EVITA
EuroHPC Virtual Training Academy

EVITA – EuroHPC Virtual Training Academy

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EVITA CQF definitions

Definition of EVITA CQF and its Integration into the European HPC Ecosystem

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Document Information

Document Name	EVITA CQF definitions
Authors	Xavier Martorell (BSC), Mary K. Chessey (BSC), Maria-Ribera Sancho (BSC), Claudia Blaas-Schenner (TUW), Victoria Döller (TUW), Kevin Lüdemann (GWDG), Jasper Seehofer (HLRS)
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1. Introduction

In this report, we define the concepts related to the EVITA Competence and Qualification Framework (CQF). They will provide the basis for the content providers to organize their courses, with a common structure based on modules and skills. Our goal is to allow the inclusion in the CQF of courses coming from different sources, University master programs, and trainings from research centres and industry.

2. Concepts and definitions

2.1. Overview of concepts

In this section we outline the concepts relevant in the CQF, i.e., courses, EVITA modules, learning outcomes and skills, to give a brief overview before we go into detail with all these concepts.

A **course** is what is taught by trainers to learners and contains learning material, a survey and an exam. Courses consist of concise, self-contained learning units, called EVITA modules, which comprise topic specific teaching material and exam questions. The CQF provides a blueprint of courses and their modules but trainers can arrange the modules to courses according to their needs in a mix and match manner. Every course has an associated set of exam questions. After passing the exam, learners obtain a certificate of attendance with the mark obtained in the course.

An **EVITA module** is a learning unit with guided content and hands-on activities that can be used for self-paced competence acquisition or for instructor-led courses. A module addressess one or multiple learning outcomes and is designed for one to four hours of learning. It references skills that are small, thematically related clusters of learning outcomes.

A **skill** is a small, clearly defined ability that a learner can demonstrate in practice and lists the learning outcomes to achieve. Skills are organised hierarchically in the Skill Tree [2].

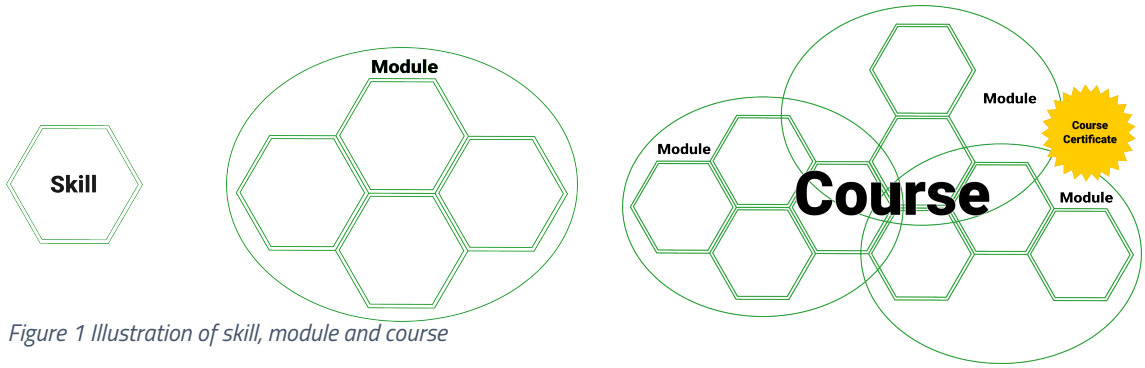

Figure 1 Illustration of skill, module and course

Modules and courses can furthermore be arranged in **learning pathways** and **professional profiles**, which in turn can show learners which courses are required to become a basic HPC Programmer for instance.

As an **example**, a course about shared memory programming contains 3 modules. One module covers the fundamental concept of memory management and access patterns, one module covers synchronization of threads, and one module covers the OpenMP implementation. The first module covers two skills, one about memory management, and one about access patterns. The second and third cover synchronizations and OpenMP implementation. For the third module two alternative skills are attached covering the OpenMP implementation in C/C++ and one covering the implementation in Python.

In the next sections we will discuss these briefly outlined concepts in detail, starting with the fine granular learning outcomes .

2.2. Learning outcomes

A learning outcome defines what a learner knows, understands and is able to do when mastering the training. The learner can demonstrate the acquisition of the kowledge and skills in an examination. Learning outcomes are phrased using the widely-use standard of the Bloom's taxonomy [1]. The learning outcomes are grouped specific to unique topics and collected in skills, organizes in the Skill Tree, which is the structural concept in the CQF.

Learning outcomes are the core element and the smallest available unit of structure in the CQF. The Skill Tree organizes them in a hierarchical structure.

Examples of learning outcomes are:

- Understand the concept of parallel programming with distributed memory and global communication.
- Apply basic bash commands in a shell script.
- Discuss the use of loops and branching in shell scripts.

2.3. The skill

We define the skill as the smallest unit of ability. As a reference, but not as a hard definition, the estimated time to acquire a skill ranges from one to four hours. Skills are organized hierarchically in the Skill Tree, and managed by the HPC Certification Forum (HPC CF) [2] (see also [3][4][5][6][7], and [8] for more details).

A skill is defined in terms of capabilities rather than content, emphasizing what a learner can do after acquiring the skill. It consists of one to several learning outcomes that are specified by the actions a learner should be able to execute or knowledge to be able to recall. These outcomes are formulated using verbs from Bloom's taxonomy to ensure clarity and measurability.

Skills can be of two main types (mixed also possible):

- Theoretical, or some knowledge that a learner acquires during the training. For example:
  - Understande the concepts of Deep Learning in neural network layers.
  - Understande the scheduling principles of the Slurm scheduler.
  - Understande the procedures of Performance Engineering with ScoreP.
- Practical, or some abilities that a learner acquires during the training. For example:
  - Use the Linux command line interpreter.
  - Work with a job scheduler for submitting jobs.
  - Program using collective communication in MPI.

Skills are also used to organize the examination questions associated with training courses. Examination questions are attached to a skill and belong to a pool of questions which can be used to select random question for several courses.

Table 1 shows the definition of the skill and Figure 1 shows its representation as used in the EVITA project.

Definition: Skill

Attribute	Description	Value type
ID	Unique ID in the Skill Tree	ID
Description	Full text description of what the skill is about.	Text
Learning outcomes	What is covered by the skill?	Bullet points using Bloom's taxonomy
Prerequisites	Previous knowledge (other skills) needed before a learner can start learning this skill	Skill tags / linked skills from the skill tree

Table 1: Definition of a skill and its attributes

Figure 2: Representation of a skill

2.4. The EVITA module

In the EVITA framework, a module is defined as the basic training unit that can be imparted separately, providing an irreducible, concise, and self-contained chunk of knowledge. Modules typically span around one to four hours of guided learning, depending on the content and prerequisites.

The schema of an EVITA module as defined in the Competence and Qualification Framework is defined using learning outcomes, prerequisites, and estimated time commitment. The module implementation comprises teaching material tackling those learning outcomes, that can be imparted as theoretical, exercise, practical, or other types of learning sessions (discussions, paper reading...). Those allow trainees to achieve the learning outcomes, and can be implemented with or without an instructor.

Modules are associated with a collection of one or more skills through the learning outcomes. The module contains the material, exam questions, and survey questions associated. Table 2 shows the structure of the module and Figure 2 shows its representation as used in the EVITA project.

Definition: Module

Attribute	Description	Value type
Module name	Name identification	String
Module ID	Unique Identifier	String
Learning outcomes	Obtained from the skill(s)	Bullet points using Bloom's taxonomy
Primary skill	Primary skill covered by this module	Skill ID from Skill Tree
Associated skill(s) (optional)	Additional skill(s) covered by the module	Skill IDs / linked skills from the skill tree
Prerequisites	Previous knowledge (skills, modules) needed before a learner can start with this module	Skill IDs / module IDs
Estimated time commitment	Average duration it takes to learn all skill(s) of the module	1-4 hours

Material	Teaching material	Jupyter Notebooks, Markdown files, ... See Module template https://code.europa.eu/eurohpc-ju/evita/module-template
Quizz/exam questions	Theoretical and practical	Jupyter Notebooks, Markdown files, ... See Module template https://code.europa.eu/eurohpc-ju/evita/module-template
Last updated	Date of the latest update of the teaching material, history	Date
Author(s)	Module author(s) and their affiliation(s)	Name(s) and affiliation(s)
Use case (optional)	Description of an industry/research application of the learned skill(s)	Demo, link (visual, if possible)
Feedback form	Feedback survey for collecting participants satisfaction	Poll
License	License for using and/or adapting the material, openness of the material is required	License name and description or link to the description, e.g., CC BY-SA 4.0 for notebooks, permissive open source licence for code.

Table 2: Description of the training module structure

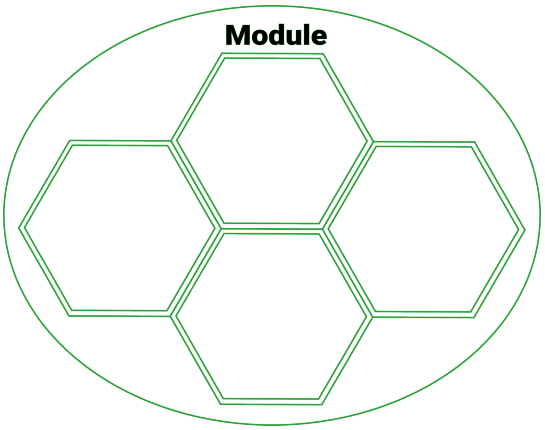

Figure 3 Representation of a module, consisting of 4 skills

2.5. The course

A course, as defined in the EVITA CQF is a structured learning package that is transferred to the learners. Courses include different types of material and teaching methods, including, but not limited to, the traditional theoretical classes, exercises and practical sessions. Other types of teaching mechanisms are also allowed, like paper reading and discussion sessions.

A course is built on top of a number of modules, as their aggregation. These modules provide the training material, the exam questions, and survey questions, which are aggregated into a course exam and a course survey. Courses can span one to four hours (if they consist of a single module or just a few short modules), a day (few modules), several days to a week (some modules), or even months (many modules).

Each course has a pool of exam questions, which is built based on the exam questions provided by the modules. For each exam a selection of questions of this pool is made and learners passing the exam are awarded a course certificate. On small courses (1–4 hours) exams need to cover all skills. On longer courses (one to several days), exams can fully cover every skill, although this is not strictly necessary and parts of skills can be randomly dropped from exams. New exam questions can be built in order to connect multiple modules.

Table 3 shows the overall structure of a course and Figure 3 shows the representation of a 3-module course.

Definition: Course

Attribute	Description	Value type
Course ID	ID of the Course as defined by the CQF mapping	ID

Course Name	Name identification	String
Associated skill(s)	Skill(s) covered by the course	Skill tags / linked skills from the skill tree
Prerequisites	Previous knowledge (skills) needed before a learner can start with this course	Skills / modules / courses
Duration	Average duration it takes to learn all skill(s) of all the module(s) that beling to the course	1 hour to several months
Material	Teaching material	Modules
Quizz/exam questions	Theoretical and Practical	Modules + additional overlapping for course
Last updated	Date of the latest update of the teaching material, history	Date
Author(s)	Instructor(s)' names(s) and affiliation(s) who teach the instructor-led version, author(s) and their affiliation(s) of all modules that comprise the course	Name(s) and affiliation(s)
Use case (optional)	Description of an industry/research application of the learned skill(s)/module(s)/course	Demo, link (visual, if possible)
Feedback form	Feedback survey for collecting participants satisfaction	Poll
License	License of the course comes from the licence(s) of the modules that comprise the course, it specifies	License name and description or link to the description, e.g.,

	the license(s) for using and/or adapting the material, openness of the material is required	CC BY-SA 4.0 for notebooks, permissive open source licence for code.

Table 3: Description of the training course and associated fields

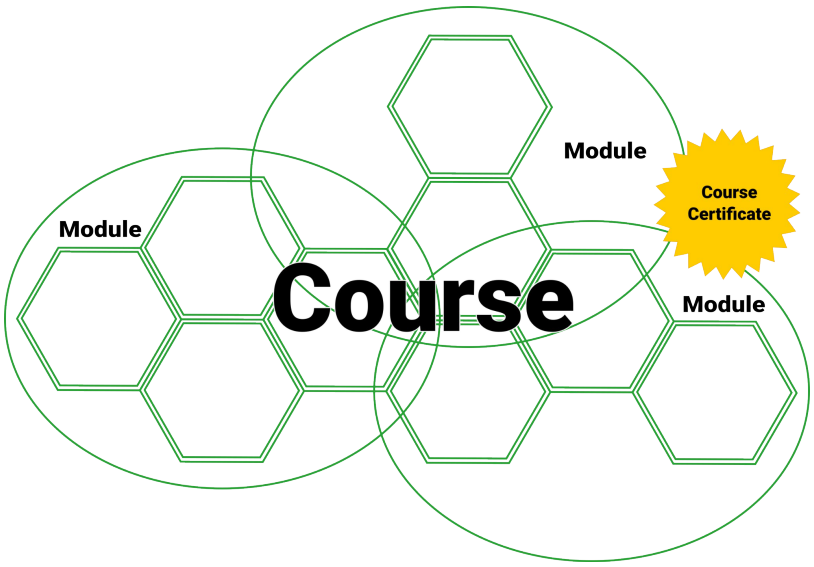

Figure 4 : Representation of a course based on 3 training modules

2.6. The exam

Exams are built based on the questions provided by each of the skills that constitute the course and its modules. The instructor can include new questions, specifically to tackle the relationships across several modules and skills. They have two different types. The first are multiple-choice questions that test knowledge and have predefined answers. The second type is hands-on and depends on the material. It can be to perform some commands in a Linux bash environment, or to compile a script with missing parts, to compile and run a new program, or to change a few lines in some coding examples. When a participant passes an exam, he/she will get a certificate.

3. Conclusions

In this report we show the definitions of the basic concepts of the EVITA CQF: course, module and Skill.

4. References

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