ROBOT 4ALL

Project No.: 2017-1-DE02-KA202-004274
NATIONAL REPORT GERMANY

Intellectual Output 1:
BENCHMARCK SURVEY ON INTEGRATING DIGITAL, CODING AND ROBOTICS
SKILLS IN VET SCHOOLS: FROM THEORY TO PRACTICE
February 2017
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Content

1. Introduction

The project „Bridging the Skills Gap: Strategies for the Promotion of Digital, Coding and Robotic Skills for Social Inclusion, Equality and Access (Robot4All)" is an Erasmus+ project coordinated by the *Leibniz University* from Hanover/Germany. The consortium consists of the VET-school *2EK Peraia* from Athens/Greece, the IT educational centres *Emphasys* and *Cyprus Computer Society* from Nicosia/Cyprus, the IT service centre *Civic* from Edinbourgh/UK, the NGO *CDIMM* from Baia Mare/Romania, the NGO *Women in Digital Initiatives* from Luxembourg and the VET-school *IES Maria Moliner* from Segovia/Spain.

Robot4All started in 2018 to introduce coding and robotics to schools for vocational education and training (VET-schools) as an innovative way to address deficits, social exclusion, prejudice and learning disparities. The project aims to create a complete toolkit and an educational pack for VET-teachers to support them in developing, implementing and monitoring various strategies to promote coding/robotics skills in VET schools. Robotics is an effective, fascinating and motivating way to introduce students to coding which integrates all STEM fields. At the same time it promotes other employability skills such as: problem solving, group work, leadership, creativity and initiative.

For the german VET-system it is a central challenge to offer attractive training opportunities in the field of digital competences. Robot4All links the creation of educational tools that motivate students to increase their skills with the real-world-needs of the german labour market. Within the framework of a multilateral consortium it also aims at establishing common standards for training measures in the countries of the European Union.

This benchmark report examines the framework for VET-Education of ICT and Robotics in Germany with a focus on Lower Saxony and the needs of the labour market in chapter 2. In addition to that this reports presents the results of an empirical research among students and teachers in chapter 3.

The findings of the benchmark report are essential for the design of the upcoming working steps of the project. The particular situation in each participating country and the particular needs of the labour market will define the competence framework for the creation of the toolkit and the educational pack for VET-teachers.

2. VET-Education of ICT and Robotics in Germany

This chapter outlines the general situation of VET-education in the field of ICT and robotics in Germany and links the findings with the needs of labour market. The first part will focus on the institutional framework of vocational education, existing training opportunities and a policy-review in the field of education regarding ICT/robotics. The second part will deal with the relationship between supply of work force in combination with the equipment of skills one the one hand and the demand of the labour market in this field on the other. This will lead to an examination on existing gaps in the labour market and an identification of the sectors that show demand for personell that posesses skills in ITC and robotics.

2.1 Political and educational framework

VET-education in Germany is mainly organized in the Dual-VET-System that is characterized by a cooperation between companies, on the one hand, and public VET-schools, on the other based on a binding legal framework. On average 52% of the population enters the Dual-VET-system and 42% achieve a graduation that is linked with a high employment security[1] (page 4).

The vocational training act[2] defines the network of the legislation with VET-schools, social partners, like employers associations and trade unions and the chambers. Regarding the field of ICT the Chamber of Industry and Commerce is in charge. Together these institutions supervise and develop the VET-system in Germany. Additionally the Federal Institute for Vocational Education and Training (BiBB) gives advices and performs institutionalised research. The German Office for international Cooperation in Vocational Education and Training (GOVET) works on international VET cooperation. The VET-system aims at sustaining the high educational standard that is recognised worldwide on the one hand and to enhance the attractiveness of this type of education on the other. The demographic change and the trend for young people to prefer an academical education creates challgenges for the VET-system. In order to remain succesfull there is a rising demand for educational concepts that address the needs of a labour market that is rapidly changing against the background of digitalization.

Digital competences are neccessary troughout all branches and the demographic change leads to a trend of automatization in the industry. Regarding this, the term industry 4.0 refers to the concept of working with robotic equipment. This trend will not

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[1] GOVET (2017): Vocational Education and Training in Germany.
https://www.bibb.de/dokumente/pdf/govet_praesentation_dual_vet_en.pdf
(access on: 20.02.2018)
[2] BMBF (2005): Vocational Training Act.
https://www.bmbf.de/pub/The_2005_Vocational_Training_Act.pdf
(access on: 20.02.2018)

only affect the workplaces located directly in the industry but will have a deep impact on the general working environment in the future.

In the federal system of Germany the institutions of the Länder, the federal states are most important in the field of education. An indicator for the relevance of ICT is the addition of the term digitalization to the title of the responsible ministry in 2017. From this year on the Ministry of Economic Affairs, Employment, Mobility and Digitalization of Lower Saxony coperates with the Federal Ministry of Education of Lower Saxony in this field.

The above mentioned societal changes led to a discreasing number of VET-students in Lower Saxony. More and more apprenticeship training positions remain empty[3] (page 4). To counter the increasing difficulties for companies to find qualified employees the fgovernment of Lower Saxony established the Fachkräfteinitiative Niedersachsen, an iniative for skilled personell. In this alliance also the social partners and chambers, in this case the federal department of the Chamber of Industry and Commerce, take part. In 2017 the initiative focused mainly on the digitalization of economy[4].

Having in mind the crucial impact of digitalization on the general working environment the iniative aims at implementing education of ICT on the curricula of VET-schools in Lower Saxony. Especially in the field of robotics the missing technical infrastructure in VET-schools is a major challenge for the implementation.

Currently mainly companies that already use robots are able to offer training in this field. Additionally projects like the Robotation Academy established by the *Deutsche Messe* in Hanover offer to experience robots in the real-world context of industry 4.0[5]. But as this mainly adresses personell that is already specialised in the field of ICT and the motivating effect of robotics as a way to be introduced to ICT and coding doesn't occur. To address this challgenge the iniative for skilled personell launched the project „BBS fit für 4.0" that aims at establishing 4 so called smart factories in Lower Saxony for the use of 11 VET-schools that can train their students in the handling of ICT-technology in the context of industry 4.0[6].

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[3] Niedersächsisches Ministerium für Wirtschaft, Arbeit, Verkehr und Digitalisierung (2017): Bericht zum aktuellen Stand der Fachkräfteinitiative Niedersachsen.
https://www.mw.niedersachsen.de/download/122267 (access on: 21.02.2018)
[4] Niedersächsisches Ministerium für Wirtschaft, Arbeit, Verkehr und Digitalisierung:
Fachkräfteinitiative Niedersachsen.
www.fachkraefteinitiative.niedersachsen.de (access on: 21.02.2018)
[5] Deutsche Messe: Robotation Academy.
http://www.technology-academy.group/de/robotation-academy/ueber-die-robotation-academy/ (access on: 21.02.2018)
[6] Niedersächsisches Kultusministerium: BBS fit für 4.0.
https://www.mk.niedersachsen.de/startseite/aktuelles/presseinformationen/bbs-fit-fuer-40--kultusministerium-und-wirtschaftsministerium-geben-startschuss-fuer-vier-smart-factories-an-berufsbildenden-schulen-in-niedersachsen-148362.html
(access on: 21.02.2018)

2.2 Needs of the Labour Market in the Sector of ICT and Robotics

Troughout Germany 428,000 out of a total 2 million companies provide VET-training[7] (page 4). In addition to the above mentioned challenge of finding enough young people who are willing to go into VET-education, many trainees don't possess the required skills to work in a digitalized working environment[7] (page 21).

Digital competences and skills in coding and robotics are especially required in all branches in the industry that are developing towards fully automated working processes. In the VET-system this mainly is connected with trainings-sections for industrial mechanics, industrial clerks and industrial managers.

But also other sectors like trade, retail business, management, office communication, healthcare, marketing or freight forwarding are affected by a fundamental change towards the implementation of digital tools into the working environment. To handle information, to organize data, to communicate with costumers it will become essential to possess particular digital competences and basic skills in coding. In these fields a training in robotics can increase the motivation to deal with coding and ICT.

2.3 Intermediary results

The German Dual-VET-system is highly recognised, but also faces challenges regarding societal changes and a changing labour market against the background of digitalization. There is an existing gap regarding the number of VET-students and their equipment of skills regarding digital competences. Companies are increasingly suffering from an absence of required trainees, espsecially in the field of ICT.

Training activities for ICT and robotics can help to close this gap. It is important to support VET-schools in establishing courses in this field, since the neccessery technical infrastructure is missing in most cases. In VET-schools courses in robotics can also address students that are not yet familiar with ICT and robotics. In this context the motivational potential of robotics as a way to be introduced to ICT and coding can come into effect.

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[7] GOVET (2017): Vocational Education and Training in Germany.
https://www.bibb.de/dokumente/pdf/govet_praesentation_dual_vet_en.pdf
(access on: 20.02.2018)

3. Empirical Research

To examine the real needs of both teachers and students in the VET-system the project Robot4All executed a multinational survey using questionnaires with open and closed questions. The aim was to include a heterogenous group of teachers and students regarding age, sex and profession/branch of study.

3.1 Sampling and Method

The questionnaires contained the sections personal characteristics and competences, existing education/training opportunities and training/education needs identification. The aim was to examine if teachers and students already have participated in training activities for ICT and robotics and if there is need for further training.
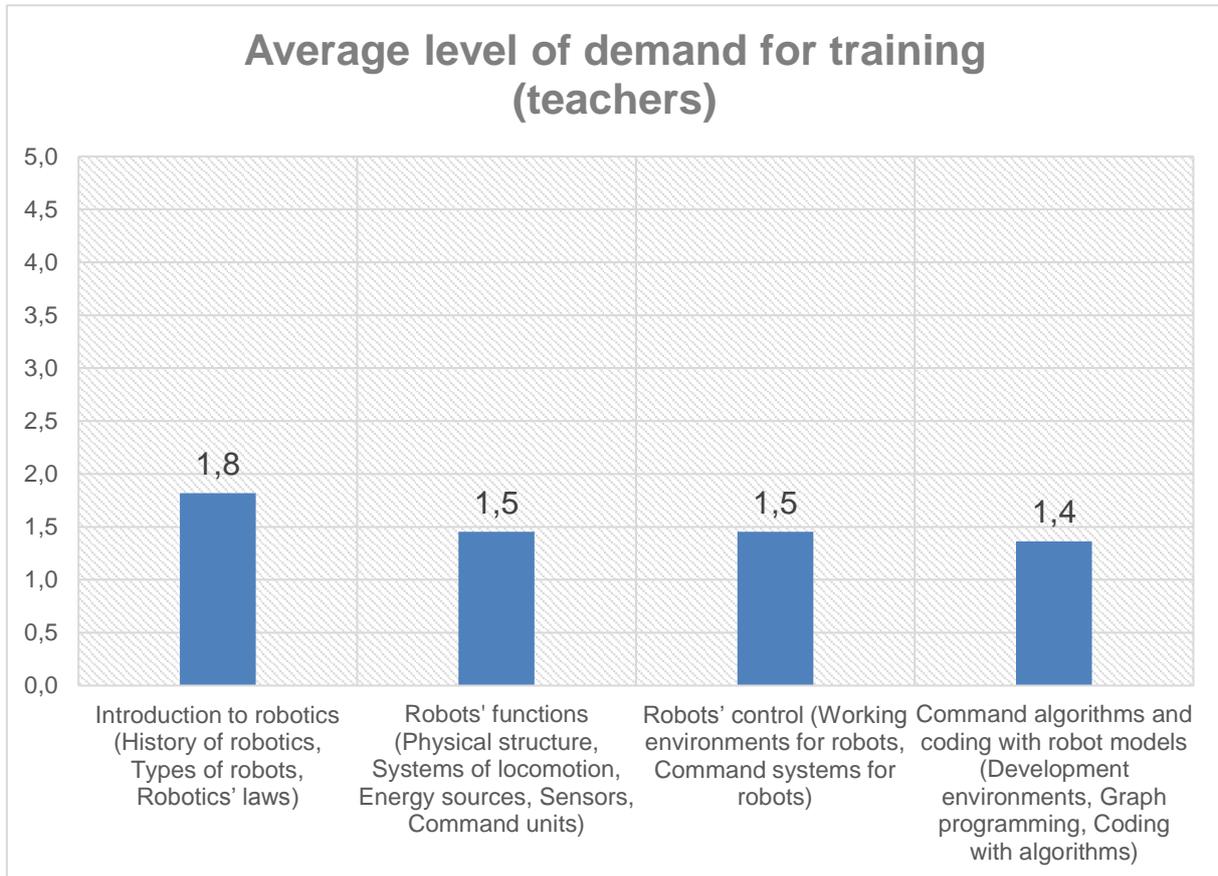
The group of participants of the research for the situation in Germany, Lower Saxony contained 14 trainees/students and 11 trainers/ teachers of the *GWDG*, the university computing centre for the Georg-August-Universität Göttingen and computing and IT competence centre for the Max Planck Society and the VET-school BBS in Göttingen.

3.2 Results

Both teachers and students advanced competences in ICT. They also have participated in various forms of training in this field. Therefore the demand for further training is low, besides the wish of some students to enhance their skills in the field continuous delivery and Continuous Integration

In the field of robotics only a few participants in the group of teachers and students posess basic skills. The experiences are mainly connected with voluntary activities in the work with simple robots. There is no existing training opportunity at the VET-school. The demand for further training among the teachers is relatively low, besides the wish of a few participants to be introduced to basic aspects of robotics.
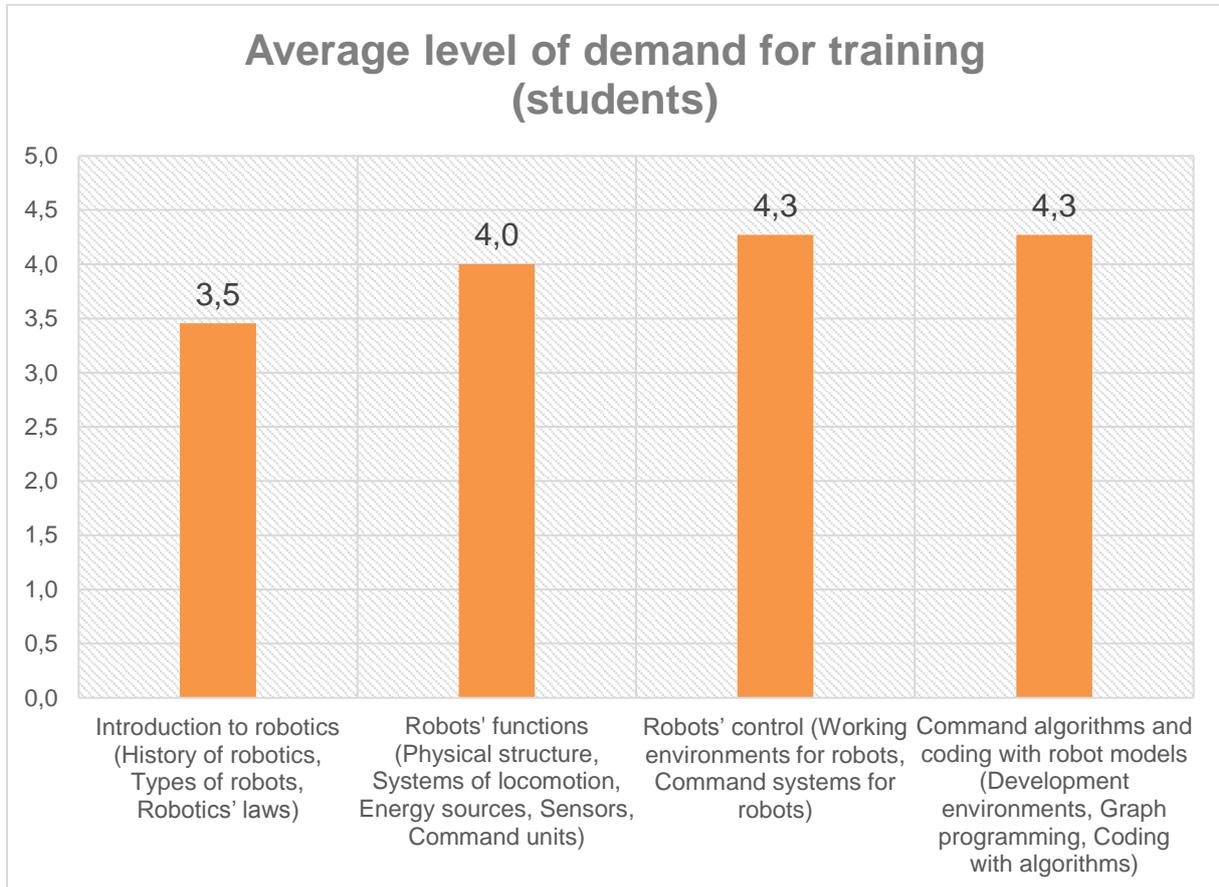
This graph shows the average demand of VET-teachers for training of robotic skills. The teachers were asked to indicate their demand for different types of robotic skills on a scala from 1-5. (1 = less interested, 5 = very interested).

Average level of demand for training (teachers)

Category	Value
Introduction to robotics (History of robotics, Types of robots, Robotics' laws)	1,8
Robots' functions (Physical structure, Systems of locomotion, Energy sources, Sensors, Command units)	1,5
Robots' control (Working environments for robots, Command systems for robots)	1,5
Command algorithms and coding with robot models (Development environments, Graph programming, Coding with algorithms)	1,4

The average interest for training in robotics among the teachers is located between 1 and 2. Several participants explain the missing interest in this type of training with the lack of benefit for their everyday work.

Among the group of students the interest in training with robotics is much higher. Those who haven't work with robots yet are willing to be introduced to this field on the basis of personal interest and the wish to improve their career opportunities. The students who already worked with simple robots report that it was a good experience and express their wish to increase their skills.

This graph shows the average demand of VET-students for training of robotic skills. The students were asked to indicate their demand for different types of robotic skills on a scala from 1-5 (1 = less interested, 5 = very interested).

Average level of demand for training (students)

Category	Value
Introduction to robotics (History of robotics, Types of robots, Robotics' laws)	3,5
Robots' functions (Physical structure, Systems of locomotion, Energy sources, Sensors, Command units)	4,0
Robots' control (Working environments for robots, Command systems for robots)	4,3
Command algorithms and coding with robot models (Development environments, Graph programming, Coding with algorithms)	4,3

Due to the wish of a majority of VET-students to work with robotic-technoloy the average demand for training is relatively high. They show special interest to training that combines coding and robotics.

4. Conclusion

Bringing the findings of the policy review together with the results of the emprical research it becomes clear that the undisputible lack of vocational training in the field of ICT can be addressed with the implementation of training activities involving the use of robotic instruments. These training courses should not only include students who are already experienced in this field. The highly motivating character of robotics can be used as a way to be introduced to ICT and coding. Because robotics brings students into the position to test their acquired skills in a real world context by moving haptical objects it increases the willingness to deal with ICt and coding.

Nevertheless there are also several obstacles. Currently most VET-schools show a lack of technical infrastructure. If only highly specialized companies are able to offer training with robots for their trainees, most students don't have the chance to experience robotics. Several politcal initiatives are addressing this problem and try to establish laboratories and training centers for VET-schools. The outputs to be created by the project *Robot4All* are adequate to step in here by supporting VET-schools in establishing a educational concept for robotic training activities.

The digital handbook for teachers to be created by *Robot4All* also addresses the problem of the missing working capacities of teachers to increase their skills in robotics to a level where they are able to introduce students to robotics. It will include step-by-step guidance to make sure that teachers can successfully establish training courses in the field of ICT and robotics.