

# ROBINI – Robotic Initiative Lower Saxony

## Development of practice-oriented education modules in schools

Julia Kramer

Prospektiv Gesellschaft für betriebliche Zukunftsgestaltungen mbH  
Dortmund, Germany

**The project ROBINI – Robotic Initiative Lower Saxony develops practice-oriented robotic education modules, which are being tested and implemented within the core curricula of general education schools and vocational schools in the Hanover Region. The practical part is established through school – company cooperation for an applied approach. By embedding the future-proof subject of robotics the Hanover Region is to be strengthened in two ways: Technical skills of students are advanced and they are given a focused occupational orientation so that in the long run the next generation of technical specialized staff will be secured. And through the integration of especially small and medium sized enterprises in the project, they are given additional information on the possibilities of the employment of robotic technology, which could make the difference in competing in a globalized market.**

*Robotics; education modules; practice orientation; customized application; school – company cooperation; occupational orientation; technically skilled staff*

### I. NEED FOR ACTION

Against the background of economically relevant technical innovations and an increasing automation of technical processes in industry, the competitiveness in the globalized market especially of small and medium-sized enterprises (SME) depends notably on the availability of specialized staff. Numerous enterprises have already given notice of recruiting problems for technical specialized staff. Analyses of the labor market of the region of Hanover have verified that vacancies especially in the field of mechanical and electrical engineering as well as vacancies in technical production cannot be filled. This negative development is particularly crucial for the region of Hanover and Lower Saxony for its economy is still widely based on these branches.

Mainly three trends are decisive: Firstly, the demographic shift, which will even enforce the lack of specialized staff in the near future. Secondly, the situation that too little school graduates choose technical vocational trainings or courses of study. And thirdly, the present technical staff is often not properly

trained according to the practical and forthcoming requirements.

The project ROBINI wants to show that the application of robots can find a remedy here. On the one hand many SMEs are not aware of the possibilities and advantages concerning the implementation of a robotic system: On the one hand the use of robotic systems helps to increase productivity and flexibility, and on the other hand – especially against the background of demographic shift – robots can take on tasks where manpower is missing or simply assist, so that wearing tasks can be carried out longer. Furthermore, the application of robots create diversified, challenging and fascinating work tasks for the technically skilled and specialized staff, which should not be underestimated.

In the face of the augmenting and further increasing relevance of robotics in the working environment, and especially in SMEs, the necessity of a further diffusion of this topic in relevant courses of education is arising, first and foremost the training of practical competences. It is imperative to make education future-proof.

### II. THE PROJECT ROBINI IN BRIEF

ROBINI – Robotic Initiative Lower Saxony is a project of the Business and Employment Promotion Office of the Hanover Region in cooperation with Prospektiv GmbH, a research institute in the field of work science. The project ROBINI focuses on the implementation of practice-oriented robotic technology education both in general education schools and vocational schools in the Hanover Region, Lower Saxony.

Overall eight schools with classes up to 30 students take part in the testing over a runtime of three years (2009-2012). Additionally, the project involves a pool of enterprises and is supported by so called strategic partners like the regional Employment Agency, the Leibniz University of Hanover, the Association of German Engineers and the Robotation Academy GmbH.

In this context ROBINI pursues several aims simultaneously:

#### A. Aims

- *Inspiring young students for natural scientific and technical themes:*

Despite a growing number of so called MINT (math, informatics, natural sciences, technology)-initiatives trying to increase the number of graduates in these courses, the lack of specialized workforce still persists. Since positive experiences in handling technology are the basic prerequisites for a lasting interest in and advanced insight also into the specialized field of robotics, early playful and hands-on socializing with MINT themes has to be part of the project's aims.

- *Accomplishing a deepened occupational orientation for students in the field of robotics:*

As a second step, students need orientation! They are to know which skills and qualifications are needed when working with robots, which opportunities of training and further training exist and which are suitable for them.

- *Generating new recruitment opportunities:*

The practical experience orientation can be called a meta-aim of the project ROBINI. The tight link-up between theory and practice and a close cooperation between different level schools and companies in carrying through the education modules, create the mutual opportunity for future apprentices and instructors to get to know each other outside and in advance of job interviews.

- *Sensibilizing and supporting regional companies in the implementation and utilization of robotic technology:*

Through the involvement in the project plus additional information and activities especially for SMEs, they are to become aware of the opportunities that a use of robots could bring with regard to business economics, regional economy and employment market.

- *Establishing a regional network of education and further training in the field of robotics:*

The project ROBINI aims at creating the basis for a regional network. A platform is to be established where theoretical, practical and of course educational experts can connect and exchange knowledge and opinions for mutual learning.

#### B. Approach

The above mentioned aims will be achieved by an intensive cooperation between schools, enterprises and strategic partners such as the Leibniz University of Hanover or the Robotation Academy. Within the framework of this cooperation education modules with a strong focus on company practice will be developed,

sampled and prepared for the transfer to other schools. For this purpose contents, material and particularly practical experiences and advices concerning the realization and implementation will be compiled in guidelines. The emphasis is placed on a specific occupational orientation and on imparting technical and economical knowledge as well as developing skills concerning work organization in connection with robotic technology in companies.

### III. ROBOTICS IN EDUCATION

It can be observed that robotics lessons have already found their way into general education schools. Besides the use of e.g. Lego systems, which are especially appropriate for quick learning progress with young students, the participation in competitions like the "RoboCup" is quite common. Thanks to committed teachers practical education outruns the formal development of curricular. However, these numerous co-existing activities are up to now primarily limited to working groups and there are no consistently regulated robotics lessons. Nevertheless, this trend is again evidence for the increasing relevance of robotic technology.

The ongoing project ROBINI contributes to furthering and above all perpetuating this trend of robotics in education. At the moment six general education schools and two vocational schools participate in developing, sampling and implementing its education modules, aiming at consolidating educational robotics and core curricular.

#### A. Education modules

The ROBINI education modules are constructed holistically, that means interdisciplinarily and cross-curricularly. They are designed to fit various courses and to be integrated into standard curricular. The modules can be adapted to different types of school, different student ages or different levels of knowledge and ability. In order to achieve this, but also to work out and highlight where diverse aspects should be followed, the topics and approaches of the education modules are regularly discussed by all participating project partners backed by experts of research and practice and evaluated by the project coordinating team.

In detail the education modules include several contents:

- Occupational orientation with regard to robotic technology,
- basic knowledge of robotics,
- practical knowledge concerning the application of robotic technology,

- case studies and feasibility studies with reference to a certain practical example,
- preparation of a check list and guideline for companies that are planning an implementation of robotic technology,
- presentation and discussion of results with representatives from involved companies.

Beside technical knowledge also social and methodical competences of the students are being trained by this interdisciplinary approach.

Furthermore, since practical experience plays a major part not only in designing and arranging the contents of the education modules, but also in the carrying through, involved companies can on the one hand share this practical experience and on the other hand benefit at the same time from compiled information concerning the implementation of robotics and from getting into early contact with qualified junior employees.

### B. Ways of implementation

As was already mentioned, the modules for general education schools and vocational schools are being realized considering the different levels of knowledge and ability. At the current state of realization the first education modules are being sampled in the lessons in close collaboration with the responsible teachers. In this way the teachers are being capacitated to continue to carry through the modules themselves after the end of the project duration. Where suitable and needed external experts are invited to provide additional input in class, for example in the field of technical details of robots, ranges of application, or in matters of occupational orientation. While the first topics are an example of where schools and enterprises work together, either in school or in the company, the latter topic affords an opportunity for the cooperation between general education and vocational schools.

To give proof of flexibility of the education modules and a little more insight, some examples of implementation shall be described. These are only two ways being tested of many more possible of how to discover and teach “basic knowledge of robotics”:

- *Robotics as part of the curriculum for an informatics course in senior class:*

Other than maybe expected at first glance the subject informatics not only allows programming of robots according to the definition of their tasks, using different methods and different programming languages. Under the heading “hardware” students for instance also get to know the possible sensors of robots and construct them in order to simulate various operations.

- *The obligatory elective subject “Robotics”:*

This way of implementation is tested in different schools at different class levels – from 5<sup>th</sup> to 10<sup>th</sup> grade. The advantage of a newly created subject is obvious: One is free in composing contents. In addition to the above mentioned constructing and programming, which is of course still main interest, topics like trends of robotics in society or advantages and disadvantages of robotics at work are being discussed. And this additional knowledge is precisely what is needed in practice.

In both cases LEGO Mindstorms NXT or fischertechnik ROBO (lines of programmable robotics/construction toys) have been used as primary learning aids.

### C. First experiences and achievements in brief

At this state of the project ROBINI the basis for evaluation does not yet substantially exist. Nevertheless, we would like to share first experiences and achievements:

- The new issue of robotics is widely accepted at schools, whereas SMEs in the Hanover Region are still more depreciative.
- The approach of students to MINT-themes and robotics cannot start too early. And especially girls get easier conversant with robots, if they can experiment in sex segregates groups.
- The implementation of robotics in regular education, i.e. within the core curricular, is possible, but it requires the customized preparation of the topics for the needs of the different types of school.
- So far the implementation and tie to the following subjects has been successfully tested: informatics, politics and labor study.

## IV. FURTHER NEED FOR ACTION

One of the important issues for the project ROBINI is that the first playful approach to robotic technology by means of LEGO Mindstorms NXT or fischertechnik ROBO has to be transferred to an entrepreneurial reality. To bring together the different actors and to inform especially further companies about the project and the chances of cooperating with schools and of implementing robotic technology, a series of workshops is being held in the project. In order to create a curricular for robotics in education, which in the long run can be applied by any type of school, an overall exchange of experiences is being initialized and shall be evaluated at the end of the project ROBINI.