

Defining learning outcomes for curriculum development in Data Science and IoT domains

Ivaylo Gueorguiev, Pavel Varbanov, George Sharkov, Christina Todorova

SEnDIng online conference

PCI 2020 Special Session “Education and training on Data Science and IoT”

21 November 2020

Ivaylo Gueorguiev & Pavel Varbanov
European Software Institute CEE

Defining learning outcomes as a part of the curriculum development process



Definition

“Learning outcomes statements help to clarify program and qualifications intentions and make it easier for those involved – learners, parents, teachers or assessors – to work towards these expectations” - CEDEFOP.

Key characteristic

- **Focus on the learner needs, not on the teaching method.**
- **Iterative process** but not one-way journey.
- **The simplicity is important!**
- Rather **generic and wide-ranging for the competence** than exhaustive or specific for any industry or market or use case.

Four-stage process ensured industry-centric Learning Outcomes

1. Verification of the Approach

2. Verification of the first draft of the Learning Outcomes

3. Validation of the Learning Outcomes and the Survey format with leading experts in DS and IoT

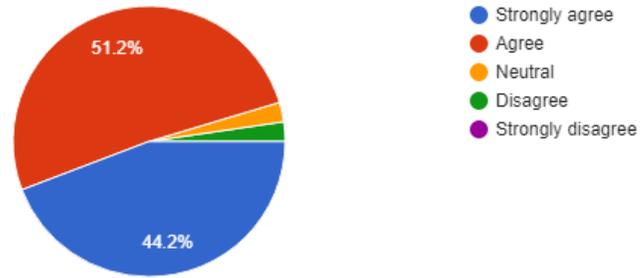
4. Validation of Learning Outcomes through a Survey and interviews with industry

As part of levels 1 to level 3 of this process, we received, discussed and implemented **21 improvements** on the form and/or the content of the learning outcomes.

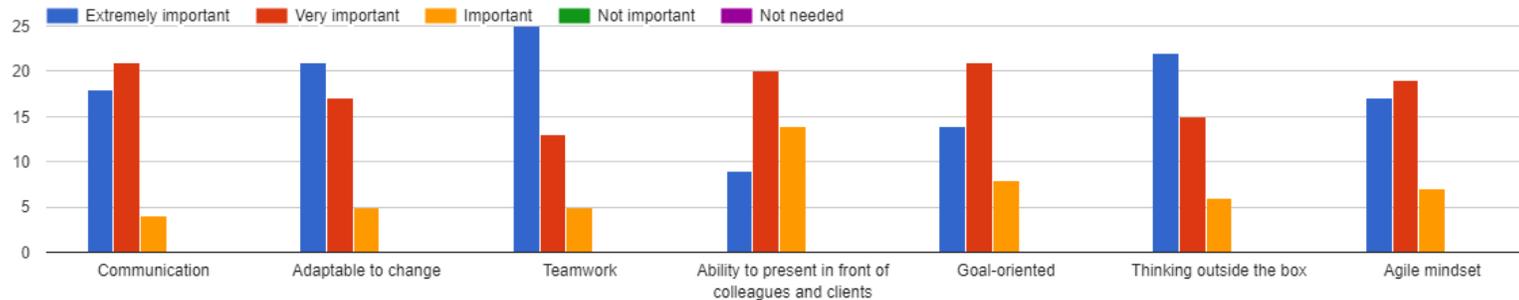
At Level 4 of the process, we obtained and analysed quantitative and qualitative data from 42 industry leaders companies/experts).

Do you agree with the following definition of IoT: "IoT is a system of distributed networks that facilitate the...controllers, computers, machines, etc."

43 responses

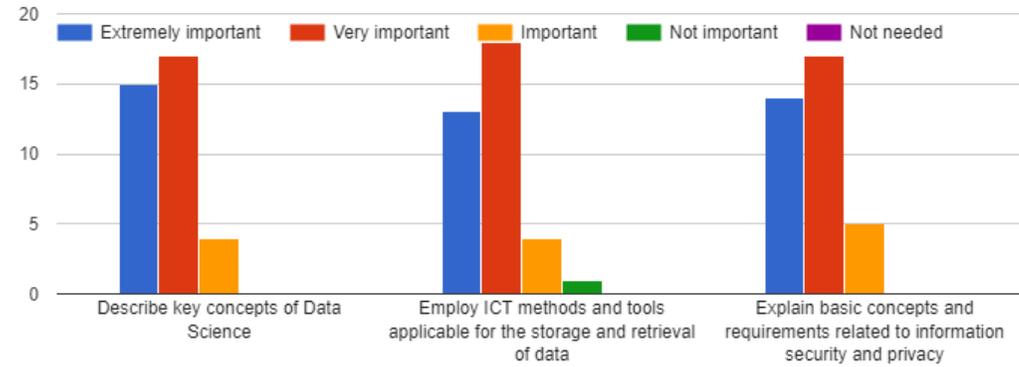


Please, rate how important are the following SOFT SKILLS



Sample Results

Please, rate how important is the following Data Science KNOWLEDGE for the learners



Competencies Level

- Exercise self-management within the guidelines of work or study contexts that are usually predictable, but still are a subject to change;
- Supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities;



**Learning
outcomes
consist of:**



Agreed IoT Definition

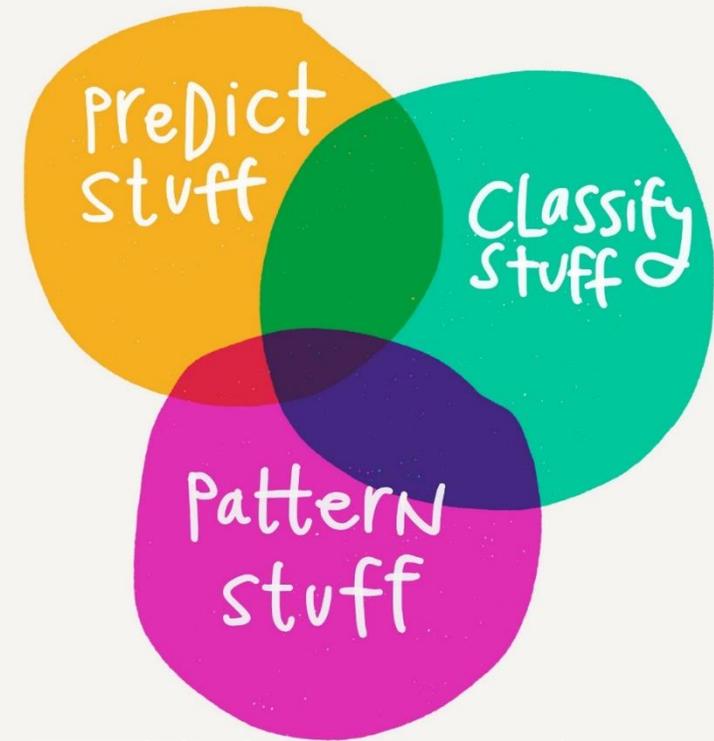
"IoT is a system of distributed networks that facilitate the communication and collaboration between various IT enabled objects (things) including but not limited to software systems and applications, sensors, controllers, computers, machines, etc."



Agreed DS Definition

"A data scientist is a practitioner who has sufficient knowledge in the overlapping regimes of business needs, domain knowledge, analytical skills, and software and systems engineering to manage the end-to-end data processes in the data life cycle."

DATA SCIENCE



Key Competences in Terms of Soft Skills

- Communication skills;
- Adaptable to change;
- Team work;
- Ability to present;
- Goal-oriented;
- Thinking outside the box;
- Agile mind-set;



IoT Knowledge

- Describe the value that IoT delivers in different business domains;
- Explain the business processes related to IoT in specific domains;
- Understand IoT architectures and the related network and communication protocols;
- Recognize different types of sensors, actuators, displays and related embedded electronics;
- Design the application level (e.g. use protocols that support different IoT applications) of IoT in the context of big data, cloud technologies and data science;
- Formulate requirements about IoT information security;

DS Knowledge

- Describe the key concepts of Data Science;
- Describe ICT methods and tools applicable for the storage and retrieval of data;
- Describe methods and tools applicable for the statistical analysis of data;
- Explain basic concepts and requirements related to information security and privacy (e.g. how to deal with people profiling in the context of GDPR);

- Describe business requirements;
- Describe different approaches and different problems, solvable through DS;
- Explain maths and statistical models;

Knowledge added
by Industry
respondents

IoT Skills

- Analyse, argue and describe the business value of a particular IoT system;
- Design an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection;
- Develop and deploy workflows and dashboards for an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection;
- Develop working code for an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection;
- Apply IoT information security concepts;
- Maintain continuous integration and verification;
- Develop network analysis;
- Operate IoT system;

Skills added by
Industry
respondents

DS Skills

- Analyse domain specific trends and present them as structured information;
- Create code to statistically analyse data;
- Apply data statistics and data visualization;
- Deploy simple machine learning techniques;
- Deploy data storage and retrieval techniques;
- Implement data models validation techniques;
- Ensure that IPR, security and privacy issues are respected;

Thank you!

For further information please contact



Ivaylo Gueorguiev
European Software Institute CEE



ivo (at) esicenter.bg



Pavel Varbanov
European Software Institute CEE



Pavel (at) esicenter.bg