

Chapter 11

Creating Educational Robots: Basics From Teacher Training to Making

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ABSTRACT

After more than 30 years of development, the designing, constructing, and programming of educational robots is still enjoying increasing popularity in formal, non-formal, and informal educational settings. Although building instructions and required technical components are easily available and accessible, the realization of own teaching projects is a special challenge and is subject to decisive influences. This includes the content-related training of teachers as well as their attitudes and ways of thinking and acting. Therefore, the first section of this chapter spans an arc from the didactic concept of the extracurricular project technicamps related to robotics. The experiences gained from it and the consequences for teacher training to the philosophical roots of technical education follows. In connection with this, the main part deals with the technological basics of creating educational robots in general. It leads from manufacturing single parts through the creation of a support structure and automation to the application of the engineering design process.

INTRODUCTION

One of the most challenging tasks preparing learners and teachers for a future we can't foresee is to prepare them in a general way regarding the current's educational robotics and the announced developments offered by tech labs, manufacturer and others. In the case of teachers, the goal is to train and educate future teachers to make them enlightened decision makers, who are independent from tech labs promises and manufacturers advertises but also from their own preconceptions to avoid a training for a single specific tool.

One of these steps to go is to familiarize them with as many different robot systems as possible during their training so that they develop an open approach by learning about similarities and particularities. In combination with appropriate instructions for abstraction and transfer, this gives them a flexible,

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pragmatic and generalist way of thinking and acting when dealing with technical aspects of and about educational robots.

Another step is to explain and present the technical basics of educational robots. This includes not only considering the different robotic systems as given, but also abstracting and explaining them in a generalized manner in such a way that a basic transferability and a deeper understanding is possible. This also includes the examination or understanding of the structure-giving physical elements in connection with the different possibilities of the necessary programming. These two steps together demystify, changes the view and understanding of robots as automated machines.

There are two sections in this paper dedicated to this topic. One presents and explains the concept and the experiences in the technikcamps project in connection to the training of student teachers at the University of Koblenz in this subject, while a second section is purely dedicated to technical components and the engineering design process (EDP) of educational robots including designing, building and programming of educational robots. This will be the main section.

While for teachers it is a matter of preparing for a conceivable teaching assignment, the teaching goals for pupils are more directed towards typical ways of thinking and acting literacy in the sense of an enlightened and emancipatory approach to technology, computer sciences and other contents after the time with educational robotics. To illustrate how this can be achieved with pupils and young people, the didactic concept of the technikcamps and its consecutive structure is described in a separate section.

Since professional teaching with educational robotics is not only based on the existence of technical artefacts, guiding to declarative knowledge and arbitrary activities, guiding to procedural knowledge, in the concrete encounter with pupils, it is finally important to consider the attitudes and views of the teachers in addition to the teaching methodological approaches in the operative engagement with pupils. It is the difference of having only the know-how and know-what or also understanding the know-why in a deeper way.

To make it clear: teaching methods themselves belong to the classic tools of the trade of teachers, which they should have received like a vocational training at least enumerative during their training. It is the attitude, view and conviction of a teacher that shape concrete action, but can hardly be conveyed instructively themselves.

This is the adjusting screw that decides whether a teaching scenario is more instructive, constructionist or constructivist and how educational robotics are used. In this respect, this chapter is dedicated to two further sections that are formative for the way teachers think and act. One section deals with the problematic relationship between science and technology education while another section discusses the relationship between educational robotics and learning through designing. Both passages can shake the foundations and teaching beliefs and are intended to stimulate reflection.

EDUCATIONAL ROBOTICS IN THE TECHNIKCAMPS PROJECT

The idea for the technikcamps project (Fislake, 2010) was conceived by the Department of Technology at the University of Koblenz in Germany and fulfils several functions at the same time. As an out of school project, it is an extracurricular place of learning. Its focus is on technology education which is complementary to the established canon of subjects in schools, especially in Rhineland-Palatinate, Germany.

It is also used as a research laboratory and considered as a teacher training centre within the framework of teacher education. This allows prospective teachers to gain both practical and valuable experience in

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