

Introduction of robotics in science lessons

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Cygnus Gymnasium in Amsterdam is one of the pilot schools which participate in teaching robotics. Robotics is part of science lessons given to pupils age 12 to 14. These pupils are very skilful in the use of computers because it is integrated in almost every lesson, but they didn't have any experience in programming. For constructing and programming, the pupils used a robot and software from LEGO Mindstorm NXT. Because there were only eight robots available for almost sixty pupils, it wasn't possible to pay much attention to designing and construction the robot. Instructions aimed at designing a program could be placed on their own computer. Final goal for the pupils was to design their own program for participation in the Robocup Jr. competition in dancing and rescuing.

Robotics – Programming – Robocup Jr. Competition -
Science – Cygnus Gymnasium

1. INTRODUCTION

In the science lessons Robotics was introduced at the Cygnus Gymnasium to pupils with the age of 12 to 14 years. At the Cygnus Gymnasium the use of computers is integrated in daily lessons. Pupils follow most of their lessons in a classroom where everyone has his own computer at his disposal. However it was remarkable that no one had any experience with computer programming. The aim is to learn pupils how construct the robot and how to program the robot in order to have it to perform some tasks. There were about ten lessons given where teachers conduct pupils. At the end of these lessons, pupils should be able to participate at the Robocup² Jr. competition in NEMO³ situated in Amsterdam. There were three classes with maximum 24 pupils and a teacher for each class.

2. PURPOSE OF THE ROBOTICS CLASSES

The purpose of the robotics classes is to have pupils in the age of 12 to 14, independently doing exercises to program restricted tasks to get some experience. Instructions how to program the robot could be downloaded to each computer as a pdf file. Finally they should be able to design their own program in order to participate in the Robocup Jr competition. The robot can either take part in a dancing or rescuing competition.

3. MATERIAL AND ORGANISATION

3.1 Choice of robot type

Before starting the lessons, we, the team of robotics teachers, have investigated which robot would be most suitable for our students. We have chosen for the LEGO Mindstorm NXT⁴, the latest robot by LEGO for educational use. It looked stable, 'pupil proof' meaning that it shouldn't break easily. The wheels are connected to servomotors which execute a movement in a very accurate way. The robot set also contains various types of sensors which are simply connected to the robot.



3.2 Preparing lessons by teachers

Due to a restricted number of lessons and only one teacher for each group, we had to prepare a short efficient introduction in programming robots. Lego suggested to have the pupils work in groups of three. There were three classes of the second level participating form which the largest class contained twenty four pupils. We used eight sets with the material to build the robots. Because the same

robots must be used in all classes, we have given the robots a number which in each class correspond to a group of pupils with the same number. By doing so, each group has a responsibility for its own robot.

3.3 Facilities in the classroom

The teacher could use the Smartbord in the classroom to give short instructions to the class by demonstrating the program. The lessons took place in a classroom where each pupil has its own computer in a Novell network. From this network the LEGO program and instructions to programming could be downloaded. Each computer had an USB connection which was necessary to download the program made by the pupils to the hardware of the robot. Also there had to be enough space in the classroom to have the robot move freely.

4. EXECUTING

4.1 Executing in the class

Robotics classes of forty five minutes were held once a week. During the first lesson in each class the groups started by assembling the robot from Lego. Assembling was very important, because a complete robot looks simple, but there are many little pieces to put together. Also it makes the pupils aware to be careful with the robot. When they have to change the construction for instance to add a sensor, it will be easier for them to do so.

Some groups worked successfully and quickly through the instructions. Every group had its own tempo. At the end of a lesson not every group completed a whole all instructions. Before starting the next lesson, the robot was not always in the same state as the group left it. This caused irritation and discouraged by several groups. Pupils started enthusiastic but before they could finish, often the lesson was over. Within the groups most of the time two pupils were busy to program the robot, while the third was doing something else. Some pupils improved their programming skills within a few lessons. Their success led to enthusiasm in other groups.

4.2 Participation in Nemo

There was little time to arrange a competition within between the three classes. The best group of each class represented the school in Nemo on the Robocup Jr. competition. On May the 26th 2007 we participated with two groups who did the rescuing competition and two groups who took part in the dancing competition. One of the groups became third in rescuing.



5. CONCLUSION

Most pupils were very enthusiastic for robotics. To have more success in a bigger group of pupils, we didn't have the ultimate facilities:

- The necessity to use the robots in more than one class did not make it possible to give attention to problems with construction or designing a different robot.
- To have the pupils improve their skills in programming the lessons should be at least 90 minutes once a week.
- It's preferable to work in groups of two instead of groups of three pupils.
- The instructions were meant to introduce the tools within the program and to stimulate the use of those tools to independently design a program. Participating in the Robocup Jr. competition was an extra impetus. Eventually one of the groups won a trophy from the competition.

REFERENCES

- [1] Cygnus Gymnasium (<http://www.cygnusgymnasium.nl>)
- [2] Robocup Junior (<http://joomla.robocupjunior.nl>)
- [3] Nemo (<http://www.e-nemo.nl>)
- [4] LEGO[®] (<http://mindstorms.lego.com>)