

How We Did Introductory Lessons about Robot

Karolína Mayerová¹, Michaela Veselovská¹

¹ Comenius University in Bratislava, Faculty of Mathematics, Physics and Informatics,
Mlynská dolina, 842 48 Bratislava, Slovakia
{karolina.mayerova, michaela.veselovska}@fmph.uniba.sk

Abstract. In this article we offer findings about our introductory activities which should help students to clarify and familiarize with the various concepts in the field of educational robotics. We are not aiming at only one specific definition of the concept of robot, but over different areas and concepts that are related with educational robotics. We assume that it is important for students to explain these topics at the beginning. Within our doctoral research we created variety of introductory activities for elementary and lower secondary school students. Modified, but similar activities we conducted also with college students at university. Process of these activities and some outputs of them are described in this article. We assume that such activities should lead students to a proper understanding of the concepts and integration these concepts into existing logical structure.

Keywords: robotics, introductory lessons, students, activities.

1 Introduction

During the last three years, as doctoral students, we had opportunity to teach many different age groups of students. They have been from the first grade primary school up to university students. For every age group we tried to create age appropriate and eye catching activity for introductory lesson. So we created drafts uses constructionist methods for acquainted students with the areas, examples, components and various other concepts related to the concept of a robot. In this article we would like to introduce drafts of these introductory lessons and experiences that we have gained during the implementation.

Within our doctoral research we try to design, apply, implement and iteratively refine our activities with LEGO WeDo for primary and lower secondary school students. Some of these activities we conducted directly in the teaching of ICT at primary school, other activities we carried out during open days at the faculty with a lot of different groups of students and some activities we conducted with university students who attended our course *Robotic kits in education* for future teachers.

In available literature from field of educational robotics are common research articles with application character. Students in these researches usually designed [1] or built [2] their models. The studies very often mention competition [3] or programming environments for students [4]. In the mentioned articles, however,

students come into contact with only one or a very limited number of robots or robotic kits. But their prior experiences of everyday life are quite rich and full of personal contact with robots in various forms. Unfortunately, students are usually unaware of these things which are part of robotics. Therefore we consider it is essential for students to organize this knowledge properly, to think about truthfulness of this knowledge, or extend them. We reckon that it would be great to do such activities at the beginning of the robotics lessons.

1.1 What Are Talking Definition about Concept of Robot

Before the teacher is considering to teach educational robotics, he/she first should be able to distinguish between what robots or robotic kits are and what are not, using several definitions. This task itself seems to be quite challenging, since the amount of the definitions in this area is significant. Brief overview of definitions previously used by researchers in the field of educational robotics is offered and presented in this chapter.

According to the authors [5], [6] and [7] the concept of robot is usually applied on devices that operate autonomously or by remote control, especially machines that perform specific tasks which are normally performed by human beings. Mioduser [8] writes that robot is in fact a concrete system embodying abstract ideas and concepts.

One of the most famous definitions from the year 1979 is as follows: "Robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks." (*Robot Institute of America*) Obviously, this is a committee-written definition. It's rather dry and uninspiring, think Kevin Downling [9]. Better ones for 'robotics' might include: „Force through intelligence. Where AI meet the real world.“

Authors of the article [10] do not express the concept of robot by one definition, but define it by using multiple categories. For example: “A robot is a system, ...”, “The robot is a *construction* ...” or “The robot is *controlled* by ...”.

For our research is also quite important to define what a robotic kit is. Gura in [11] describes LEGO Robotics kits as a kit that should contain the things needed to construct a fully functioning robot: parts needed to construct the robot's body; sensors; motors to power the robot; gears and other mechanical components; and a small processor, a programmable brick.

There are a lot of other definitions, but we haven't found any of them based on concrete examples that would declare what a robot is. Each of these definitions has its own potential and expresses the truth from a different perspective. However, we neither were able to select one, nor on the basis of these definitions to create our own definition. Therefore, we decided to create at least a few areas of focus based on the definitions and responses we have obtained from students.

2 Design of Introductory Lessons

In this chapter we would like to briefly describe activities, which were conducted with various groups of students. In the process of designing activities we considered

cognitive levels of learners, their ages, interests and some other aspects stated in previous chapter.

2.1 Discussion

In this activity, students rearranged their chairs in a circle, so they could clearly see and hear everybody. Discussion was conducted by a teacher and it has been taken in the form of semistructured interview. A teacher asked students several questions:

- Have you ever seen robots? (Where?)
- What types of robots do you know?
- What types of activities can robots perform?
- What components can robots consist of?
- Can robots think about something?
- Are there good or bad robots?

During discussion teacher was trying to respond to students' answers and he placed it into context with their previous experiences. This way teacher can help students with better organisation of their knowledge. Teacher was also trying to encourage all students to participate in discussion. This activity lasted 10 – 20 minutes. Our observation was that students between 10 – 11 years old were not as opened and they were not as willing to communicate with a teacher like 7 – 11 years old students. Therefore we couldn't precisely debate about all parts of discussion (we couldn't analyse every question). And that's why we've decided to design different types of introductory activity.

2.2 Mind maps

Mind map represents relations and contexts of several areas. We think it is suitable tool for students for working with the concept of robot. So we designed several variants of activities for using mind map in introductory lessons about the concept of robot or related areas. At the beginning of the activity we explained to students what represents the mind map and how they can create it. Students had not any problems with creating a mind map.

Working in Pairs. At the beginning of this activity teacher divided students into pairs and he gave them one paper (A4 format) and two pens to each pair. Then students wrote a word robot in the middle of paper and they circled it. Thereafter they wrote all words on the same paper, which they associated with word robot. They also drew a line from new word to word robot to connect them. If they thought, that some new words were related, they could connect them too. They could even draw a picture (some students drew several pictures of different robots). Students could argue about words written on a paper. Therefore teacher had to confirm, which words fit into mind map and which weren't. After this activity teacher could continue with several other types of activities. **In lower secondary school** we (as teachers) continued with creating mind map at the black boards drawn based on students' suggestions. At first students had to select three most important words, which represented their perception of robot. Then one by one (pair) dictated those words to teacher and teacher used those words to arrange them into categories and created a mind map. We (as teachers) also created a mind map using almost the same way **with the university students**, but this time students themselves suggested names of categories in which we inserted proposed words. We were creating this map with software and we were showing it through the projector. During this activity we were discussing about relevance of names of categories and relevance of inclusion concrete words into concrete category with students. Another possibility, as further work with the created mind map, is compare this map with the prepared mind map by the teacher and trying together to find some differences and discuss them.

Creating a Mind Map with Sticky Notes. This activity is for larger group of students. We tried it with nine university students, who have been studying teaching of primary and secondary subjects for two and more years. In this activity all students worked together. They stationed around the board, laid on the table (it can be a black board or a notice-board) and they received couple of sticky notes in different colours, some pens and a twine. Then they created the mind map with the central word robot and with sticky notes around. On each note was one word, which they associated with central word robot. They used twine to link related words. During this activity students can acquaint new concepts and they can try to manage work of other students in group, they can develop collaboration, communication and many other social skills.

Selection of Words. We created this activity, because we wanted to acquaint students with specific concepts. Students could work separately, in small or larger groups (based on teachers' decision). Students received a paper with some - purposefully selected - printed words, randomly located in the paper. Students had to organize related words into categories. Then students (or groups) could compare their categories or they could compare those categories with a mind map, which was prepared by a teacher in advance. This activity took less time like previous activities, because students didn't create whole mind map but they are acquainted only with selected words or concepts. At the end students could add their own words into created categories.

2.3 Video

Video is another interesting possibility how we can show students major benefits of robotics, robotic laws or specific examples of robots. There are many possibilities how teacher can use video. For example: we created short film as a video cut of several videos, which included some movie or famous fairy tale trailers, advertisements for electrical appliances and videos from factories. Then we showed this short film to lower secondary school students and discussed it together about robotics. Another type of this activity we did with the university students. They were finding specific examples of robots on youtube and then we discussed why they picked exactly these videos. There are even other variants of using video, which teacher can combine with any of previous activity.

3 Concept of a Robot Defined by Students

In this chapter we describe how the various age groups expressed their opinions about the concept of a robot. We tried to describe also what kinds of knowledge have been typical for particular age groups and we show some examples of definition created by students. The results presented in this chapter were obtained from the data that we observed and recorded during the lessons described in the previous chapter. For collecting data we used structured observation, video and audio recordings, photo shoot and collecting mind maps. For analysing data we used multiple qualitative methods.

3.1 Concept of Robot According 8-10 Years Old Students

At the beginning of each discussion with primary school students, they did mention only a few examples of the robot, if any they knew. It was needed to guide them with extra questions and simple examples. Then they started to connect different previous experiences and knowledge, and they began to realize which things from their everyday life are robots. Subsequently primary school students during discussion about the concept of a robot mentioned very often examples of a film characters (*Wall-E, I Robot and Transformers*), household appliances (*blender, vacuum cleaner, dishwasher, etc*), different types of electronics and vehicles (*car, plane, a wheelchair motor, etc*). The main activity which should robot does according them was helping people. Students described not only specific parts of robots (*metal, iron, tow, torches, etc*), but they described also appearance and some properties of robots. Even though they had no experience with programming, they mentioned that robot is controlled in a certain way. Some of them said that someone had had to program robot. At the end of the discussion, students admitted that there are "good" and "bad" robots and they justified their arguments with examples from fairy tales, movies and from own observations based on logical thinking ("*... if the robot works, it is good, and if the*

robot does not work so is bad " or *"Robot would be bad if someone gave him a bad program."*

3.2 Concept of a Robot According 10-12 Years Old Students

In this age category three groups of students attended our activities. We did activities with them using mind maps. Analysing these maps, we found the following results. Students wrote in these maps usually various types of robots (*home appliances, electronics, toys, vehicles, etc*), activities (*helping and protecting people*), control (*manual, electronic and signals*) and many other different components of a robot. Thereby areas we were starting to form: types, activities, control and components. This is exactly what we mentioned it in chapter 1.1.

One year later, two of these three groups participated in similar activities. At the end of these activities they wrote what according to them is a robot. Some students created quite short, but interesting definition of a robot such as: *"Robot is an artificial life form."* or *"The robot is an artificial intelligence which thinks itself."* Only one definition was short and not very general: *"Robot is a device which helps technology removing explosives."* However, most of the definitions were longer. Students in them tried to describe the main role of the robot as it is something that is helping people. Usually they added either a description of its appearance, the list of its components or activities in which the robot can be used. An example such a definition, e.g.: *"Robot is a machine which serves for what it was programmed. In order to work it needs the processor, RAM and hard disks. It helps people and makes it what for it was composed."*

3.3 Concept of a Robot According University Students

We conducted an activity with a mind map with the university students, in which they worked as one group and they used sticky notes to create a mind map. In this activity participated students of teaching primary and secondary school subjects (subjects: mathematics, physics, ICT and geography). They created a mind map in such a way that they can use it to explain a concept of robot to primary and secondary school children. Subsequently they were instructed to write down their own definition of a robot based on the created mind map. The examples of definition: *„People create robots to help them with different jobs and in different situations. Robots are controlled by a program, which is written by a human. Shape of robots and their function can be various – based on their purpose. Robots explore world with sensors.“* or *„Robot is a machine, which is made by humans to help them in their work and in several fields of life – housework, robot as replacement of human organ.“* Other definitions were similar.

3 Conclusion

Activities with robotic kits provide many opportunities to attractive, creative and playful teaching and learning. When we intend to incorporate robotic kits into learning process, we should provide students space for active exploration of deeper context of robotics and purpose of robotics in our society. Appropriately chosen activities can enhance pupil's understanding of this context and purpose. We think that teacher should select introductory activity with robotic kits, which can clarify fundamental concepts from the field of educational robotics. In pursuance of pupil's answers from our research, we created four fields, which we consider appropriate and important for educational robotics. They are namely **composition**, **controlling**, **utilization** and **types**. At the beginning of teaching educational robotics every teacher should go with students through these topics and check whether they were for pupils obvious.

Based on our experience we think, that discussion is suitable form of introductory activity for students under 10 years of age and students gladly participated in it. In lower secondary school students didn't like participating in the discussion. Therefore, it is more suitable to use different activities with the mind maps or activities with videos. That way, students have more time for thinking, reasoning and discussing about their opinions and ideas with a team partner. Knowledge of each student is different and by interacting each other they may enrich it. In each form of introductory activity is essential to coordinate and evaluate students work.

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