Instructional design with Nao-Robot

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Abstract

This document shows a first trying to develop an instructional session with Nao robot. The objective is to identify the additional requirements to become Nao enough skilled to develop a learning-teaching process. By utilizing instructional models classic elements are identified to be developed by the Nao robot to run and encourage the incorporation of a basic concept of programming. This proposal seeks to contribute to the area of educational robotics in the paradigm of materials development and use of a specific programming methodology for this type of robot. A first approach to the usefulness and usability of the proposed instructional design is explored in college students in a test session.

Keywords: Nao robot; Robot Services; Learning Path; Teaching Sequences

1. Introduction

With the development of technology, humanoid robots gradually enter in our life especially for education, but incorporating a process of teaching and learning can cause problems if it uses a tool like the robot. Instructional design deals with the planning, preparation and design resources and environments for carrying out the learning [1]. Instructional design has been created for humans, but when we try a humanoid robot develop an instructional session, instructional design seems be useful, however, it is likely that the methodology should be adapted. The development of educational robotics is booming hence the need to develop methods, techniques and materials to implement an instructional design for students but also for the robot learning as a teaching tool.

To get a humanoid robot acts as a human teacher requires to program each functionality of the robot to it be able to do activities like to walk and identify obstacles, to see and recognize faces, to feel when their sensor are touched, to interpret the human voices, etc. Beyond to control the behavior of a humanoid robot, to get a humanoid robot be able to teach, instructional design techniques must be implemented, and surely, Intelligence Artificial techniques too.

In this document we present a first trying to develop an instructional session with Nao. It aims to identify missing elements in an instructional session for robots using a methodology developed for humans. This project is developed under a robot service paradigm [2] and contributes to the development of educational materials within the educational robotics.

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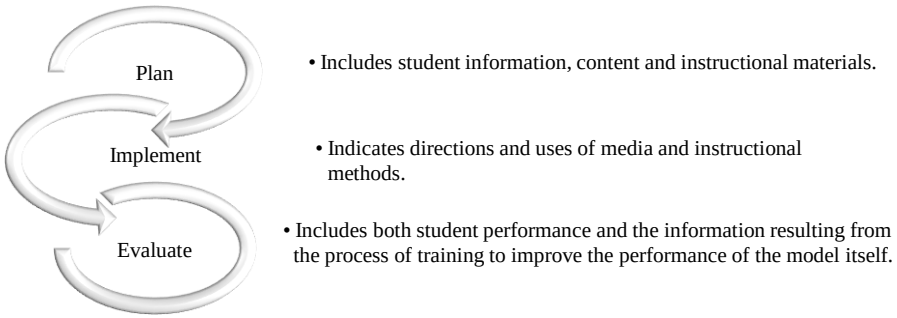
2. Instructional Design

2.1. Instructional Design

Instructional design deals with the planning, preparation and design resources and environments for carrying out the learning [1]. In this process the educational model that has been considered is taken into account, from this a class structure is established. There are different paradigms of instructional design.

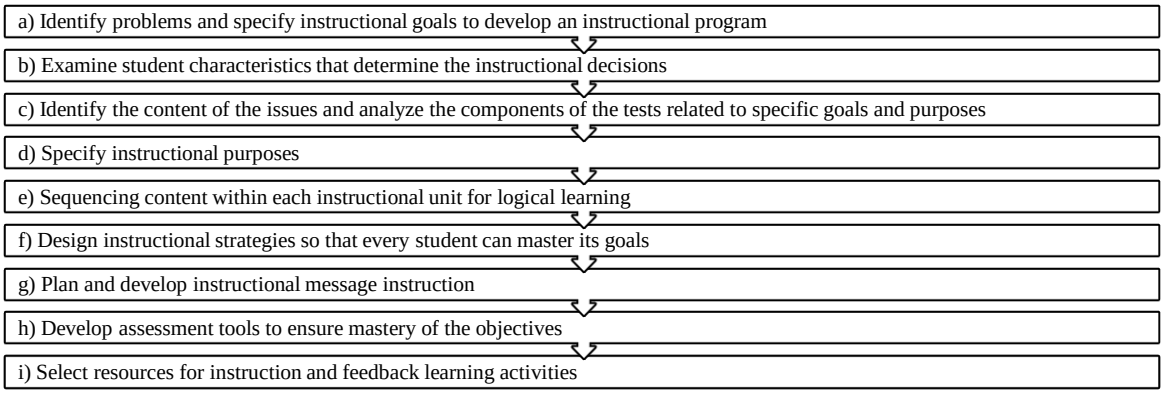
Newby et.al [8] proposes an instructional design model which emphasizes the focusing on the student and the classroom, also it take care on the technological means because their use is carefully planned.

Fig. 1. Instructional design Newby [8]



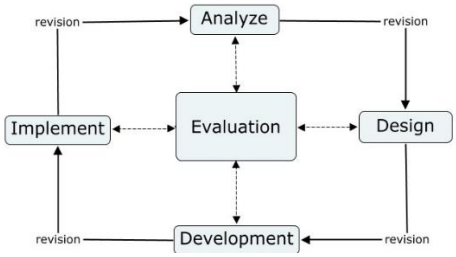
The Morrison, Ross & Kemp model [9] a continuous cycle with a review of each activity associated with all other elements. All elements are interdependent i.e. they affect others and are affected by the rest. This model requires a framework of conventional job and suggested that the developer start designing task analysis. The model also emphasizes the content of the issues, goals and objectives and selection of resources that makes it more attractive. The evaluation is twofold, i.e. emphasizes the formative assessment and summative assessment as a continuum of all activities within the context of the goals.

Fig. 2. Instructional design Morrison & Ross & Kemp [9]



The ADDIE model of instructional design [10] with the phases: analysis, design, development, implementation and evaluation. The goal was to finish each step before proceeding to the next. All existing Instructional Design models draw heavily from ADDIE process. This model is considered a generic model, in this project ADDIE model was used.

Fig. 3. Instructional design model ADDIE [10]



2.2. Educational model.

Regarding educational models, Sagimin & Abdulwahab [7] give in-depth review of popular models, and they identify for main models:

a) Mastery Learning Education. As a set of instructional practices, it helps most students to learn at high levels. As a theory, it postulates that all students if given the time can master the coursework. It is based on the belief that all students can learn, it is a student output-based system in which student need is based on output performance; setting outcome expectations for students to achieve, ensuring through teaching and re-teaching in as many different ways as possible for as long as it takes until everyone meets them. Strategies increase student learning. It develops cooperation instead of competition. Learning differences among students decrease and improves attitude towards the subject matter [7].

b) Outcomes-based Education is based on a constructivist philosophy of education, competency-based education is commonly defined as an educational model in which there is a clear, measurable definition of mastery, along with procedures and tools for tracking that mastery. Students progress at their own pace, based on what they can show that they know. The creative and active students can participate in building their own meaningful knowledge that aligns with the results. The curriculum and teaching-learning strategies are aligned to achieve the results or objectives [7].

c) Competency-based Education. Competency-based education is commonly defined as an educational model in which there is a clear, measurable definition of mastery, along with procedures and tools for tracking that mastery. Students' progress at their own pace, based on what they can show that they know [7].

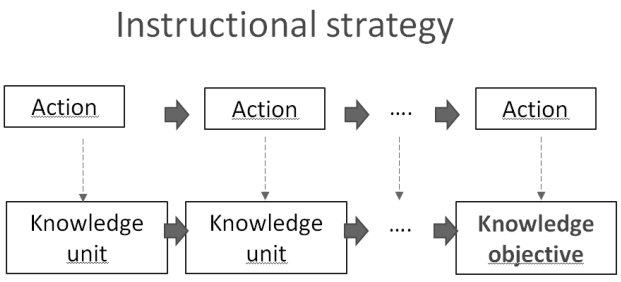
d) School-based Education. The terms school-based and competency-based have been used to describe the next generation learning that challenges the traditional mode of education. School-based learning customizes education to prepare students for college and career, the author argued, "learning objectives within specific content domains must be discarded in line of objectives that reflect more realistic life roles" [7].

2.3. Structure class

Under an educational model, instructional design is applied and the structure class is established.

Jorba & Sanmartí [4] established phases of exploration, concept introduction, structuring knowledge and application activities. A similar paradigm is presented by Diaz-Barriga [5]. Nevertheless, it is difficult to implement instructional design for nonhumans, the human teacher understand instructions such as "Identify problems and specify instructional goals" or "Includes both student performance and the information resulting from the process of training". A robot is not be able to understand, it only understands precise instructions. Therefore we have sought a simplified structure that allows for instructional design in automated systems. Pérez et al [3] proposes an instructional session structure as a sequence of actions which are related with a knowledge.

Fig. 4. Instructional session structure [3]



3. The Nao Robot

Nao Robot it's a humanoid robot, it measures 55 centimeters, with two loudspeakers, it can speech written text in eight languages, (see Fig 5).
This robot has two high resolution 1280x720 cameras for face detection or recognition.
Nao is able to recognize speech, and to speech by its 4 microphones.
Besides include a programming software, and Ethernet communication.
It's possible Nao moving by 25 degree freedom
The robot has an adaptive walk and an anti-self-collision system

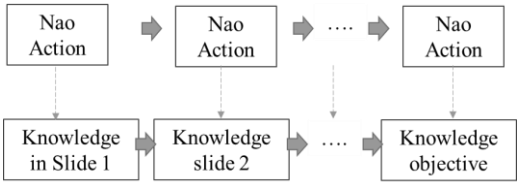
Fig. 5. Nao Robot

Nao recognize sound localization
So, Nao can to move, to fell, to hear, to speak, to seek, to connect.

4. Design of a Programming Class

To implement a programming class the ADDIE model has been implemented, the structure class is taken from the model of Perez et al [3], which can be viewed as a set of action sequences carried out by the Nao robot, each action sequence are related with a knowledge represented in a slide as a teaching resource.

Fig. 6. Structure class proposed



5. Learning Estrategy

To make this instructional session, one educational resource about programming was taken [11]. The following didactical sequence shows how the slides was created for Nao, and the programming for Nao in each one. The words Nao say are the violet words.

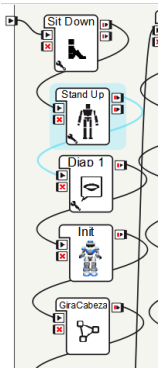
The learning approach as knowledge construction is based on the idea that learning takes place when a teacher actively constructs a representation in active memory. This methodology is used to teach about initial conditions in a loop, in a programming class. The role of the instructional designer is to create an environment in which students interact significantly with academic material, stimulating student selection processes, organization and information integration. As it can be seen, the interaction is not get yet, but it supposes it will be a future work in this project. But the basic structure of an instructional session has been implemented.

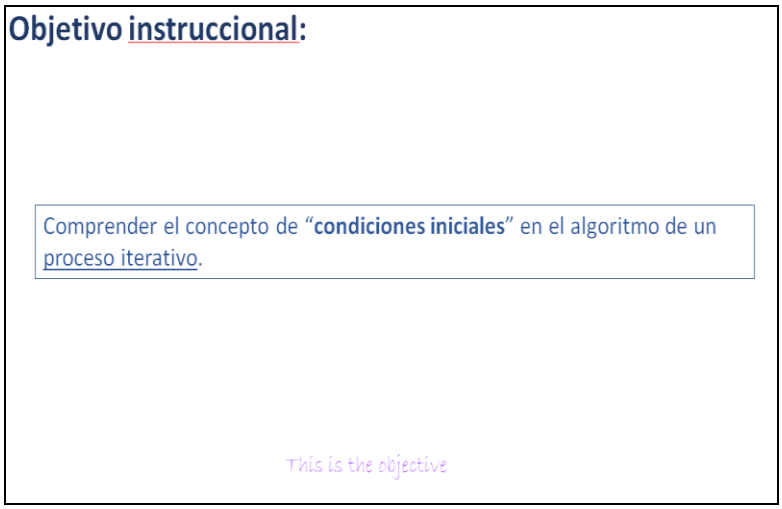
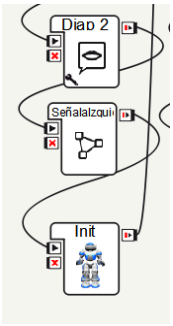
In the case of Nao robot, this becomes the material that encourages learning by designing an environment that includes activities to encourage learning, these activities planned by the instructional design in search of students to construct meaningful learning.

It was considered the following elements in the structure class: Presentation of the activity that allows you to locate content in a matter to decentralize , in this case programming; instructional objective of the activity to identify the goal to reach, initial conditions of a scheduling algorithm; Opening activities or introduction to work with the robot; Structuring knowledge activities that decentralizes the tasks to achieve the objective; Development activities to introduce concepts -procedures and modelization besides indicating the knowledge structuring activities; Application activities to verify the acquired knowledge; Closing finally activities.

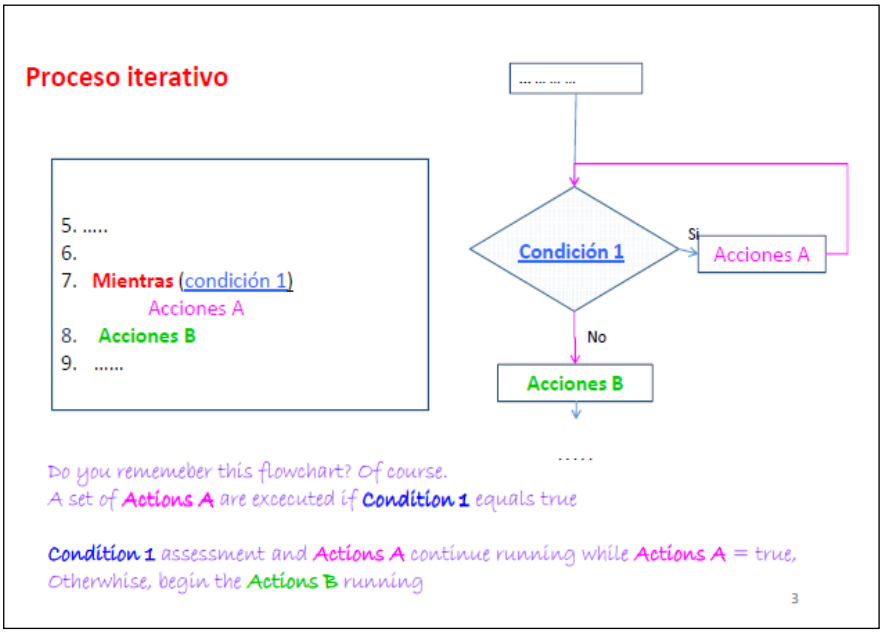
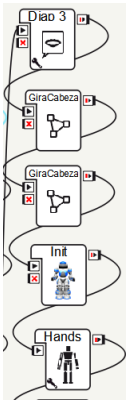
Presentation

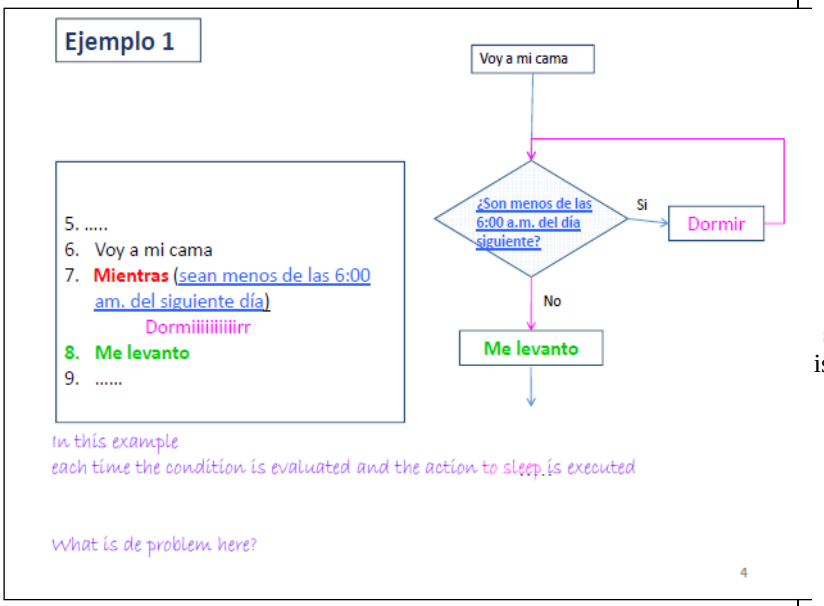
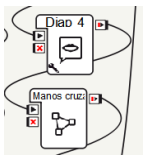
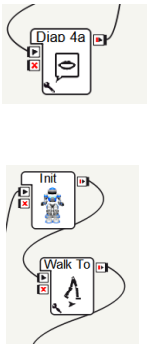
To show general information about the session and the instructional objective

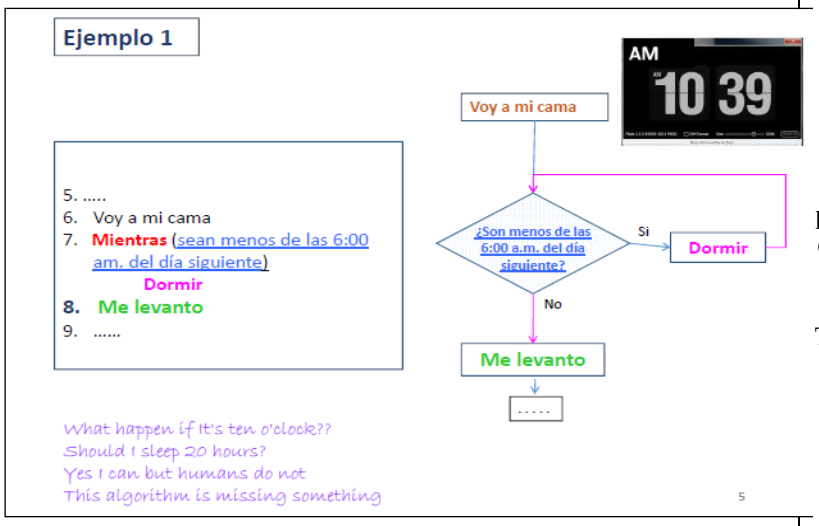
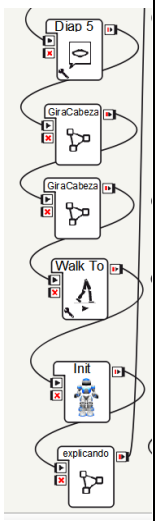
Knowledge: Slide 1	Action	
	Nao stands up and shows the class objective	Nao programming 

Knowledge	Action	
	Instructional objective Is showed Nao greets to students, it try to establish a kindly environment. The students must to know what are going to learn today.	

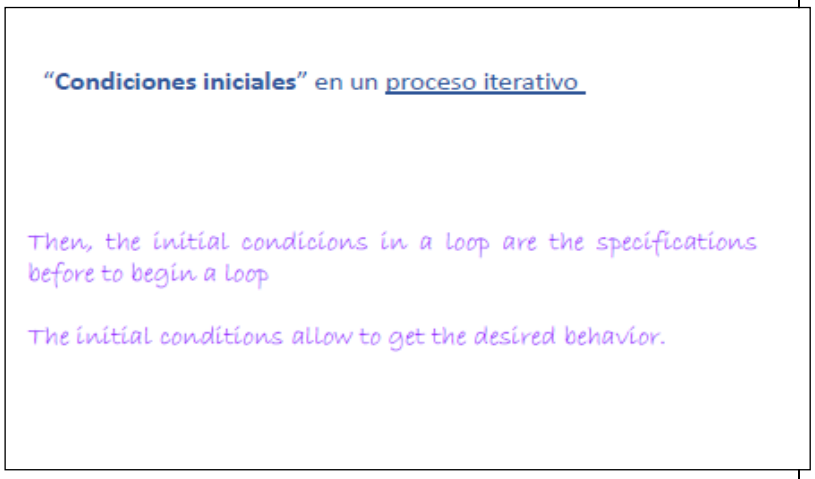
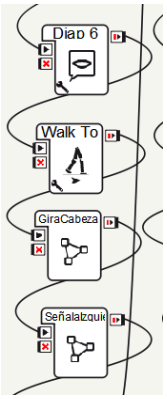
Opening activities

Knowledge: Slide 3	Action	
	Initial conditions concept Prior knowledge of the student are discussed, the question about initial conditions is presented, after the concept is showed in the slide. An explanation about the concept is necessary.	

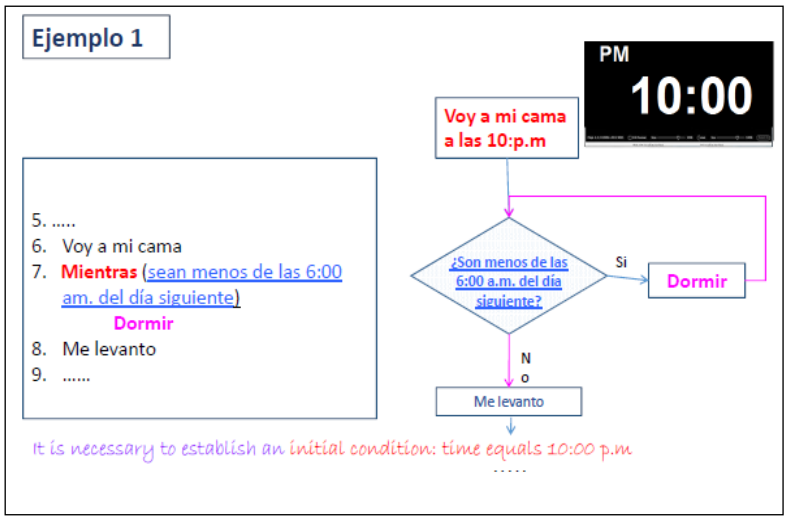
Knowledge: Slide 4	Action		
	One quotidian situation is presented. The student analyze the situation and it is prepared to be questioned about the situation.		

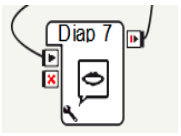
Knowledge: Slide 5	Action		
	It seeks to raise the students' attention A particular situation is proposed, which captures student attention. Then the student look for a solution, it is probably the student resolve the problem.		

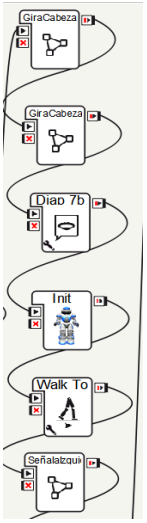
Development activities / Introduction of concepts-procedures /modelization

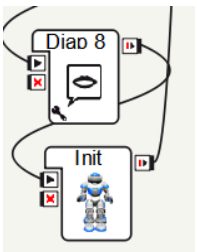
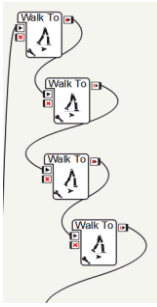
Knowledge: Slide 6	Action	
	Before the solution be presented, the new concept is defined.	

Structuring knowledge activities

<table>
<tr><th>Knowledge: Slide 7</th><th colspan="2">Action</th></tr>
<tr><td> 
</td><td>The problem is resolved

The student organize and systematizes their knowledge.</td><td> 


</td></tr>
<tr><td colspan="3">Application activities</td></tr>
<tr><th>Knowledge</th><th colspan="2">Action</th></tr>
<tr><td>Slide 8

Problema: Mostrar los números desde un número nInic que proporcione el usuario hasta un número nFinal</td><td>The student needs to apply the new knowledge in some problem. Then an activity for the student is proposed.</td><td> 
</td><td> 
</td></tr>
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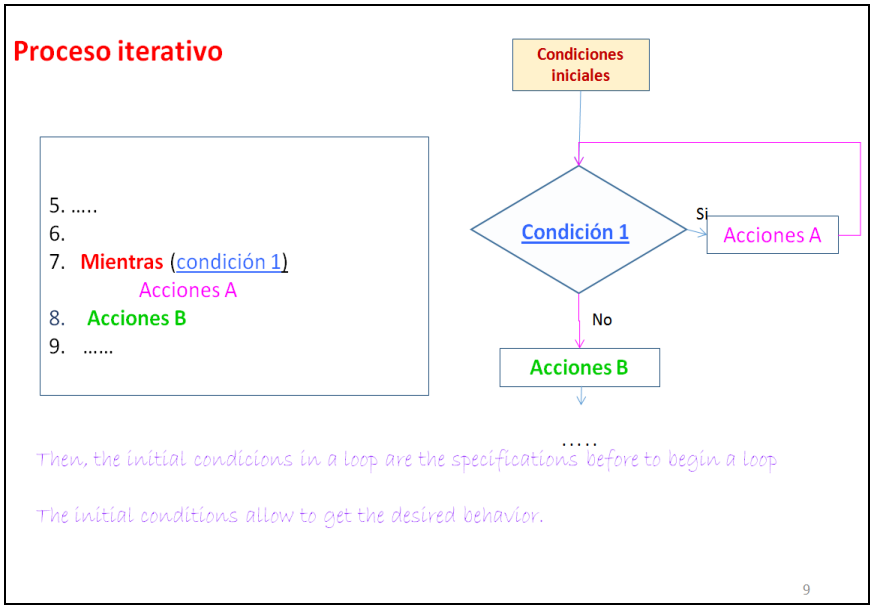
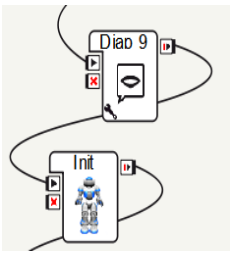
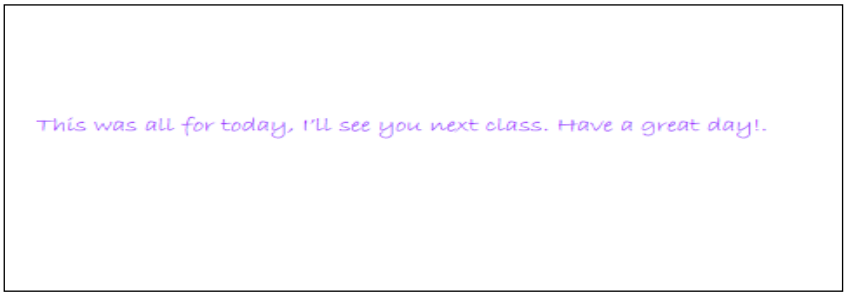
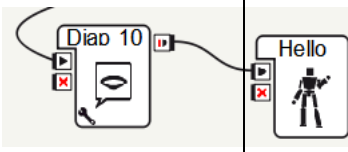
<table>
<tr><td colspan="3">Closing activities</td></tr>
<tr><td>Knowledge: Slide 9</td><td colspan="2">Action</td></tr>
<tr><td> 
</td><td>Based on the example, the definition and the exercise, a conclusion is presented, it contains the new acquired knowledge.</td><td> 
</td></tr>
<tr><td>Knowledge</td><td colspan="2">Action</td></tr>
<tr><td>Slide 10
 
</td><td>A friendly farewell is programmed, the robot must make the student feel satisfied.</td><td> 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What is the most noticeable deficiency in this instructional session? Even the process follows a methodology, instructional session is not able to interact with students. The teacher does not establish a strategy based on evaluation results. There is no pre-assessment to help define the strategy for a particular group of students. The teacher doesn´t regard the frame of mind of the students. This tasks and others need to be implemented in Nao Robot.

6. Conclusions

In this document a case study about instructional session with Nao robot is presented. A first approach to the usefulness and usability of the proposed instructional design are explored in college students in a test session. A methodology for human teachers has been applied for a humanoid robot. This is the beginning of a research about Nao-based teaching sequences and a prototype was developed. In this exercise are identified the missing elements in the instructional session with a Nao robot, for example: What is the more suitable structure of a sequence teaching for a robot like Nao? Which human teacher characteristics could be reproduced in a robot like Nao? How to implement didactic sequences using the Nao robot in engineering careers? What is one suitable learning path to implement in a Nao robot?

There are many tasks to Nao become a good teacher, from the area of artificial intelligence computer sciences it seems to have enough tools to keep improving each of the features of Nao, for example monitoring expressions of students to solve an exercise, then make a classification of such expressions to determine the acceptance of students. According to the future research, many techniques will be applied.

This research will be developed in Tecnológico de Estudios Superiores de Chalco in collaboration with UAEM CU Valle de Chalco.

References

1) Bruner, J. S. (1969). On knowing: Essays for the left hand. Cambridge, MA: Harvard University Press.
2) ISO, 2016. ISO 13482:2014(en) Robots and robotic devices extracted March 25, 2016 from https://www.iso.org/obp/ui/#iso:std:iso:13482:ed-1:v1:en
3) Pérez et al., (2015). Perez, C., Martinez, M., Lopez, G. Gelbukh, A. Wikipedia-based learning path generation. Journal Computación y Sistemas. ISSN 1405-5546. Vol. 19, No. 06
4) Jorba, J., & Sanmartí, N. (1994). *Enseñar, aprender y evaular: Un proceso de regulación continua.* Recuperado el 01 de julio de 2016, de https://books.google.com.mx/books?hl=es&lr=&id=a_rCXrBxikwC&oi=fnd&pg=PA4&dq=momentos+de+la+ense%C3%B1anza&ots=rFCucO__L4&sig=BgB8o6HMdzgxYOdNkNPn3P5xl2U#v=onepage&q=momentos%20de%20la%20ense%C3%B1anza&f=false
5) Diaz-Barriga, A. (2016). Guía para la elaboración de una secuencia didáctica. Comunidad de conocimiento UNAM . Recuperado el 01 de julio de 2016 de http://www.setse.org.mx/ReformaEducativa/Rumbo%20a%20la%20Primera%20Evaluaci%C3%B3n/Factores%20de%20Evaluaci%C3%B3n/Pr%C3%A1ctica%20Profesional/Gu%C3%ADa-secuencias-didacticas_Angel%20D%C3%ADaz.pdf
6) [6] Williams Peter, Schrum Lynee, Sangra Albert, Lourdes Guardia. (2009). Universitat Oberta de Catalunya. P06/M1103/01179. Recuperado el 5 de julio de 2016 de http://aulavirtualkamn.wikispaces.com/file/view/2.+MODELOS+DE+DISE%C3%91O+INSTRUCCIONAL.pdf
7) [7] Sagimin, S. & Abdulwahab. (2015). Models of Education: In-Depth Review. International Journal of Education and Learning .
8) [8] Newby, T., Stepich, D., Lehman, J., & Russell, J. (2000). Instructional Technology for teaching and learning: Designing instruction, integrating computers, and using media (2nd ed.). Upper Saddle River, NJ: Prentice-Hall.
9) [9] Morrison, G., Ross, S., & Kemp, J. (2001). Designing effective instruction (3rd ed.). New York: John Wiley & Sons.
10) [10] Forest, Ed. (2014). The ADDIE Model: Instructional Design. Educational Technology. Recovered fromhttp://educationaltechnology.net/the-addie-model-instructional-design/
11) [11] Pérez, C. (2015). Fundamentos de Programación. Slideshare. Recuperado el día 01 de Julio de 2016 de http://es.slideshare.net/ClaudiaPerezMartnez/algoritmos-52692203