis (Table 2) of the collected data allows us to note that some of Nao's interventions are more frequent, such as reading the text or stating the question or checking the answer. These three categories come up on average more than once per group and per workshop. Then, the instructions for carrying out the activity as well as the procedure for accessing it is asked on average once in the

first workshop and decreases as the workshops progress. This can be explained by the habit that the pupils have developed during the other workshops. Finally, the objectives of the activity as well as the time remaining for its completion are the two interactions least solicited by the pupils.

However, it seems that Nao is most useful to the students during the verification feedback, given the highest averages in this category.

Table 2. Frequency and average of Nao interventions.

Intervention by NAO	Workshop 1		Workshop 2		Workshop 3	
	Frequency of occurrence	Average per group	Frequency of occurrence	Average per group	Frequency of occurrence	Average per group
Reading	15.00	1.36	13.00	1.18	16.00	1.45
Gives the objectives	1.00	0.09	0.00	0.00	0.00	0.00
Gives the instruction	11.00	1.00	9.00	0.82	8.00	0.72
Organisation	4.00	0.36	4.00	0.36	2.00	0.18
Procedures	11.00	1.00	8.00	0.73	6.00	0.54
	Frequency of occurrence	Average per group and per question	Frequency of occurrence	Average per group and per question	Frequency of occurrence	Average per group and per question
Feedback for each question	162.00	1.47	166.00	1.51	164.00	1.49
Statement of a question	127.00	1.15	134.00	1.22	122.00	1.11

Source: Kumps, Temperman, De Lièvre (UMONS)

If we count all Nao's interventions in the three workshops, 983 requests, i.e., 29 requests per group and per workshop, were processed by the humanoid robot during the completion of the required work.

4. Conclusion

4.1. What is the place for Nao in education?

This research adds to the vast field of applications of the humanoid robot the possibility of supporting the task of students in a workshop in order to make them independent in the management of their work. Without ever getting tired and with infinite patience, the Nao robot repeated the instructions and the reading of the story as many times as necessary. Each child can then understand at his or her own pace and ask as many questions as he or she wishes. The possibility of having quick feedback on their answer makes learning fun and all this without direct intervention of the teacher. However, there is a limitation. NAO only responds to the various questions anticipated and it is difficult for the teacher to anticipate everything. Pupils' questions therefore remain unanswered.

Other results from this experiment with Nao are also interesting to report. At the level of the development of the targeted competence, our analyses show that the pedagogical device allows the progression of the pupils in a significant way whatever their starting level as well as for the management of the explicit information as the implicit information.

If its use as a learning tool with children with certain learning disabilities, sometimes with communication difficulties (Karsenti et al., 2017), or to introduce pupils to the field of programming (Romero et al., 2014), has already proved its worth, our experimentation tends to show that it can be a valuable aid for the teacher in supervising learning carried out independently.

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