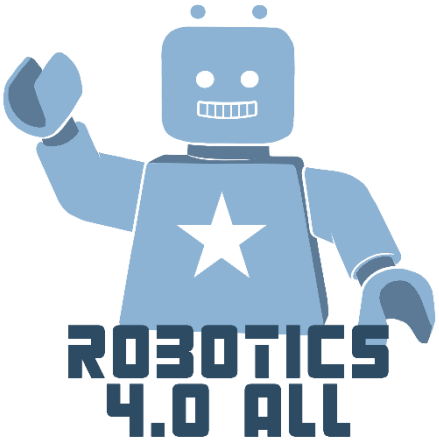

IO4 - METHODOLOGY FOR THE RECOGNITION OF LEARNING OUTCOMES

Report

Based on research and input from Norway, Spain, Greece, Cyprus, Croatia, Estonia and Bulgaria

Developing STEM Competences with Robotics

2018-1-NO01-KA202-038813

FIRST Scandinavia

ROBOTICS 4.0 ALL

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Co-funded by the Erasmus+ Programme of the European Union

Project "ROBOTICS 4.0 ALL"

Project "**Developing STEM Competences with Robotics**" (acronym: "ROBOTICS 4.0 ALL") is a transnational Erasmus+ project, developed within Key Action 2: Cooperation for innovation and the exchange of good practices, which involves partner organizations from 7 European countries (Norway, Spain, Greece, Cyprus, Croatia, Estonia and Bulgaria).

The European Commission strongly supports the new Digital Era and is willing to promote methods like coding and programming as a valuable formal and informal educational technique that could improve skills, as well as social inclusion in various educational environments. The main intention is the creation of a suitable framework that will enhance the implementation and integration of these techniques in early life stages and through formal educational curricula.

In this regard, the project was conceived and developed as an answer to recently published estimates stating that, in the near future, around 65% of children who are in primary school today will ultimately end up working in completely new types of jobs that do not exist yet. The reason is that we are currently experiencing the fourth industrial revolution (Industry 4.0) that emphasizes on automation, cyber-physical systems and the internet of things (IoT), which already has an impact on our lives, expected to be multiplied in the future. In such a rapidly evolving landscape, the ability to anticipate and prepare for future skills requirements is increasingly critical for individuals as well as for organizations in order to fully seize the opportunities presented. Hence, 21st century skills in STEM (Science, Technology, Engineering & Mathematics) and digital competencies, analytical and critical thinking, team spirit and cooperation, are deemed necessary to enhance one's educational capacity and to increase future employability opportunities, while adapting and keeping up-to-date with modern technology.

Through the implementation of our project, both youngsters and adult participants will have the opportunity to develop, enhance and acquire key competencies and skills relevant to STEM education and training. The acquired and newly developed skills and competencies will help them be better prepared and equipped for future educational and professional chances, while the liaison, the exchange of good practices and the establishment of synergies among the participating organizations and relevant stakeholders will help maximize the impact in the present and in the future.

For more information, please visit: https://robotics4all.eu

Co-funded by the Erasmus+ Programme of the European Union

Introduction to the goals of this Report

Through the implementation of project "ROBOTICS 4.0 ALL", we have brought together organizations with rich experience in educational robotics, as well as organizations with experience in Vocational Education and Training (VET).

Our aim under Intellectual Output 4 (IO4) is to develop a methodological roadmap for the recognition of learning outcomes of educational robotics learners, based on an ECVET, EQF and/or ECTS framework, in order to add value to the practices of the project partners and of other European robotics-VET providers in general.

Although this is an ambitious objective, all partners have worked together on identifying a common and shared transnational methodology (methods, tools and criteria) for the assessment of the learning outcomes acquired during and after the participation in an educational robotics curriculum.

More specifically, all partners have shared their organizations' and/or their countries' relevant templates, while wide research has been conducted over the European as well as global methodology and standards for assessment and recognition of learning outcomes, with the ultimate goal being to combine all inputs in order to suggest a pathway for integrated approach based on ECVET, EQF and/or ECTS.

This way, all organizations involved in the project, and especially the VET-oriented ones, will have the opportunity to improve their STEM educational capacity and profile by potentially integrating the robotics curriculum into their VET programmes and priorities.

Based on this notion, this Report's structure begins with the aim to provide a theoretical background and presentation of the methodological guidelines for designing assessments of learning outcomes to be utilized by various stakeholders, based on ECVET, EQF, ECTS and other standards, and continues with the presentation of the seven partners' collected results of assessment processes and schemes in their respective countries (Norway, Spain, Greece, Cyprus, Croatia, Estonia and Bulgaria).

Subsequently, an external assessment of the developed Report will take place, where each partner will define 1 external to the project expert to provide feedback for improvement (i.e. "fine tuning"). Lastly, project partners will promote the Report to other VET providers, with a specific aim to Robotics educators, as a means to disseminate it and initiate the further development of such a methodology.

Assessment and Recognition of Learning Outcomes

When designing assessments, it is important to make sure that any exams or assignments match the learning outcomes of the course. Assessments should be based on material you've covered in the course, and students should perceive the material as relevant and fair. As summarized in the Stanford Testing Handbook:

Testing not only lets you and your students know how much they have learned, it also provides a chance for more learning to take place, by reinforcing course material or by requiring students to use or think about what they have learned in a new way. Tests should be designed with primary course objectives in mind and should cover material from all components of a course (sections, lectures, textbooks, etc.). The nature of the exam will directly influence how students prepare, study and learn. For this reason, the format and frequency of your testing will directly influence what and how much students learn. If students have reason to believe that you will mainly stress recall of information, for example, then they are much less likely to devote time to the mastery of concepts and the synthesis of material. On the other hand, if your tests will demand a deep knowledge of the ideas discussed, students are likely to respond accordingly.

In this regard, the European Standards and Guidelines (ESG) emphasize the centrality of learning outcomes in the concept of student-centred learning and teaching. Assessing and demonstrating the achievement of learning outcomes are of vital importance for connecting education with larger society. Achieved learning outcomes are what students take with them as they enter the labour market and embark on a career in work and lifelong learning. While the adoption of learning outcomes to describe the final qualifications of study programmes has been accepted well in higher education in the European Higher Education Area (EHEA), assessing and demonstrating achieved learning outcomes still need attention, as is underlined in the Bucharest Communiqué of 2012.

The topic of achieved learning outcomes brings up several issues connected with the use of learning outcomes in general on which there still is a lot of uncertainty and difference of opinion among stakeholders. These issues include the technique and idiom used in formulating learning outcomes, the balance between formalism and autonomy in the use of learning outcomes in developing programmes, the involvement of students and other stakeholders, and the role of internal and external quality assurance in all of this. Besides, the

contexts of higher education and the practices of implementing learning outcomes differ a lot. Considering this, it becomes evident that:

a) the topic of achieved learning outcomes and their assessment and demonstration cannot be seen in isolation from the general use of learning outcomes;
b) there is no one single method or guideline for the implementation of achieved learning outcomes.

Learning Outcomes and Quality Assurance

Learning outcomes are accepted because of evident benefits to all stakeholders. Quality assurance has an important role to play in supporting the use of learning outcomes by establishing guidelines and good practices for the design of programmes and methods of assessment, as well as for aligning teaching with the learning outcomes and facilitating cyclical improvement. Enforcing the use of learning outcomes in a rigid manner through quality assurance without proper attention for the professional's insights and experiences has not been beneficiary to the implementation of the concept. Providing insight in the quality of programmes supports the demonstration of achieved learning outcomes as it assures the validity of the awarded degrees. Benchmarking learning outcomes with national and international qualification frameworks is effective in connecting learning outcomes with the demands in society. Further benefits include the improvement of student mobility and the establishment of a 'brand' of higher education that is recognized in society as well as abroad.

Learning outcomes do not always cover what teachers or students perceive as the "essence" of a study programme, that part that is in between the modules and often has to do with building personality and gaining experiences outside of the comfort zone of regulated learning.

The discussion on the added benefit of learning outcomes and the role of quality assurance brings up important questions. The pressure of many different changes and developments is felt throughout society and not in the least in the field of education.

Even without the introduction of student-centred learning, there has been growing pressure on higher education to account for their output to society in a quantitative and qualitative sense.

Learning outcomes provide a valid and effective framework to assure quality. But, in any case, some critical points are still under discussion by the scientific community:

- Does quality assurance based on learning outcomes leave enough room for innovation?
- How can institutions and quality assurance agencies find the right balance between autonomy and regulation?
- Are students interested or involved in the process of implementing learning outcomes?
- What if the pressure from external quality assurance is gone, will innovation last?
- Is the terminology that is used in the process clear for all those involved, is there a common language?

Nevertheless, the use of learning outcomes has an impact on a range of education and training practices and policies. The main aim of transforming education provision by emphasizing learning outcomes in curricula and qualifications is to enhance learning and to make that learning explicit. When it comes to curricula, the main role of learning outcomes is related to the willingness to actively engage learners in management of their learning process alongside their teachers. If this shift is actually taking place it should be possible to observe an impact of learning outcomes on pedagogy whereby teachers are increasingly adopting a role of learning facilitators alongside delivering instruction.

From a qualifications' perspective, using learning outcomes to recognize learning contributes to:

- Better matching of qualifications with labour market expectations.
- Greater openness of education and training systems to recognize learning achievement independent of where it was acquired.
- Enhanced flexibility and accountability of education and training systems which are expected to deliver the defined outcomes whilst enabling greater autonomy in defining the routes to those outcomes. Learning outcomes need to be written so that they are fit for purpose – for setting occupational and educational standards, for describing single qualifications and curricula, for outlining assessment criteria and for orienting learning and teaching processes.

As a conclusion, the importance of learning outcomes has been repeatedly stressed in policy papers at the European level, where cooperation in education and training has increasingly adopted the learning outcomes approach as a defining principle. All the European instruments

and processes currently being developed and implemented, notably European qualifications frameworks and credit transfer systems, are based on this approach. This should not be surprising since learning outcomes are the only common factor in all education and training efforts and mechanisms used to achieve more, better and more equitable lifelong learning throughout Europe and the world.

National Qualifications

National qualifications systems are inevitably complex because they have to be based on social and cultural traditions and the institutions of the country. This complexity can make the systems difficult to understand from outside the country, but they can also appear complex for people inside countries as well. Learning outcomes can bring some transparency to systems in terms of the learning individuals are expected to demonstrate. It follows that the interest in learning outcomes at national level is also high and whilst reflecting European level policy, the national interests tend to focus on:

- The need for education and training to be based on explicit standards defined jointly with stakeholders representing the interests of the society, labour markets as well as individuals. This illustrates that transparency of learning is not only about making it easier to 'read' qualifications, systems and institutions, but it is also about having a common language for a dialogue about the objectives of education and training. This in turn leads to a better understanding of learning.
- The desire to create transparency of qualifications and learning pathways for individual learners and for employers as well as creating flexibility in terms of organization of learning.
- The willingness to set up clear expectations that education and training institutions are to meet based on national/regional or sectoral standards.
- The improvement of quality assurance processes linked to education and qualifications systems.

Any guideline on assessment and demonstration of learning outcomes should take the perspective of the creation of quality as its point of departure and not that of quality assurance in formal systems and standards. Quality in education is created in its specific context, be it an institution, programme or classroom, which means that the process will differ for each context

and that the implementation of learning outcomes will vary, depending on the context in which this takes place.

As practices will differ in each context, good practices that work in one context, may therefore not always be effective or realistic in other contexts. Still, communication and exchange of experience and practices is needed to build bridges between the various contexts in the EHEA and make progress in implementing the Bologna reforms and student-centred learning.

These differences concern the institutional structures and the extent to which quality assurance emphasizes or formalizes the use of learning outcomes, either intended or achieved. On one side of the spectrum there is the Swedish system which, since its revision of the evaluation of first and second cycle programmes in 2010, focused on student attainment of intended learning outcomes specified in the national qualification descriptors.

The cycle of reviews from 2011-2014 almost exclusively focused on output, and very little on pre-requisites and processes. On the other side, the Austrian system of accreditation considers learning outcomes in the review of new programmes, but the check whether intended outcomes are achieved is not part of the framework for accreditations. These reviews focus more on internal quality management and the way learning outcomes are made explicit in programmes.

Another case is the UK, which has largely moved towards institutional accreditation, which places the responsibility for making sure that learning outcomes are implemented and achievement is assessed and demonstrated on the institutions.

Countries where achieved learning outcomes have been part of the frameworks of external quality assurance include the Netherlands and Flanders. The experience with this element in various cycles has been that it may raise debates on the autonomy of institutions when external reviewers evaluate final projects or theses of individual students, especially when they criticize the grades given by institutional or external examiners connected to the programme.

Nevertheless, this practice has been effective in raising the level of achieved learning outcomes in certain sectors, raising public confidence in the value of awarded degrees.

In the Dutch system, the focus on the level and the achievement of learning outcomes provided an incentive to programmes to improve the level of knowledge and skill, and improve the systems of assessment. Exam committees became more independent, assessments were critically evaluated by experts and teachers were trained in methods of assessment.

In most countries, the evaluation in external quality assurance is at meta-level and reviews the system of assessment, rather than that it includes the evaluation of individual projects and

theses. Other major areas of difference in the implementation of the assessment of achieved learning outcomes include:

- the level at which knowledge, skills (and attitudes or behaviour) are integrated in the assessment;
- the use of internal & external evaluators;
- the level of formalization of the assessment and the inclusion in internal quality assurance.

Overall, the development of national qualifications frameworks with descriptors based on learning outcomes, is a step towards making qualifications and levels of learning (that are often implicit) explicit for all users. Many countries have had at least part of education and training systems based on learning outcomes for some years. However, the move towards use of learning outcomes in all parts of education and training has intensified over the last few years and remains a challenge for most countries.

Designing an Assessment

Learning outcomes are statements that predict what learners will gain as a result of learning. Each intended learning outcome should describe the observable knowledge or skills that you expect students to be able to demonstrate as a result of their work in the unit. A carefully thought-out learning outcome will give a solid indication of what kinds of assessment are appropriate, and of the skills and knowledge the learner will have to demonstrate to pass. Finally, the clearer the learning outcome, the easier it will be to devise an appropriate assessment.

When designing a new assessment or revising an old one, the most important component is to be sure there is a match between the objectives of the unit/course/lesson being assessed, the teaching/learning activities used, and the assessment tool. Therefore, one should consider asking the following questions:

- What are the objectives of the course/unit/lesson that are being assessed?
- What is the level of knowledge, comprehension, application, analysis, synthesis and/or evaluation? Is the level appropriate given the objectives for the course/unit/lesson?
- Is the assessment at a level appropriate to the level of the course (first year, graduate etc.)?
- How well does the content of the assessment match the objectives being assessed?

- How well does the content of the assessment match the learning opportunities presented in the unit/lesson/course (i.e., does the assessment assess what was taught)?
- Is the assessment organized in such a way as to aid clarity and understanding of its requirements?

Moreover, when designing assessments to match learning outcomes, one must remember:

- The assessment should align firstly with the overall desired learning outcomes and secondly with the more detailed content of the course.
- Be clear about what you are trying to assess. This will make writing assessment tasks or questions much easier. Most courses will need a range of assessment methods to adequately assess the content and desired learning outcomes.
- Pay attention to the cognitive level of the assessment task or question. Some tasks operate at a low level of factual recall, while others asks students to analyze, synthesize, or evaluate information. The cognitive level of the task or question should match your goals in the desired learning outcomes or curriculum plan.

Strategies for Developing Assessments

Creating effective assessments can be accomplished through the use of mapping out the assessment tasks and how they align with learning outcomes, or mapping out the content of an exam against course content. Effective assessments must be both valid and reliable. Validity refers to what the assessment is actually testing and reliability to the consistency of the assessment.

<u>Getting Started:</u>

- If you are taking over a pre-existing course, review old tests to see what material was covered and how knowledge was assessed.
- Inform students, at the beginning of the course, what kinds of assessments will be used.
- If possible, provide sample copies of at least one previous exam to all students.

<u>Building Your Assessment:</u>

Create a table to help align your assessment with your course outcomes. This table can have a column for each of the following:

- Learning to be measured (course outcomes)

- Weighting (relative importance)
- Level and domain of knowledge (i.e. taxonomy)
- Timing/Pacing

Reviewing an Assessment

Each assessment format has its own strengths and weaknesses, and is best used to assess different kinds of learning and skills. Assessments can be either subjective or objective:

Objective Assessments require students to choose a response. These assessments include multiple choice, true/false, or matching questions. It can be more time consuming to develop effective objective assessments, however they are easier to score.

Subjective assessments Subjective assessments require students to construct a response. These types of assessments include essays, short and long answer questions, case studies, projects, or demonstrations. It can be easier to develop a subjective assessment than an objective assessment, however they are harder to score.

Additional ways for reviewing the difficulty of your assessment tool include:

- Can the assessment be reasonably completed in the time provided?
- Is each section preceded with clear directions and an indication of its point value?
- Does the assessment require any skills, knowledge, or vocabulary that wasn't central to the course content? Are you assessing something you haven't taught?
- Do the problems echo examples or exercises previously used in the course?
- Are the problems of graduated difficulty, going from simplest to most difficult?
- Do the problems create a potentially frustrating situation in which the solution to one problem depends on the successful completion of another?
- Is each question clear and unambiguous?
- Is there only one possible correct answer for each question?
- Have any partially correct answers been identified?
- Does each question test at the desired level of knowledge, skill, or attitude?

FIRST Scandinavia

ROBOTICS 4.0 ALL

NORWAY

Template methodology for the recognition of learning outcomes

Modeling

The goal of the training for the student is to able to:

- Explain how computers and applications work, including a selection of widely used programming languages and their applications
- Convert problems into specific sub-problems, consider which sub-problems can be solved digitally, and design solutions for these
- Document and explain program code by writing appropriate comments and by presenting own and others code

Coding

The goal of the training for the student is to be able to:

- Use multiple programming languages where at least one is text-based
- Apply basic programming principles such as loops, tests, variables, functions and simple user interaction
- Develop and troubleshoot programs that solve defined problems, including science issues and the control or simulation of physical objects
- Transfer solutions to new problems by generalizing and adapting existing program code and algorithms

Grade	Subject	Learning goals
8th-10th grade	Electives programming	Modelling: Explain how computers and applications work, including a selection of widely used programming languages and their applications
		Modelling: Convert problems into specific sub-problems, consider which sub-problems can be solved digitally, and design solutions for these

		Modelling: Document and explain program code by writing appropriate comments and by presenting own and others code
		Coding: Use multiple programming languages where at least one is text-based
		Coding: Apply basic programming principles such as loops, tests, variables, functions and simple user interaction
		Coding: Develop and troubleshoot programs that solve defined problems, including science issues and the control or simulation of physical objects
		Coding: Transfer solutions to new problems by generalizing and adapting existing program code and algorithms
8th grade	Math	Exploring how algorithms can be created, tested and improved with the help of programming
9th grade	Math	Simulate outcomes in randomized trials and calculate the probability that something will happen, using programming
10th grade	Math	Explore mathematical properties and contexts using programming
	Science	Use programming to explore natural phenomena
	Science	Explore, understand and create technological systems that consist of a transmitter and a receiver
	Science continuous assessment	Students show competence when using programming and exploring technology
11th grade	Math	Formulate and solve problems using algorithmic thinking, various problem solving strategies, digital tools and programming

	Math continuous assessment	The teacher will be in dialogue with the students about their development in programming and strategies to solve problems

Objectives

Different approaches to program development.

Development of program code on top and down principle. Break down an overall problem into smaller problems that can be solved by programming.

Iterative and incremental process

Repetition of process or parts of the process to get closer to a desired goal or result.

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CYPRUS

Template for describing a professional qualification

PROFESSIONAL QUALIFICATIONS FRAMEWORK

	DETAILS OF PROFESSIONAL QUALIFICATIONS
1.	**PROFESSIONAL QUALIFICATIONS IDENTITY**
1.1.	**Professional Qualifications Title:**
1.2.	**Level of Professional Qualification as per EQF:**
1.3.	**ISCO Code και Occupation:**
1.4.	**Professional Qualifications Code:**
2.	**PROFESSIONAL QUALIFICATION DESCRIPTION**
2.1.	**Description of Work:** **Working Environment:**

	DETAILS OF PROFESSIONAL QUALIFICATIONS
	Potential organisations/businesses for employment: **Additional training for acquiring new skills:** **Related Professional Titles:** **Paths leading to the acquisition of this Professional Qualification according:** PATH 1 Prerequisite Qualification: Experience: PATH 2 Prerequisite Qualification: Experience: PATH 3 Prerequisite Qualification: Experience: PATH 4 Prerequisite Qualification:

	DETAILS OF PROFESSIONAL QUALIFICATIONS
	Experience:
2.2.	**Mandatory areas of work:**
2.3.	**Equipment:**
3.	**ANALYSIS OF AREAS OF WORK**
3.1.	

AREA OF WORK:
Knowledge
The person should be in the position to have:
Skills
The person should be in the position to:

	DETAILS OF PROFESSIONAL QUALIFICATIONS
	Competences (Responsibility and Autonomy)
	The person should be in the position to:
3.2.	**Assessment Methods as per Area of Work:**
4.	**GENERAL INFORMATION**
4.1.	**Project Team:** **Project Manager** **Expert**

	DETAILS OF PROFESSIONAL QUALIFICATIONS
	Writer
4.2.	**Contracting authority:**
4.3.	**Technical Committee for Professional Qualifications:**
4.4.	**Approval Date:**
5.	**APPENDICES**
5.1.	**Glossary:**

Cyprus does not yet have a national framework for validating non-formal and informal learning but this is currently under development, through a project, ESF part funded, to establishing an appropriate mechanism. This project has supported a mapping study of the current situation in Cyprus and a national action plan setting up a validation mechanism for the validation of non-formal and informal learning ("*epikirosi mathisis"*).

GREECE

Template of a robotics student survey

We ask teams to complete their surveys after they have finished their FIRST LEGO League season, as a means to evaluate and recognize their learning outcomes.

1.

How much were you involved in each of the following activities?	**A Lot**	**A Little**	**None**
a. Deciding which missions to do in the Robot Game	O	O	O
b. Designing your team's robot or designing a specific part of the robot	O	O	O
c. Building your team's robot	O	O	O
d. Programming your team's robot	O	O	O
e. Testing your team's robot	O	O	O
f. Setting up or fixing the team's robot at an event/tournament	O	O	O
g. Explaining how your team's robot works to the judges at the tournament	O	O	O
h. Raising money for the team	O	O	O
i. Creating team materials (creating a logo, t-shirt, buttons, team name, etc.)	O	O	O
j. Identifying a problem for your research Project	O	O	O
k. Doing research at the library or on the internet for your research Project	O	O	O
l. Getting information from a scientist or other expert for the research Project	O	O	O

How much were you involved in each of the following activities?	A Lot	A Little	None
m. Creating an innovative solution for the team's research Project	O	O	O
n. Sharing the research Project solution with your community	O	O	O
o. Helping to prepare the presentation on the team's research Project	O	O	O
p. Presenting the team's research Project at the tournament	O	O	O
q. Helping your team prepare for judging on the League Challenge for Core Values.	O	O	O

2. Did your team have an adult who was an engineer, scientist or someone who knew computer programming help you? (Check all that apply)

O Yes, our team coach

O Yes, a team mentor or volunteer

O No, the team did not have anyone like that

3. If YES, how much did that person help you do any of the following:

	A Lot	A Little	None
a. Think about the kinds of things you needed to study if you wanted to become a scientist or engineer	O	O	O
b. Learn about the science involved in the RePlay Challenge	O	O	O
c. Learn about science and technology careers	O	O	O
d. Solve a problem with building or programming your team's robot	O	O	O

4. Please tell us if you Strongly Agree, Agree, Disagree, or Strongly Disagree with each of the statements below. Please remember, there are no right or wrong answers.

Do you agree or disagree with the following statements?	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
a. The kids on my team made the important decisions, not the adults	O	O	O	O
b. I had a chance to do lots of different jobs on my team	O	O	O	O
c. I had important responsibilities on my team	O	O	O	O
d. I got all the help I needed to do my jobs on my team	O	O	O	O
e. The adults working with my team paid attention to me	O	O	O	O
f. The adults on my team talked with us about college	O	O	O	O
g. I had fun working on my team	O	O	O	O
h. I felt like I really belonged on my team	O	O	O	O
i. My team learned how to work well together	O	O	O	O
j. My team meetings felt like a safe and friendly place for me to be	O	O	O	O
k. The adults working with my team expected us to act responsibly when we were together	O	O	O	O
l. I had a chance to learn about careers in science and engineering	O	O	O	O
m. What I learned in was more important than what my team won at a tournament	O	O	O	O

5.

As a result of participating, I learned:	Strongly Agree	Agree	Disagree	Strongly Disagree
a. That science and technology (like computers and robots) can be used to solve problems in the real world	O	O	O	O
b. About some of the kinds of jobs people do that use science and technology	O	O	O	O
c. That science and technology are important in everyday life	O	O	O	O
d. That subjects I study at school (like math or science) can help me solve problems in the real world	O	O	O	O
e. That I have skills that can help other people	O	O	O	O
f. That every team member has ideas that are valuable	O	O	O	O
g. That both boys and girls can be good at computers or robotics	O	O	O	O
h. That helping other people solve problems can be fun	O	O	O	O
i. The importance of gracious professionalism	O	O	O	O

6.

As a result of participating:	Strongly Agree	Agree	Disagree	Strongly Disagree
a. I want to learn more about science and technology	O	O	O	O
b. I want to learn more about computers and robotics	O	O	O	O

As a result of participating:	Strongly Agree	Agree	Disagree	Strongly Disagree
c. I want to learn more about how science and technology can be used to solve problems in the real world	O	O	O	O
d. I want to learn more about real-life projects like the RePlay Project	O	O	O	O
e. I am more interested in having a job that uses science or technology	O	O	O	O
f. I am more interested in going to college	O	O	O	O
g. I want to be a scientist or engineer	O	O	O	O
h. I want to be able to solve problems for my community when I am older	O	O	O	O
i. I am more interested in doing well in school	O	O	O	O
j. I believe that I can succeed when I try hard	O	O	O	O
k. I feel like I am better at math or science than I thought I was before *FIRST* LEGO League Challenge	O	O	O	O

7.

As a result of participating, how much did you learn to do the following?	A Lot	A Little	Nothing at All
a. Work with other team members to identify and solve a problem	O	O	O
b. Brainstorm ideas with other team members	O	O	O
c. Think about problems in a new or creative way	O	O	O
d. Decide who is going to do what job on a group project (like researching a real-world problem)	O	O	O

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As a result of participating, how much did you learn to do the following?	A Lot	A Little	Nothing at All
e. Solve disagreements between team members	O	O	O
f. Accept other people's suggestions about my ideas	O	O	O
g. Offer suggestions to someone else working with me on a group project	O	O	O
h. Make decisions without adult help			
i. Work well with both girls and boys	O	O	O
j. Identify the steps I need to follow to get something done	O	O	O
k. Manage my time so that I can get all the steps in a job done	O	O	O
l. Use trial and error to figure out if something (like my robot) is going to work or not	O	O	O
m. Research a problem to find a solution	O	O	O
n. Make a presentation	O	O	O
o. Talk to people I don't know about something I think is important	O	O	O
p. Treat others with respect even when I am competing against them	O	O	O

8. We also want to know whether you liked or disliked each of the following aspects of the experience.

	Liked a Lot	Liked a Little	Did not Like or Dislike	Disliked a Little	Disliked a Lot
Building the robot	O	O	O	O	O
Programming the robot	O	O	O	O	O

Working on the PePlay research Project	O	O	O	O	O
Going to an event/ tournament	O	O	O	O	O
My team coach	O	O	O	O	O
Being with my friends	O	O	O	O	O
Being part of a team	O	O	O	O	O
Other, please specify _____	O	O	O	O	O

9. Overall, how would you rate your experience this year?

O Excellent O Good
O Fair O Poor

10. Do you plan to participate again next year?

O Yes
O No, I didn't like the program
O No, I don't have the time
O No, I will be too old

11. How many years (including this one) have you been on a FLL Robotics team?

1	2	3	4	More than 4
O	O	O	O	O

12. Did you also participate in the Junior program before starting this Challenge?

O Yes O No

CROATIA

VET framework for manipulators and robots (I 13)

From curricula and framework programmes for the electrotechnics, Secondary Schools (VET), Republic of Croatia

Occupations:

- electrician
- electrical engineering technician
- electronics technician
- process technician
- computer technician

Goals and objectives

Modern automated production machines (automata), manipulators and robots represent a significant set of technicians' work in the field of electrical engineering. Modern automata, manipulators and robots are built in many ways and for many purposes in all manufacturing and other activities.

The objectives of this course are the acquisition of basic theoretical and practical knowledge of the principles of construction and the operation of industrial production machines — automata, manipulators, and robots — and linking that knowledge with basic theoretical and practical knowledge in the field of electrical engineering, electronics and automation.

The tasks of this subject are:

- to acquire basic theoretical knowledge about the principles of operation and performance of production machines, manipulators and robots,
- to acquire basic theoretical and practical knowledge about the principles of operation and performance of measuring elements, measuring circuits used in the control of automata, manipulators and robots,
- to acquire basic theoretical and practical knowledge about automatic control circuits on automata, manipulators and robots,

- to acquire basic theoretical and practical knowledge about the ways of working and building a system for numerical microprocessor control of automata, manipulators and robots.

The contents

1. Basic concepts of production machines

The concept of cyclical work programs.

The concept of production machines, division of machines (automated production machines, manipulators, robots).

Types of machining of materials (particle separation processing, deformation processing).

The concept of automatic control of production machines, position control, functional control, serial, parallel and combined control of automata.

Types of kinematics of objects and tools: the concept of degrees of freedom of movement, motion of the object of processing, motion tools, concept and types of coordinate motions, linear and rectilinear, helical, spiral and spherical motions items and tools.

The concept of cyclic abrade on production machines, cyclic abrade programming, program matrices and time diagrams. Kinematic schemes of automata.

2. Management of production machines

Measuring sensors and coordinated displacement measuring transducers, potentiometer transducers, inductive converters, differential converters, selsin, inductosin, analogue-to-digital displacement converters.

Coordinate shift controllers and controls, positioning circuits, unit offset determination, input A / D and output converters.

Signal interpolation circuits: line, spherical and spherical interpolators.

Exhaust parts of control circuits: DC setting motors, stepper motors, synchronous motors, pneumatic and hydraulic outboard motors.

Mechanical program assemblies: curve program mechanisms and assemblies, kinematic schemes program mechanisms.

Program units of automatic shift control circuits: input program circuits for data entry, Wei with cards, tapes and magnetic disks, input memory reference programmed shifts.

Examples of numerical controls of an automatic drill, lathe, milling machine and copier.

3. Control of manipulators and robots

The concept of manipulator, basic parts of manipulator (hand, grips), degrees of freedom of movement of hand and grips, displacements and force of movement and grip, basic forms of manipulator designs for one, two and three degree of freedom of movement of the hand and grips, displacement and force transducers on the parts of the manipulator.

Examples of design and control of manipulators for transport of piece products, warehouse manipulators and manipulators of radioactive materials.

Concept of robot, functional representation of robot, elements of robots (undercarriage, arms and grips), degrees of freedom of movement and kinematic schemes of robots, dynamics of robot motion.

Circuits for automatic control of the movements of the undercarriage, arms and grips of the robot.

Program control of robots, analysis of work operations, time diagram of work, program for cyclic performance of work operations, subject of the robot's work program of the robot.

Microprocessor robot control systems, CNC and ONC control systems, input and output units, microprocessor, program and operational memory of the processing and computing unit.

Examples of control of industrial robots for spot welding and dyeing.

<u>Explanations and material conditions</u>

Knowledge of automatic control of production automation, manipulators and robots is important part of the overall knowledge of automation technicians. This knowledge is based on knowledge of the process of production with cyclic performance of production operations on production machines, measurements and automatic controlling the operation of automata. Particular attention must be paid when exhibiting the material of these objects clarifying the basic laws of motion of objects and tools, other significant parts of production machines and measuring and automatically making these movements. The need for accuracy must be emphasized regarding measuring and control systems for the rational use of processed materials and energy. The lectures need to be illustrated by practical examples of automata, manipulators and robots, where the principles should be emphasized.

Examples for independent work should be carefully chosen, the consolidation of theoretical knowledge and for laboratory exercises which, as a rule, should be followed by theoretical classes and introductory lectures. For laboratory, exercises must be prepared in writing, based on written and oral instructions from teachers and facilitators. When performing practical work and exercises, maximum attention should be paid to adoption and repetition of basic

rules for protection, protection at work and protection from fire, and rational use of materials and energy.

Contents that are mastered by independent work (laboratory exercises in the range of 18 hours):
- getting to know the construction and operation of an automatic drill, lathe, milling machine and copier,
- recording and analysis of the operation of kinematic schemes of production machines,
- recording schemes, analysing the operation and tuning the circuits for measuring coordinate displacements, control and overhead parts of control circuits on production machines,
- analysis of schemes, modes of operation and performance of measuring and control systems for manipulators and robots,
- introduction to programming the operation of automata, manipulators and robots.
Staff,
- graduate electrical engineer (electrical engineering and automation),
- mechanical engineer.

SPAIN

The European Digital Competences Framework in the case of Spain

The European Digital Competences Framework (commonly abbreviated as **DigComp**) is a reference framework to measure citizens' digital competence**s** which are considered essential by the European Union in order "to access the new opportunities to learn, work, create and engage in a society which is shaped by digital technology."

Developed by the European Commission, DigComp aims to explain what it means to be "digitally competent" in today's increasingly digital and robotised world through its reference framework, which is free, flexible and adaptable to support learning, development of skills and understanding of digital competence in any setting, for all ages and applicable in a variety of formal and non-formal environments.

It can be used to recognise digital competences by a wide variety of people; from trainers to employers, educators and policymakers as well as anyone else interested in implementing digital skills recognition.

How can DigComp be used?

DigComp can be used in a variety of ways and by a variety of actors (not exclusively educators) and can be applied in the following scenarios:

- DigComp can be adapted and applied to support policy or practice, to develop digital competence for a target population in a specific context.
- DigComp can be used to assess digital competence level, strengths and weaknesses of an individual or target population.
- DigComp can be used to support the development and digital competences of educators, trainers and teachers.
- DigComp can be used to design teaching and learning experiences for the individual learners to develop their digital competences.
- DigComp can be used to identify, assess and certify learning achievements and digital competence development.

DigComp has already started being incorporated by various regional education authorities in Europe to officially recognise digital literacy and digital skills. Further on it will be explained how the DigComp framework has been integrated in the autonomous community of Andalusia, Spain to recognise digital abilities among the local population.

What is DigComp 2.1?

DigComp 2.1 is the latest version of the DigComp framework launched in 2017. It is the furthest developed version of DigComp yet since its proposal in 2013 with its latest previous version having been launched in 2016. Based on its earlier version DigComp 2.0 (the very first DigComp version was DigComp 1.0), the reference framework programme now has 8 proficiency levels recognising a total of 21 competences in 5 key areas, also known as competence areas.

These five competence areas are grouped in DigComp's Dimension 1 and are as follows in the diagram below:

Within these five key areas or competence areas (1. Information and Data Literacy, 2. Communication and Collaboration, 3. Digital Content Creation, 4. Safety, 5. Problem-Solving)

DigComp recognises a series of individual digital skills (21 in total), from browsing the internet and filtering data to interacting through digital technologies, creating digital content and programming, to name a few.

What digital skills and competences does DigComp validate?

We've already established that DigComp recognises the level of knowledge, skills and attitudes necessary for citizens in 5 key areas, and we've illustrated these areas in the diagram above. In its first version DigComp had three proficiency levels but ever since its introduction in 2016, the framework has continued to evolve and now has 8 proficiency levels in each of its 5 key areas or subjects.

DigComp 2.1 recognises a total of 21 competences (dimension 2) grouped into the 5 different competence areas (dimension 1) with 8 proficiency levels (dimension 3) and examples of use (dimension 5) as illustrated in the table that follows on the next page. Unlike its predecessors, DigComp 2.1 does not include dimension 4 (knowledge, skills and attitudes).

Competence areas (dimension 1)	Competences (dimension 2)	Proficiency levels (dimension 3)	Examples of use (dimension 5)
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content 1.2 Evaluating data, information and digital content 1.3 Managing data, information and digital content	Eight proficiency levels for each of the 21 competences	Examples of use of the eight proficiency levels applied to learning and employment scenario in the 21 competences
2. Communication and collaboration	2.1 Interacting through digital technologies 2.2 Sharing through digital technologies 2.3 Engaging in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 2.6 Managing digital identity		
3. Digital content creation	3.1 Developing digital content 3.2 Integrating and re-elaborating digital content 3.3 Copyright and licences 3.4 Programming		
4. Safety	4.1 Protecting devices 4.2 Protecting personal data and privacy 4.3 Protecting health and well-being 4.4 Protecting the environment		
5. Problem solving	5.1 Solving technical problems 5.2 Identifying needs and technological responses 5.3 Creatively using digital technologies 5.4 Identifying digital competence gaps		

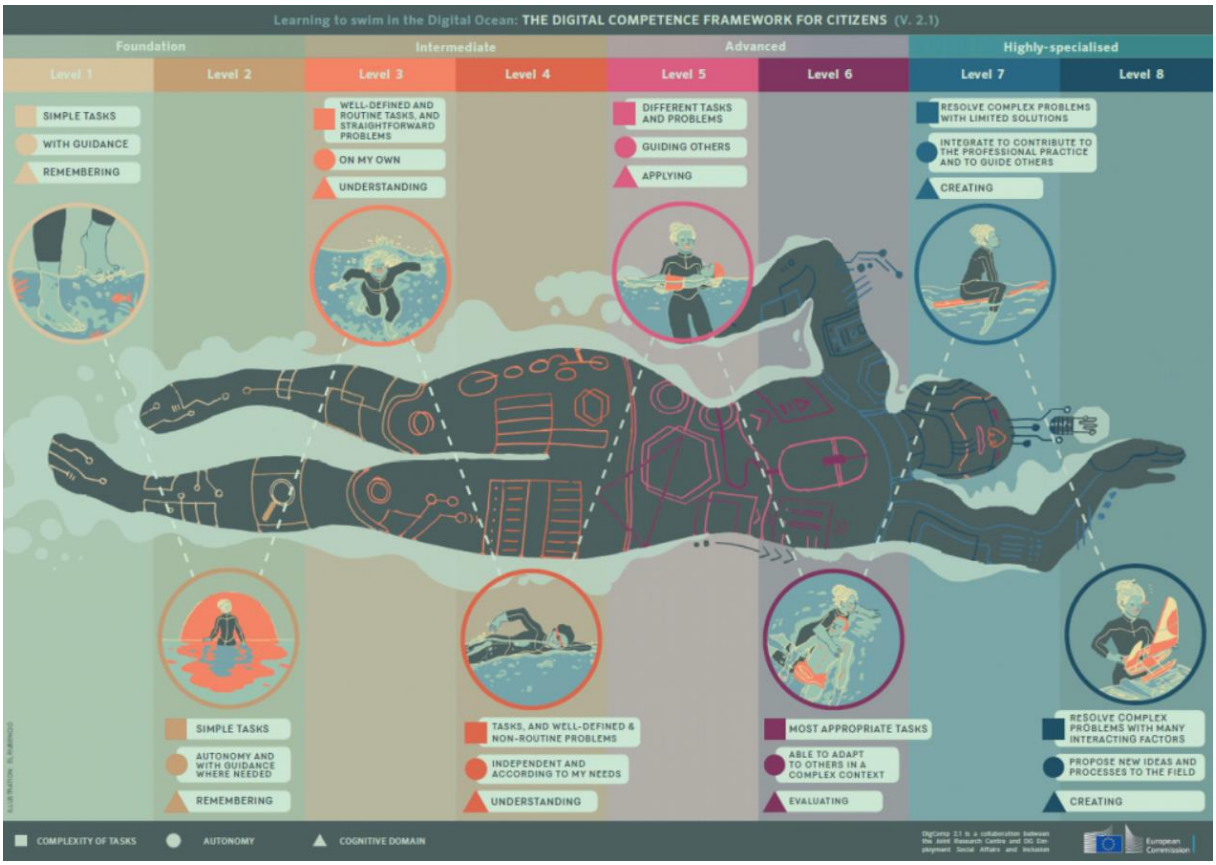
So, when it comes to what kind of digital skills specifically DigComp recognises and tests individuals do, they are the 21 digital competences listed in the above table's second column.

DigComp's 8 proficiency levels

To have their digital skills recognised in either of DigComp's 5 main competence areas and obtain a DigComp certification, individuals are required to perform a series of tasks through DigComp-certified online tests and will be ranked according to their degree of knowledge and ability in 8 proficiency levels. Depending on their level of digital skills in either of the 5 competence areas they will obtain a Foundation, Intermediate, Advanced or Highly Specialised certification. Moving from one level to the next will require a higher degree of understanding, applicability, evaluation and creative capacity. The following table, illustrates DigComp's 8 proficiency levels and what is required in each level.

Levels in DigComp 1.0	Levels in DigComp 2.1	Complexity of tasks	Autonomy	Cognitive domain
Foundation	1	Simple tasks	With guidance	Remembering
	2	Simple tasks	Autonomy and with guidance where needed	Remembering
Intermediate	3	Well-defined and routine tasks, and straightforward problems	On my own	Understanding
	4	Tasks, and well-defined and non-routine problems	Independent and according to my needs	Understanding
Advanced	5	Different tasks and problems	Guiding others	Applying
	6	Most appropriate tasks	Able to adapt to others in a complex context	Evaluating
Highly specialised	7	Resolve complex problems with limited solutions	Integrate to contribute to the professional practice and to guide others	Creating
	8	Resolve complex problems with many interacting factors	Propose new ideas and processes to the field	Creating

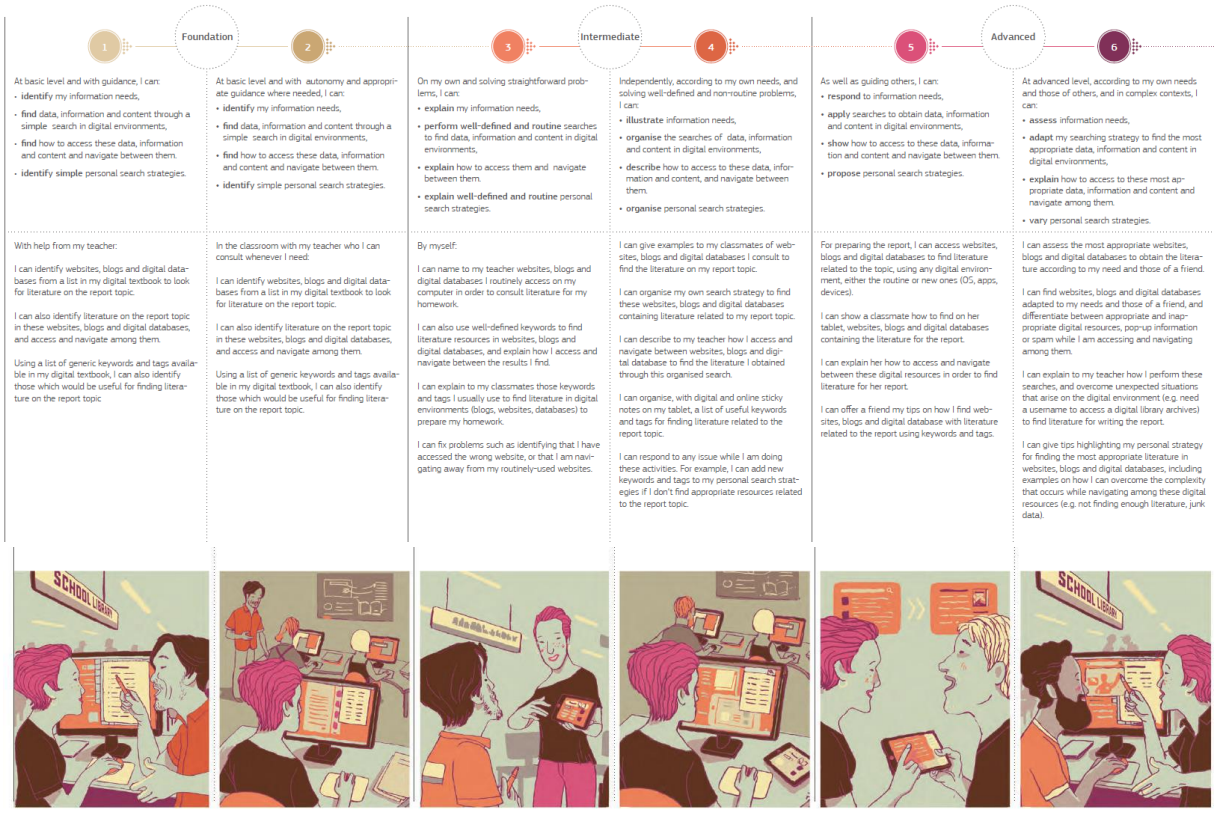
To better understand DigComp's 8 proficiency levels and how they work, they have created a helpful diagram, equating the acquisition of DigComp's competences with learning to swim in a digital sea. The visual graph, which we include here below, perfectly illustrates in simple terms how each proficiency level demonstrates different abilities and depth of knowledge, from remembering and understanding to applying, evaluating and creating.



Examples of use – putting DigComp into practice

Dimension 5 of the DigComp framework refers to contextualised scenarios for two main areas of use: employment and learning. These examples have been updated in DigComp 2.1 and also illustrate the 8 proficiency levels to help with the implementation of DigComp 21. in various learning and working scenarios. In the DigComp 2.1: The Digital Competence Framework for Citizens publication there are two illustrative examples, one example illustrating the use of DigComp in an office or work scenario and another exemplifying the use and application of DigComp in a learning environment. For the purposes of this report and

given the background of the Robotics 4.0 All project, we will include the example of the learning scenario only, illustrated below.



Higly Specialised

7

At highly specialised level, I can:

- **create solutions to complex problems with limited definition** that are related to browsing, searching and filtering of data, information and digital content.
- **integrate** my knowledge **to contribute to professional practice and knowledge and guide others** in browsing, searching and filtering data, information and digital content.

I can create a digital collaborative platform (blog, wiki, etc.) which can be used by other job seekers to browse and filter job portals and offers according to their job seeking needs

8

At the most advanced and specialised level, I can:

- **create solutions** to **solve complex problems with many interacting factors** that are related to browsing, searching and filtering data, information and digital content.
- **propose new** ideas and processes to the field.

I can create new apps or platforms for browsing, searching and filtering job portals and offers, according to job seekers' needs.

DigComp in real life / applying knowledge and proving digital skills

Ever since its launch in 2016, many independent organisations and education authorities in Europe have made use of the DigComp framework to recognise and validate the digitals skills of employees, students and citizens in general, at company level, school level, city level or national level. DigComp's flexibility means that it can adapt to a wide array of learning and working scenarios for the validation of its competences and DigComp certification can be obtained by any individual citizen through certified tests. DigComp tests may vary slightly in the way questions are formulated in tests but are very similar and follow strict guidelines as established by the JRC (Joint Research Centre, the European Commission's science and knowledge service) and obtaining the certification is free. However, some companies, regional or educational authorities or independent organisations may charge for offering the tests in order to get the certification (as is the case with Catalonia, which offers DigComp certified accreditation through an online self-assessment platform called ACTIC) or for offering specific training to tackle the test and be better prepared to pass a certain proficiency level.

DigComp in Spain

In Spain the formal introduction of DigComp by education authorities at government level has been spearheaded by the autonomous community of Andalusia, whose Department of Economy, Knowledge, Enterprise and University (*Consejería de Economía, Conocimiento, Empresas y Universidad)* working closely with JRC (which has headquarters in Seville, the capital of Andalusia) created an online platform that allows citizens to self-assess their digital skills through a series of online tests, at the end of which they can obtain DigComp 2.1 certification. Accredited by DigComp and fulfilling the European reference framework's requirements, the tests are based on DigComp's 21 competences in its 5 key areas. Thus, Andalusia became the first autonomous region in Spain to offer its citizens an online platform to test and validate their digital skills using the DigComp framework. The test is accessible by all citizens and offered completely free of charge. All they need to do is register on the platform and follow the online instructions.

DigComp in Andalusia – from individual citizens to schools

Andalusia's self-assessment platform for recognising digital skills under the DigComp framework is called *Plataforma de Autodiagnóstico and once users log in,* they're shown a panel clearly indicating the amount of questions (between 21 and 84), the time it will take the user to answer them (between 30 and 40 minutes) as well as indications about what will

happen at the end of the tests, explaining that users get a report with the level of their skills in each digital competence and personalised recommendations to improve their competences through selected training.

The platform can also be used by teachers who can adapt the tests (in terms of questions and levels) to offer them to students and allow them to validate acquired skills in class. This is what will happen with the selected students that have been chosen to receive the Robocamps sessions in Spain, at the end of the Robocamps they will take the test and obtain Level 3 or 4 in DigComp's Problem-Solving competence area. This would validate their digital problem-solving skills at secondary school level. Normally, tests at this level would be offered to students at the end of secondary school (in Year 10 or 4º de ESO), yet by doing the Robocamps they would be ahead of their classmates and accomplish this milestone sooner. The 14 students chosen for the Robocamps in Spain are all in Year 7 (the first year of secondary school) and aged between 12 and 13.

To self-assess the digital skills acquired during the Robocamps in DigComp's Problem-Solving area, the selected students from Spain would use the following options on the DigComp tests: Drag and Drop, Match, Sort and Simulate.

Teachers can also validate results on the platform without kids having to do the test if they consider that they have acquired and demonstrated the digital competences in the tests. They can also create special itineraries (the fourth box on the earlier image showing the self-assessment DigComp platform in Andalusia) to create specific learning content to adapt to the DigComp tests.

All students doing the Robocamps in Spain will do the DigComp online test at start and end of the Robocamps to see how they've advanced on their digital skills through their participation in the Robotics 4.0 All project and how they've moved from one proficiency level to the next. To this end, Andalucía Compromiso Digital (whose Technical Manager, Rafael Alcoholado Meana, also attended the C1 Training of Trainers activity in Bodo) has added to the LEGO MindstormsV3's scientific and technical training, an extra dimension in the five key areas that DigComp's framework contemplates. LEGO's scientific and technical part has been integrated following the Robotics 4.0 All's trainers' manual and curriculum with another competence dimension following DigComp's reference framework.

Andalusia's DigComp self-assessment online platform (http://www.digcomp.andaluciaesdigital.es/) has been developed in conjunction with the European Commission's Joint Research Centre (JRC) and Andalucía Compromiso Digital,

Inercia Digital's strategic collaborators in this project and an initiative by the Junta de Andalucía's - Andalusia´s government - to make the most of new technologies, help citizenship adapt to the new digital era and adapt the digital skills of the Andalusian population through free training programmes for all ages.

In order to develop DigComp's digital skills among students, teachers must have DigComp training. The European Commission regularly organises training courses in Brusses in 4 languages: English, Spanish, French and German. In order to attend these training, you must be employed by a public body. In order to be able to develop digital competences among kids, teenagers and adults you must complete the three course levels: basic, medium and advanced.

In light of COVID-19's consequences and the problems experienced when adapting classes to an online digital format all teachers in public schools in Andalusia will have to measure and update their digital skills.

Official recognition of ROBOTICS 4.0 ALL's Curricula Robocamps in a Spanish school

The Robocamps in Spain started in the last week of February 2020 (before being interrupted in March due to the COVID-19 lockdown) and were offered to a total of 14 students from Year 7 aged between 12 and 13. The students were selected on the criteria of showing good disposition for advancing their knowledge and taking on the LEGO Mindstorms challenge, having advanced Maths skills for their age (all selected students are considered advantaged, gifted or talented) and obtaining good grades in science subjects. All 14 students will complete the Robocamps training once its resumed in September (when schools in Spain open again) and out of these 14 kids, eight of them will be selected to participate on the Robotics 4.0 All tournament in Greece based on their attitude during the Robocamps, teamwork skills, participation and efforts to improve their English ahead of the trip.

The secondary school that carries out the Robotics 4.0 All Robocamps in Spain is IES Guadaiza from the town of San Pedro Alcántara in Malaga. The Robocamps teacher, Olga, participated in the project's Training of Trainers activity in Bodo and has **adapted the Robocamps curriculum for their integration next year in the school's official curriculum**. Therefore, the school plans to incorporate Robotics 4.0 All's Robocamps and curriculum into their formal lessons as part of one of their elective subjects in Year 7.

In Spain's secondary school system, in Year 7, there are two hours a week called "free provision hours" in which students can select from a variety of elective complementary

subjects to enhance their knowledge in the areas of their choice or receive extra help in subjects they struggling with. In the case of the school doing the Robotics 4.0 All Robocamps in Spain the elective lessons are as follows: three rotational workshops (Chess, Greco-Roman Legacy and Reading Club), Revision classes for those who need extra help in the subjects of Maths and Spanish and a new PEC programme (Curricular Enrichment Programme) which is currently in development (a novelty this year) and where the Robocamps are being included and currently being offered during these two “free choice” weekly hours.

Starting next year, the plan is to expand the PEC programme to offer the LEGO Mindstorms Robocamps in Year 7, Astronomy in Year 8 and Economics for Life in Year 9. In this way, we can see how Robotics 4.0 All´s curriculum will be officially included in this school´s educational offer and afterwards, Inercia Digital working closely with Andalucía Compromiso Digital plan to and extend its impact via seminars for teachers all around Andalusia so that many other schools can do the same or even include Robotics 4.0 All´s curriculum within subjects like Technology or Applied Technology. Of course, their integration into schools’ educational offer will heavily depend on each school’s ability to purchase LEGO Mindstorms kits, which is ultimately the biggest barrier to the Robocamps’ integration in public schools in Spain which often lack funding for even core or basic needs let alone extras.

DigComp and the European Qualifications Framework (EQF)

Furthermore, the DigComp framework can be matched to the European Qualifications Framework (EQF) and the Robotics 4.0 All curriculum would validate EQF levels 2 and 3. DigComp’s digital skills proficiency level reaches up to EQF level 4 equivalent.

The European Qualifications Framework is a translation tool that helps standardise and homogenise formal, informal and vocational qualifications across EU member countries to better understand and compare qualifications awarded by different education authorities across members states as well as different training systems to allow for the better mobility of EU workers and learners and, at the same time, foster lifelong learning. It was officially adopted by the European Parliament and Council in April 2018 and has 8 levels described in terms of knowledge, competences and skills. Since 2012, all new qualifications issued in Europe carry a reference to an appropriate EQF level.

BULGARIA

Description of mechanisms for assessment, validation and recognition of learning outcomes in the perspective of the ECVET system

1. SUMMARY DESCRIPTION

The national NQFs relate their qualification levels to the levels set out in the EQF. This helps to improve the transparency and recognition of qualifications in Europe; supports the mobility of learners and workers; encourages the achievement of unified training quality criteria; and facilitates the validation and transfer of non-formal and informal learning outcomes.

The NQF of Bulgaria encompasses the whole education system and all its qualifications. It includes nine levels, including level zero (preparatory level). Levels 1 to 4 correspond to the stages of education and qualification acquisition within the systems of general and vocational education and training. Level 5 includes training at a vocational college for acquisition of the fourth level of vocational qualification after the completion of secondary education. Levels 6 to 8 relate to qualifications acquired in the higher education system: 'bachelor's', 'master's' and 'doctorate'. The separate levels are defined on the basis of a learning outcomes-oriented approach. They are described in terms of knowledge (theoretical and/or practical) and competences (personal and professional).

Following a government decision, the Ministry of Education, Youth and Science has been designated as the competent body for supporting and updating the NQF.

The overall objective of developing and introducing a comprehensive national qualifications framework (NQF) compatible with the European qualifications framework (EQF) and the QF-EHEA is to make Bulgarian education system levels clearer and easier to understand by describing them in terms of learning outcomes. This will also improve understanding of national qualifications among target groups and stakeholders. It is hoped that this will raise trust in education and training and make mobility and recognition of qualifications easier.

More specific aims addressed by BQF development are to:

(a) develop a device with translation and bridging functions;

(b) promote mobility within education and in the labour market;

(c) promote learning-outcomes orientation of qualifications;

(d) support validation of prior learning, including non-formal and informal learning;

(e) strengthen orientation towards a lifelong learning approach;

(f) increase cooperation between stakeholders

Apart from offering transparency, the BQF is seen as an enabler – rather than a driver – of wider reform, with implications for setting up a system for validating non-formal learning, improving education quality, modernising curricula and strengthening provider accountability.

Levels and use of learning outcomes

The BQF comprises eight levels and an additional preparatory level (BQF level 'zero', covering pre-school education). Level descriptors take into account EQF and QF-EHEA descriptors. All levels are described in terms of knowledge (theoretical and factual), skills described as cognitive (use of logical and creative thinking) and practical (manual dexterity and use of methods, materials, tools and instruments), and competences. Descriptors distinguish between personal and professional competences. They include autonomy and responsibility, and key elements such as learning competences, communicative and social competences are also emphasised. Learning-outcomes-based qualification levels are expected to give learning outcomes a more prominent role in planning education provision. This is especially the case for development of VET standards divided into units of learning outcomes.

Specified learning outcomes at the qualification levels reflect the legal acts governing different subsystems of education and training, as well as State education requirements for contents and expected learning outcomes in the national education system (general and VET) and in higher education.

The national strategy for lifelong learning for the period 2008-13 (5) does not only provide definition of the term 'learning outcomes'; one of its priorities (along with vocational training, key competences and recognition of qualifications) is 'assessment of learning outcomes'. Learning outcomes (in Bulgarian, резултати от учене) are defined as 'acquired knowledge and skills as a result of formal, non-formal and independent (informal) learning' (6). In January 2014, the Council of Ministers adopted the new national strategy for lifelong learning (for 2014-20) (7) which addresses the challenges in all forms of education, training and learning – formal, non-formal, independent [informal] –which an individual could undertake throughout his life. The new national strategy for lifelong learning, like the previous one, provides explanation of the phrase 'learning outcomes' and contains a definition of the term 'Learning outcome units' (in Bulgarian: единици учебни резултати) (8), which is understood as 'a component of qualification, consisting of coherent set of knowledge, skills and competences, which could be assessed and validated through a certain number of credit points, linked to them' (9). As a whole, the term 'learning outcomes' is widely used in the strategy.

Although the phrase 'learning outcomes' is not so widespread in policy documents on general education, it is used or referred to in national curriculum, assessment and examination documents, particularly in State educational requirements. However, an action plan for implementing the approach has not been adopted nor discussed in the country. The current position in the various subsystems shows that implementation of the approach has continued in the new State educational standards adopted after the new law on pre-school and school education entered into force. It is also in the new State educational requirements on acquisition of higher education in regulated professions, adopted after the BQF entered into force.

Two bills amending the law on VET introduce the term and propose a legal definition of it. State educational standards (10) and examination programmes, especially those for acquiring vocational qualification, have been updated (or new ones developed), to describe or to refer to learning outcomes. This update is a prerequisite for implementing the validation procedure and awarding of credits.

Higher education institutions are autonomous and responsible for developing curriculum, assessment and examination rules, and some have learning outcomes within study programmes, so implementation differs from one institution to another. The New Bulgarian University is an example of an institution using learning outcomes in its study programmes (11). The Burgas Free University also uses learning outcomes in some of its master programme courses (12). However, there is no systematic approach for implementing a learning outcome approach in higher education. According to a recent Cedefop study (13), the law on higher education in Bulgaria (14) which governs accreditation of universities, does not stress the importance of learning outcomes for the accreditation process.

Stakeholder involvement and institutional arrangements

The Ministry of Education and Science of the Republic of Bulgaria coordinated and led drafting of the BQF and is now coordinating its implementation. National coordination point (NCP) responsibilities lie with the International and European Cooperation Directorate in this ministry. All staff are on permanent contracts as State officials. A new working group will be set up in near future, to prepare amendments to the BQF at secondary education levels. Responsible for maintaining and updating the BQF, the group will comprise representatives of the Ministry of Education and Science along with other relevant stakeholders, including social partners and employer and employee organisations. Although there is active participation by stakeholders in elaborating the new draft projects of State educational standards and

requirements, there is a need for stronger cooperation and sufficient experience (in methods of cooperation) among them.

The National Agency for Vocational Education and Training (NAVET) management board, as well as experts at NAVET, are permanently involved in developing and updating the list of qualifications for VET, which is integrated in BQF.

2. METHODOLOGY AND FLOW

Bulgaria does not have an overall national strategy or policy on validation of non-formal learning to encompass all educational sectors. Other grassroots initiatives have been either recently launched, are little known or still do not have results. It was only in 2014 that the VET Act was amended aiming to introduce the legislative basis for validation of prior learning in VET and 2015 that the ordinance on the conditions for validation entered into force. (16) VET Act (as amended) defines validation as the establishment of equivalence between vocational knowledge, skills and competences (acquired through non-formal or informal learning), with State Educational Requirements (SER) related to a specific professional qualification (Art.40, SG No.61/2014). SERs specify the learning outcomes necessary for the acquisition of a vocational qualification. Validation is a visible part of national learning strategies particularly in relation to lifelong learning. For example, the National Strategy for Lifelong Learning (2014-2020) foresees the introduction of a system for validation of knowledge, skills, and competences attained through non-formal training and informal learning until 2018. In addition, the National Strategy for the Development of VET for the period 2015-2020 defines validation as a priority axis in the context of lifelong learning. The National Strategy for Lifelong Learning (2014-2020) defines validation as a 'process of confirmation by an authorised body that a certain person has achieved learning outcomes measured vis-à-vis the educational and professional standards and the assessment standards'.

Ordinance No. 2 regulates monitoring (supervision) of validation procedures. According to the Ordinance, monitoring is carried out externally by: 1) regional inspectorates of education – they monitor the following validation institutions: vocational secondary schools, vocational schools, art schools, sports schools, vocational colleges; and, 2) the National Agency for VET (NAVET), which monitors the vocational training centres that are licensed by NAVET. Alongside external monitoring, the institution in charge of validation shall have in place internal quality assurance mechanisms (for example, compliance with qualification requirements for assessors).

In Bulgaria, a so-called Register of experts on validation willing to assist the vocational training centres in the validation procedure was developed. The register includes more than 500 experts according to regions and professions. The experts include both teachers and social partners, who have passed a specific training within the project 'New opportunity for my future". Procedures were developed through the project System for validation of non-formal acquired knowledge, skills and competences (2013-15): new opportunity for my future implemented by the Ministry of Education and Science in cooperation with the National Agency for Vocational Education and Training, other relevant ministries and social partners (17). National employers' organisations (such as the Bulgarian Industrial Association, Bulgarian Chamber of Commerce and Industry, and the Bulgarian Industrial Capital Association) and employees' organisations (the Confederation of Independent Trade Unions in Bulgaria and Confederation of Labour, Podkrepa) were partners in this project. They contributed to developing internal quality assurance mechanisms related to assessing evidence of previous learning. In the project a 'Manual for vocational schools for validating non-formal and informal learning' has been developed.4 The manual provides methodological guidelines and instruments (e.g. comparative tables) for the assessment of equivalence between competences declared by a candidate and competences defined for a specific vocational qualification (or part of one) in the corresponding State Educational Requirement (SER).

The main goals of the project include:

- creating and testing a system for identification and recognition of informally acquired knowledge, skills and competences;
- enhancing employability through increasing the opportunities for acquisition of vocational qualifications;
- developing legislation regarding the process of identification and recognition of knowledge, skills and competencies acquired through non-formal training and informal learning;
- issuing certificates to persons who have acquired their knowledge, skills and competences though non-formal or informal learning; and,
- promoting the validation of non-formal and informal knowledge, skills and competences in Bulgaria.

The project was linked to the formal education system, e.g.: candidates have the possibility to acquire a certificate for validation of vocational qualification or a certificate for validation of vocational competences (part of qualification) whereby these certificates have the same value as certificates acquired through the formal education system.

Adoption of the BQF, presenting detailed descriptions of learning outcomes in line with State educational requirements (SER) (18), will promote possibilities to implement validation of non-formal and informal learning. Through the update of the SERs, Bulgaria is gradually introducing the learning outcomes approach in curricula and assessment. The use of (units of) learning outcomes supports validation of non-formal and informal learning so validation practitioners may have to take specialised training on learning-outcomes-based assessment and may have to rewrite (and update) the SERs by professions.

In VET, where validation is currently possible, SER are the standards used; in higher education, institutions are autonomous and have their own standards for validation and recognition. These should be in line with the SER on acquisition of higher education at bachelor, master and professional bachelor degree levels; they should also feature on the SER of university education acquired in foreign higher education institutions, and of periods of studies completed at such establishments Some aspects of validation (such as awarding credit units and access to higher education) are covered by the Higher Education Act, although validation practices are not broadly used.

Bulgaria has no overall quality assurance framework for validating formal and non-formal learning. In 2015, Ordinance No 01-845 for quality assurance in VET was adopted (19): in this established rules, requirements and quality assurance criteria for VET provider activities (including validation) are described. The New opportunity for my future project has made a valuable contribution to the development of internal quality assurance measures. Special training has been provided to validation practitioners to aid their ability to compare learning outcomes acquired through non-formal or informal learning with learning outcomes defined for certain vocational qualifications.

According to the Law on Pre-school and School education, a person of compulsory school age who is seeking or has received the status of a refugee (under the Geneva convention) can validate competences for a completed period of schooling, class or stage of primary education or for a completed class from the first stage, or first stage of secondary education, where it is not possible to present the relevant documentation (Art. 166, para 6 SG no. 79/2015).

NQF implementation

Although in Bulgaria there is no uniform legal framework for validation encompassing all educational sectors, validation is covered in the Law on Pre-school and School Education, VETA and the 'Ordinance No. 2 on the conditions and procedures for the Validation of professional knowledge, skills and competences'.

One of the main priorities of the National Strategy for Lifelong Learning (2014-2020) is to introduce a learning outcomes validation system in order to ensure equality of formal education and training, non-formal training, and informal learning. Furthermore, the National Strategy for the Development of VET (2015-2020) defines, as a priority, the building up of a system of validation of knowledge, skills and competences acquired through non-formal and informal learning.

Validation is seen as supporting policy goals e.g. in accordance with the Council Recommendation on the validation of non-formal and informal learning of 20 December 2012, the National Strategy for Lifelong Learning for the period 2014-2020 foresees the introduction of a system for validation of knowledge, skills, and competences attained through non-formal training and informal learning until 2018. Furthermore, validation will be a key factor for attracting new social groups, which currently have a very low level of participation in lifelong learning (for example, persons without education and qualification). (Information provided by NAVET)

The VET Act (art.40) defines validation process, requirements for educational level of citizens, the type of the certificates issued and determines institutions providing validation. According to the VET Act, candidates have to successfully pass the exams in theory of the profession and practice of the profession in order to obtain certificates for vocational qualification (or part of it) (SG 96/2014). The main difference compared to obtaining an ordinary diploma is that candidates do not need to attend classes from the formal education system (e.g. VET study programmes). Furthermore, the certificates issued by validation have a specific title e.g. 'Certificate for validation of vocational qualification' or 'Certificate for validation of vocational competences' (part of profession) (Art.40, SG 61/2014) and describe validated competences.5 In comparison, the certificate obtained through formal education describes subjects and has another title.6

According to 'Ordinance No. 2', validation includes two main stages, e.g.: a) identification of professional knowledge, skills and competences acquired by a candidate; and, b) recognition of professional qualification degree or partial professional qualification (Art.6, SG No.96/2014). These stages are more broadly defined compared to the definition used in the EU Recommendation of 2012: the Recommendation defines four stages, including identifying, documenting, assessing and certifying skills and competences. Nevertheless, the components of the EU definition are integrated within the Bulgarian one. For example, the first stage (identification of professional knowledge, skills and competences acquired by a candidate) corresponds to the stage of 'identifying', as defined in the EU Recommendation.

This stage includes the following sub-stages:

1. Determination of the professional field and profession (according to the list of professions for vocational education and training) on which the person wishes to validate his/her professional knowledge, skills and competencies;

2. Preliminary comparison of the declared professional knowledge, skills and competencies with the learning outcomes included in the State Educational Requirement (SER) of the selected profession. The comparison covers:

– analysis of the evidences collected and submitted by the person (collection of evidences relates to the stage of documenting as defined in the EU Recommendation)

– verification of the declared professional knowledge, skills and competencies for which he/she cannot present evidence or the evidence does not correspond to the learning outcomes in the SER;

3. Guidance to additional training in the case of disparity between the professional knowledge, skills and competencies declared by the person and the learning outcomes in the SER;

4. Verification of the acquired professional knowledge, skills and competencies after completed additional training; it is made sure that the missing professional knowledge, skills and competencies have been acquired. This can be based on the certificate obtained by the training institution delivering the additional training.

5. Examinations pursuant to Art. 36 and 37 of the VETA (this stage corresponds to assessing in the EU Recommendation):

– state exams in theory and practice of the profession for the recognition of vocational qualification degree;

– examinations in theory and practice of the profession for the recognition of professional qualification for a part of a profession.

The second stage (recognition of professional qualification degree or partial professional qualification) corresponds to the stage of 'certifying' as defined in the EU Recommendation.

Both stages are consecutive and individuals can take advantage of them in combination. At any moment and according to his/her will, a candidate can suspend the validation procedure; in order to re-start it he/she has to submit a new application at the institution performing validation.

At this stage in Bulgaria there are no labour market validation arrangements included in collective labour agreements.

There is no legislation and there are no collective labour agreements related to skills audits. Nevertheless, the Public Employment Agency has put in place measures that are similar to

skills audits, such as career guidance (provided as a mainstream service), and elaboration of individual plans (within specific projects/programmes). The Information Consultancy Units of the Public Employment Agency provide career orientation to all citizens. This includes initial consultation, facilitation, and matching of skills and competences of jobseekers with the requirements of current job vacancies. Additionally, information on retraining options is provided. Particularly in relation to unemployed persons, including those from disadvantaged groups, 'labour mediators' working in the local labour offices elaborate an individual action plan, which describes the steps, both for the person and for the mediator, to be undertaken towards job placement and/or training enrolment. The action plan determines the relevant measures and services (e.g. vocational guidance, improving of employability, job search services) that apply for the person. The elaboration of the plan is facilitated through an individual profile, which is drawn up based on a person's individual needs. Skills are possibly identified through the preparation of the individual profile. There are examples of collaboration between private sector organisations and formal educational institutions, e.g. vocational training centres (90 % of the vocational training centres are private organisations) carrying out validation procedures can be supported by VET teachers (acting as consultants) who are experienced (Experienced' means that teachers have participated in training for validation practitioners and have experience in carrying out validation procedures) in validation issues.

Currently there is no system for the recognition of skills and competences acquired by volunteers. The main difficulties with regard to recognising skills and competences acquired by volunteers relate to limited popularity in the society. For example, the Youthpass certificate is still not known as a document reflecting the informal learning and knowledge of young people acquired under European youth projects. In this context, the National Youth Strategy 2012-2020 foresees the introduction of a 'voluntary license' as an official document certifying the circumstances related to volunteering for young people. There is no information available regarding the progress towards this objective. A recent initiative is the creation of an online platform, 'Time heroes', with the support of the private sector e.g. several companies have signed a declaration that they recognise and appreciate volunteering as experience. (Information based on an interview)

Links to national qualification systems

The Bulgarian national qualifications framework (NQF) for lifelong learning (BQF) was officially adopted by the Council of Ministers in the beginning of 2012. The referencing report was

adopted by the Minister for Education and science in March 2014. BQF is one of the main documents used in the development of new and the update of old SERs. According to the referencing report, one of the aims of the BQF is to facilitate the validation and recognition of prior learning including non-formal and informal learning and work-place training (MES 2013:13). At this stage of development, the BQF is restricted to qualifications from the formal education and training system.

The BQF is structured according to learning outcomes, described as knowledge, skills and competences for each qualification level. It is based on the detailed descriptions of the content and expected learning outcomes defined in the SERs. The description of expected learning outcomes in SERs can facilitate validation procedures, particularly at the stage of assessment (MES 2013:91). Bulgaria has implemented the European Credit Transfer System (ECTS) since 2004 and is on track to implement the European Credit System in Vocational Education and Training (ECVET) as a part of the implementation of the National Lifelong Learning Strategy. The credit transfer and accumulation were introduced in the VET system with amendments of the VET Act in July 2014 (art.32e). The National Agency for VET (NAVET) is the National Coordination point on ECVET. Its activity is supported by the National expert group for coordination of the activities related to the introduction of ECVET in the national VET system. A part of the work of the expert group is to explore best practices related to testing and deployment of the European system of credit transfer in VET as well as establish contact with international projects teams related to the testing of ECVET. The formulation of 'units of learning outcomes' in the SERs by professions is a prerequisite for implementing the procedure of validation and awarding of credits both in training (or validation) leading to the acquisition of a vocational qualification degree or professional qualification for a part of profession.

Standards

In Bulgaria there are State Educational Requirements (SERs) used in formal education and training and they are the same as the requirements that support the delivery of validation. Assessment and evaluation standards defined in SERs apply also to validation arrangements and are used in the same way. In cases where for a certain profession there is no SER for obtaining a vocational qualification, the curriculum for the respective profession (approved by the Minister of Education) should be applied. The term 'State educational requirements' is changed with the Preschool and school education act (2015) into the 'State Educational standards'. The term will be changed in VETA also, but SER is still in use.

Organisations and institutions involved in validation arrangements and its coordination

According to the VETA, organisations and institutions involved in validation arrangements and its coordination include:

- Ministry of Education and Science – prepares draft laws on validation procedures, develops guidelines, monitors and provides quality assurance of the validation system;
- Vocational secondary schools, vocational schools, art schools, sports schools, vocational colleges as well as vocational training centres (licensed by the National Agency VET) - provide validation procedures;
- Regional inspectorates of education (which are under the Ministry of Education and Science) – monitor validation procedures in vocational secondary schools, vocational schools, art schools, sports schools, vocational colleges;
- National Agency for VET – provides support to the vocational training centres, monitors and controls the process of validation in the centres;
- Ministry of Labour and Social Policy and the Public Employment Service – raises awareness and organises information campaigns;
- Employers' organisations – raise awareness among employers regarding 'validation' opportunities and inform their members regarding opportunities and requirements to validate their non-formal or informal acquired knowledge skills and competences;
- Trade unions – inform their members regarding opportunities and requirements to validate their non-formal or informal acquired knowledge skills and competences.

Quality assurance

In Bulgaria, there is no overall quality assurance framework for the validation of formal and non-formal learning. In 2015, Ordinance No. 4 for quality assurance in VET was adopted. There are established rules, requirements and quality assurance criteria regarding all VET providers' activities (incl. validation).

In relation to VET, the stakeholders involved in developing/delivering quality assurance are the regional inspectorates and the National Agency for VET (Art.20-22, SG 96/2014). The regional inspectorates are responsible for monitoring of validation procedures at vocational schools and colleges and NAVET for monitoring at vocational training centres. Both the regional inspectorates and NAVET provide consultation and guidance to validation institutions including methodological and legal documents related to validation as well as examples of good practice. In addition, validation institutions develop internal quality assurance measures,

for instance the qualification requirements for individual consultants and assessors (e.g. they should meet the criteria for teachers specified in the SER of the vocation, for which validation is carried out), the possibility of external professionals to be among the assessors.

The 'New opportunity for my future' project has made a valuable contribution to the development of internal quality assurance measures – special training has been provided to validation practitioners in order to enhance their ability to compare learning outcomes acquired through non-formal or informal learning with learning outcomes defined for certain vocational qualifications. The involvement of representatives of employer and employee organisations in the training should be seen as a step to increase the willingness among stakeholders to participate in validation procedures. The project has developed a 'Manual for vocational schools for validating non-formal and informal learning'. The manual provides methodological guidelines and instruments (e.g. comparative tables) for the assessment of equivalence between competences declared by a candidate and competences defined for a specific vocational qualification (or part of one) in the corresponding State Educational Requirement.

Evidence of benefits to individuals

According to stakeholders some of the main benefits of validation arrangements relate to the following (Information provided by NAVET).

- Due to the structural changes in the labour market (and in the economy) in the last 20 years, many Bulgarians have jobs that are not relevant to their secondary or higher education. They mainly acquired competences necessary for the job on the workplace. Therefore, validation provides an opportunity to recognise these competences.
- Validation facilitates employability, e.g. it is the fastest way for individuals to receive evidence for their competences acquired through non-formal and informal learning. Furthermore, people find it easier to apply for a job when they have a certificate.
- Validation in Bulgaria is important for companies in some specific fields, such as construction and tourism where there are legal requirements for the qualification of the people working in these companies.
- Validation can prevent 'unnecessary learning' and in the case of further training it can shorten the time spent in formal education, also it will reduce costs for individuals and the state.

Information on benefits to individuals is available for the 'New opportunities for my future project' - by the end of 2014 around 13 000 people were consulted about the possibilities of

validation and 3 600 of those who started a validation procedure acquired a vocational qualification. (Information provided by NAVET)

Validation methods

The portfolio method was widely used as a supporting validation instrument within the 'New opportunities for my future' project. This method is also defined in Ordinance No. 2: the portfolio is a set of documents, artefacts, photos, projects, etc., presented by the candidate as well as those created in the course of the validation process to demonstrated professional knowledge, skills and competences of a vocational qualification (or part of it) acquired through non-formal and informal learning (SG 96/2014). In relation to assessment and certification, examination is an obligatory method used for validation purposes; e.g. in order to obtain certificates for vocational qualification (or part of it) candidates have to successfully pass the exams in theory of the profession and practice of the profession (SG 96/2014).

As mentioned earlier, for each person who has applied for a validation procedure an individual consultant is allocated who considers the specific needs of the candidate and supports him/her throughout the validation process. The consultant is responsible for the preparation, completion and delivery of the candidate's portfolio and personal information in the archives of the validation institution, as well as the preparation and registration of the certificates following a successful validation procedure [Art. 11 (4), SG 96/201].

The methods, in particular, the portfolio method and the exams in theory of the profession and practice of the profession are stipulated in Ordinance No. 2. The evidence used in the portfolio may differ according to the characteristics of the way learning has taken place; they can include a labour experience book, social security book, document for educational level, attestations, references, certificates of previous vocational training, artefacts and photos of artefacts. (Information provided by NAVET.) Furthermore, the setting of the practical examination may vary depending on the vocational qualification ('cook' or 'computer operator').

There are no nationally or regionally standardised tools for validation. Nevertheless, there is a project-based example, mentioned in the 2014 inventory report and more extensively described in the 2014 case study. The example refers to the Leonardo da Vinci project 'Validation of self-acquired learning and credits transfer in web design and computer animation' (CREATE). It uses ICT based assessment methods in order to prepare candidates for validation procedures. However, ICT based assessment methods are not used in validation procedures as such.

Important lessons and future plans

The NQF aims to increase transparency in education and training and aid knowledge and skills transfer, improving labour force mobility. Level descriptors defined in learning outcomes aim to provide a reference point and common language for diverse qualifications from different education subsystems. By referring to educational levels and State educational requirements, the BQF has been given a strong input orientation. It is expected, however, that learning-outcomes-based level descriptors will play an important role in supporting dialogue and that discussion among stakeholders will strengthen the learning- outcomes dimension in qualifications design.

The framework can play an important role, but only if it is part of a wider strategic policy resulting in necessary reform and institutional regulations. The recently adopted Pre-school and School Education Bill, the Higher Education Act and amendments to the VET Act will feed into these developments.

Although it is an explicit aim of BQF work to strengthen orientation towards a lifelong learning approach, it remains a challenge that lifelong learning aspects are inadequately focused. There is little information so far on system flexibility and the conditions and role of the framework for promoting lifelong learning and supporting access, progression and adult participation.

Future plans include necessary legislative changes, modernisation of curricula in schools and higher education, and promotional activities. Implementing the BQF at institutional level is seen as a major challenge, particularly by higher education institutions. To support this development, a string of capacity building seminars were held in late 2015.

Stakeholders (including State institutions) in some economic sectors have recently started discussions regarding all sectoral qualifications on levels 2 to 7 from BQF: labour market needs, current possibilities, horizontal and vertical permeability (IT, machinery, transport). This might be perceived as a step towards development of a sectoral qualifications framework.

ESTONIA

Framework of templates from the Government's qualifications system

1. National robotics competences exists in Estonia. Closest national evaluation method is Occupatioal Qualification Standards: Mechatronic, level 5.

ESF programm "Kutsete süsteemi arendamine"

OCCUPATIONAL QUALIFICATION STANDARD

Mechatronic, level 5

Kutsestandard on dokument, milles kirjeldatakse tööd ning töö edukaks tegemiseks vajalike oskuste, teadmiste ja hoiakute kogumit ehk kompetentsusnõudeid.

Mehhatroonik-tehniku 5. taseme kutsestandard on aluseks kutsehariduse jätkuõppekavadele, täiskasvanute täiendusõppe õppekavadele ja isikute kutsealase kompetentsuse hindamisele.

Occupational title	Level of Estonian Qualifications Framework (EstQF)
Mechatronic, level 5	5

Part A
DESCRIPTION OF WORK

A.1 Description of work
Mehhatroonika on mehaanika-, elektroonika- ja infotehnoloogiasüsteemide samasuunalist koostoimet käsitlev tehnikavaldkond. Mehhatroonik on oskustööline, kes töötab mehhatroonika-, automaatika-, aparaaditööstuse või elektroonika valdkonna ettevõttes. Tema peamine tööülesanne on mehhatrooniliste seadmete ja süsteemide koostamine, kasutamine ja testimine, kindlustamaks nende tõrgeteta toimimise. Ta häälestab tööjuhendi alusel mehhatroonilisi süsteeme, kasutades selleks sobivaid kontroll- ja mõõtevahendeid. Oma tööülesannete täitmisel juhindub mehhatroonik etteantud tööjuhendist, tehnilistest ja normdokumentidest ning kvaliteedinõuetest. 5. taseme mehhatroonik-tehnik töötab iseseisvalt või meeskonnas, juhtides mehhatroonika projektide teostamist ning vastutades meeskonna töö tulemuste eest. Ta valib ja rakendab uute lahenduste leidmiseks erinevaid tehnoloogiaid ja meetodeid, võttes seejuures arvesse energiatõhususe, säästlikkuse ja keskkonnahoiu põhimõtteid. Mehhatroonik-tehniku töö eeldab lisaks kutsespetsiifilistele tegevustele ka meeskonna juhendamist, klientide nõustamist, ressursside jaotamist ja tööde delegeerimist ning koostööd elektrikute, automaatikute, tehnoloogide, IT- jm sidusvaldkondade spetsialistidega.
A.2 Tasks
A.2.1 Mehhatroonikasüsteemide koostamine ja paigaldamine 2.1.1 Mehhatroonikasüsteemi komponentide ja lülituste koostamine, paigaldamine ja demonteerimine. 2.1.2 Mehhatroonikasüsteemide koostamine, paigaldamine ja demonteerimine. 2.1.3 Tööde dokumenteerimine, kasutusjuhendite ja teostusjooniste koostamine. 2.1.4 Tööde kvaliteedi hindamine. A.2.2 Mehhatroonikaseadmete ja -süsteemide käit 2.2.1 Elektriliste ja mitteelektriliste suuruste mõõtmine. 2.2.2 Seadmete seire.

This document describes job and skills needed to successfully do the tasks within the job. Mechatronics is a study on the parallel interaction of mechanical, electronic and information technology systems. A mechatronics is a skilled worker who works in the mechatronics, automation, apparatus industry or electronics company in the field. His main task is to design mechatronic equipment and systems, use and test to ensure their smooth operation. He tunes the mechatronics according to the work instructions systems using appropriate means of control and measurement. In performing his duties, the mechatronics is guided by the given work instructions, technical and normative documents, and quality requirements.

Level 5 mechatronics technician works independently or in a team, managing the implementation of mechatronics projects; and is responsible for the results of the team work. He selects and applies different technologies to find new solutions and methods, taking into account the principles of energy efficiency, sustainability and environmental protection. The work of a mechatronics technician requires not only profession-specific activities but also team supervision and clients consulting, allocation of resources and delegation of work, and cooperation with specialists in electricians, automation, technologists, IT and other related fields.

2. Very intresting finding: Robotic Technician Qualification, level 5:

Kutsekoda

OCCUPATIONAL QUALIFICATION STANDARD

Robotic Technician, level 5

Kutsestandard on dokument, milles kirjeldatakse tööd ning töö edukaks tegemiseks vajalike oskuste, teadmiste ja hoiakute kogumit ehk kompetentsusnõudeid. Kutsestandardeid kasutatakse õppekavade koostamiseks ja kutse andmiseks.

Occupational title	Level of Estonian Qualifications Framework (EstQF)
Robotic Technician, level 5	5

Part A
DESCRIPTION OF WORK

A.1 Description of work
Robotitehnik, tase 5 töö on tagada robotite tehniline korrasolek, oskuslik kasutamine ja ohutus. Robotitehnik, tase 5 käsitseb ja häälestab tööstuse (nt masina-, keemia-, elektroonika-, toiduainetetööstus) ja logistika valdkondade roboteid ja -süsteeme (edaspidi robotisüsteeme) info- ja kommunikatsioonitehnoloogia (IKT) jt tehnoloogilisi lahendusi kasutades. Tööülesanded hõlmavad kommunikatsioonitehnika ja tehnovõrkude paigaldamist, ajami- ja andurtehnikatöid, robotisüsteemide töö jälgimist, käitamist ja hooldust ning programmeerimist. 5. taseme robotitehnik on omandanud 4. taseme roboti operaatori või mehhatrooniku kutseoskused. Ta on valmis juhtima ja juhendama roboti operaatorite tööd, vastutama meeskonna töötulemuse eest, nõustama kliente ning tegema koostööd elektrikute, automaatikute, tehnoloogide, IT- jt sidusvaldkondade spetsialistidega. 5. taseme robotitehniku kutses eristatakse universaalseid robootika ja IKT kompetentse, mida saab kasutada teiste kutsealade (nt teenindus ja olme) robotite ja -robotisüsteemidega opereerimisel. Robootika ja IKT universaalsed kompetentsid, tase 5: - Programmeerimine - Robotisüsteemide käit ja hooldus - Robotisüsteemide tööprotsesside jälgimine - IKT-alane tegevus Lähedased kutsed: Mehhatroonik, tase 5 Mehaanikainsener, tase 6 Robotitehnik, tase 4 Plastitöötluse seadistaja, tase 4
A.2 Tasks
A.2.1 Robotite programmeerimine 1. Robotisüsteemide programmide koostamine ja optimeerimine 2. Programmiversiooni haldus

Robot technician, level 5 job is to ensure the technical condition, skilful use and safety of robots. Robot technician, level 5 handles and adjusts robots and systems (hereinafter robotic systems) of the fields of industry (eg machinery, chemical, electronics, food industry) and logistics information and communication technology (ICT) and other technological solutions. Tasks include the installation of communication technology and utility networks, drive and

sensor engineering work, monitoring, operation and maintenance of robotic systems and programming.
A level 5 robot technician has acquired the professional skills of a level 4 robot operator or mechatronics. He is ready to lead and supervise the work of robot operators, be responsible for the work of the team, advise customers and work with electricians, automators, technologists, IT and other related professionals. The level 5 robotics profession distinguishes between universal robotics and ICT competencies that can be used by others operating robots and robotic systems in professions (eg service and domestic).
Universal competences in robotics and ICT, level 5:
- Programming
- Operation and maintenance of robotic systems
- Monitoring of robotic systems work processes
- ICT activities

Upcoming invitations:
Graduate Certificate, Level 5
Mechanical Engineer, Level 6
Robot technician, level 4
Plastic Processing Adjuster, Level 4

Tasks within this job include:
A.2.1 Robot programming
1. Programming and optimization of robot systems
2. Program version management

A.2.2 Sensor technology work
1. Installation and operation of sensors
2. Fault detection and correction and testing

A.2.3 Drive technology work
1. Operation of drives
2. Error detection
3. Troubleshooting and testing

A.2.4 Installation of communication equipment and utility networks
1. Connection of robotic systems to communication and technical networks
2. Installation of industrial communication networks
3. Installation of industrial work networks
4. Tuning of industrial communication networks
5. Setting up industrial work networks

A.2.5 Operation and maintenance of robotic systems
1. Setup, tuning and calibration
2. Troubleshooting
3. Carrying out and organizing technical maintenance

A.2.6 Monitoring the work processes of robotic systems
1. Regular monitoring of work processes.
2. Monitoring the quality and volume of production.
3. Control measurement

A.2.7 Documentation
1. Documentation of inspection and maintenance operations
2. Preparation of work instructions

A.2.8 Leadership and supervision
1. Organization of work
2. Instruction

3. There is also robot operator Qualification:

Kutsekoda

OCCUPATIONAL QUALIFICATION STANDARD

Robot operator, level 4

Kutsestandard on dokument, milles kirjeldatakse tööd ning töö edukaks tegemiseks vajalike oskuste, teadmiste ja hoiakute kogumit ehk kompetentsusnõudeid. Kutsestandardeid kasutatakse õppekavade koostamiseks ja kutse andmiseks.

Occupational title	Level of Estonian Qualifications Framework (EstQF)
Robot operator, level 4	4

Part A
DESCRIPTION OF WORK

A.1 Description of work
Roboti operaator, tase 4 töö on tagada robotite tehniline korrasolek, oskuslik kasutamine ja ohutus. Roboti operaator käsitseb tööstuse (nt masina-, keemia-, elektroonika-, toiduainetetööstus) ja logistika valdkondade roboteid info- ja kommunikatsioonitehnoloogia (IKT) jt tehnoloogilisi lahendusi kasutades. Tööülesanded hõlmavad kommunikatsioonitehnika ja tehnovõrkude kasutamist, ajami- ja andurtehnikatöid, robotite töö jälgimist, käitamist ja hooldust ning programmidesse muudatuste tegemist. Töö robotitega eeldab laiemat kutseoskuste spektrit, kuna robootikatööd seonduvad mehhatroonikaseadmete paigaldamise, häälestamise ja testimisega. Roboti operaator töötab iseseisvalt ja meeskonnas ning on valmis täitma tööülesandeid muutuvates olukordades. 4. taseme roboti operaatori kutses eristatakse universaalseid robootika ja IKT kompetentse, mida saab kasutada teiste kutsealade (nt teenindus ja olme) robotitega opereerimisel. Robootika ja IKT universaalsed kompetentsid, tase 4: - Programmeerimine - Robotite käit ja hooldus - Robotite tööprotsesside jälgimine - IKT kompetentside kasutamine Lähedased kutsed: Mehhatroonik, tase 4 Robotitehnik, tase 5 Plastitöötluse seadistaja, tase 4
A.2 Tasks
A.2.1 Robotite programmeerimine 1. Robotiprogrammide koostamine ja korrigeerimine 2. Programmiversiooni haldus A.2.2 Andurtehnika tööd

Robot operator, level 4 work is to ensure the technical condition, skilful use and safety of robots. The robot operator handles industrial (eg mechanical, chemical, electronics, food) and logistics robots using information and communication technology (ICT) and other technological solutions. Tasks include the use of communication technology and utility networks, drive and sensor technology work, robots monitoring, operating and maintaining work and making changes to programs.

Working with robots requires a wider range of professional skills, as robotics works involve mechatronic equipment installation, tuning and testing. The robot operator works independently and in a team and is ready to perform tasks in changing situations. The Level 4 robot operator's distinction distinguishes between universal robotics and ICT competencies that can be used operating robots in other professions (eg service and household).
Universal competences in robotics and ICT, level 4:
- Programming
- Operation and maintenance of robots
- Monitoring of robot work processes
- Use of ICT competencies

Upcoming invitations:
Graduate Certificate, Level 4
Robot technician, level 5
Plastic Processing Adjuster, Level 4

4. Assessment of the course we developed is described following:
The assessment of the Robotics course should be carried out on an ongoing basis, based on practical work. Lesson-based assessment should take into account the specifics of a robotics course, which means that reaching an ideally working solution may not always happen. Therefore, emphasis should be put on the work process and the completed solution analysis, i.e. what was done well, what could have been done better, what could be changed to make the result better. Make students' oral feedback where students have to explain what they have completed also a part of the assessment process. Attention should be given to programs and how well students can explain the completion of these programs.

The most important task is certainly the project at the end of the course, which summarizes the knowledge acquired during the course. The project should be evaluated with emphasis on the integrity of the solution. The assessment should look at different parts of the completed system: mechanics, program, team work, documentation, and presentation.
In Estonia, course is graded in high school from 0-5.

In conclusion these occupational standards are international and we could take something they have and modify it according to our needs.

For example, robot technician needs to show competences B.2.1-B.2.8 and general competences are B.2.9-B.2.13 in this page:

https://www.kutseregister.ee/ctrl/et/Standardid/vaata/10675623

If we take out industry specifical requierments, remaining could be applied for educational robotics.

Conclusions and Limitations

A high level of interest is indicated in learning outcomes development and the objectives that countries share when it comes to the development of the European Qualifications Framework (EQF) and national qualifications frameworks (NQF), European Credit system for Vocational Education and Training (ECVET) and the capacity of systems to validate and recognize non-formal and informal learning.

The European and national level discussions have also highlighted the need for some common ground with respect to learning outcomes so that European level tools (EQF, ECVET, the developing taxonomies of knowledge, skills and competences) can function efficiently. This does not imply that there should be a common approach to defining and using learning outcomes across countries. As explained above, such a restrictive approach would not account for important differences in the ways in which learning can be described within national systems.

Among all other stakeholders, this Report should be directed at national policymakers (and their advisers) in the fields of education, training, qualifications and labour market analysis. It is also relevant for those with an interest in counselling services for learners, workers and job seekers, as well as for European level experts in these areas as well as those implementing or using the European instruments based on learning outcomes (EQF, ECVET, or others).

Limitations of using learning outcomes

The use of learning outcomes is well supported by arguments from policy and practice. It is arguably one of the strong and common policy trends across Europe. However, it is just one method for defining the expectations of learning. The necessary efforts of education and training professionals to deliver high quality learning programmes are another way of looking at these expectations. These teachers and trainers take it as their task to use their knowledge and experience to interpret standards and broad aims to create the right environment for the development of competent people. It can be argued that learning outcomes alone cannot fully capture the qualities of the learner and of the learning process delivered through programmes.

In general, it is evident that much more research is needed to give an overview of how the assessment and demonstration of achieved learning is put into practice by institutions and quality assurance agencies throughout the European Union and beyond. The questions

remains, is there a way to develop a common accepted framework for recognizing robotics competences?

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