Transforming CS Curricula into EU-standardized Micro-Credentials – The Hard Parts

Since the working environment continues to develop, mobility and flexibility are becoming increasingly important for both companies and employees. Therefore, universities need to transform their study programs into smaller units, so called micro-credentials, which offer flexible and individual learning pathways. To permit EU-wide exchange, micro-credentials have to be recognized and quality-assured and the certificates have to provide a transparent and universal skill set. The process for converting modules into micro-credentials still contains some open issues: micro-credentials typically have a size between 1 and 3 ECTS which means that bigger modules must be broken down into smaller parts. The division of units leads to the problem of assigning especially transversal skills and how to assess, verify and certify them. Additionally, it is not yet clear how micro-credentials are to be classified in the European Qualification Framework (EQF) as modules are accredited in study programs within a certain EQF level. Since micro-credentials can be taken stand-alone this is not always possible. This paper discusses these problems and gives an overview of the state of the art for solving some of them. Therefore, the concept of partial skills is introduced.

Keywords: *micro-credentials, lifelong learning, skills, partial skills*

Introduction

Micro-credentials are the EU-way of establishing flexible learning pathways in Europe. Micro-credentials (MCs), “the record of the learning outcomes that a learner has acquired following a small volume of learning” (Council of the European Union, 2022, p. 5), are meant to allow the description, certification, and recognition of skills in a transparent and portable way across universities, especially in different countries. One target of MCs is to enable members of the workforce to adapt quickly to changes in the labour market and gather required future skills. They allow the recognition not only of skills acquired during a study program but also of practical experience and lifelong learning activities. Therefore, a second target is integrating flexible learning pathways into the classic forms of education defined in the European Qualification Framework.

Universities can convert existing programs to MCs by unbundling them: Existing modules are broken down into smaller units of typically 1-6 ECTS which are described and offered as MCs. A core feature of MCs is that they can be stacked to larger units. At least in theory, complete programs can be converted to stacks of MCs by rebundling.

To use the full potential of MCs, it is necessary to convert all elements of existing modules like skills, outcomes, assessment, prerequisites, qualification level, size etc. to a standard EU-wide recognizable form.

In our previous paper (Berkling et al., 2023) we described this process and the lessons learned during converting modules from an existing Computer Science

Curriculum at DHBW to MCs. In this paper we will focus on one aspect of the bundling/unbundling part: how to handle (assess, document, certify etc.) skills at the level of an individual MC, which are developed and assessed over the course of a whole module resp. a stack of MCs.

Problems with Micro-credentials

Implementing micro-credentials (MCs) has several known problems, starting with the name. There are still some global ambiguities and different understandings regarding the nomenclature of MCs. Many synonyms are used in the literature for what the European Union calls MCs, such as digital badges, open badges or mini degrees (European Commission et al., 2020c, p.38). Moreover, there are various educational institutions that offer small programs with certificates under different names, such as “NanoDegrees” or “MicroMasters”. Since there is no common and standardized definition for MCs, this impedes the validation and recognition outside of the respective provider (European Commission et al., 2020a, p.10). The lack of a commonly defined standard and quality assurance can easily lead to uncertainty and doubts about the quality of MCs. (McGreal et al., 2022, p. 293) A coherent and consistent approach to MCs is necessary to solve all those barriers successfully (European Commission et al., 2020c, p.42). Therefore, the agreement about a common and generally recognized definition and implementation of MCs within an alliance must always be the first elementary step.

Furthermore, it needs to be clarified if and how MCs can be classified within the European Qualification Framework (EQF). Currently, the EQF doesn’t have a clear mapping or level assignment for MCs. MCs are often generated out of study programs in higher education. These programs are accredited within a certain EQF level which are the levels 6 and 7 for undergraduate and postgraduate studies. However, since the European Union intents to use MCs as an approach for lifelong learning, they can be taken stand-alone and completely independent from a study program (Council of the European Union, 2022, p. 5). A single MC is not necessarily classified in the EQF level of the whole study program. Maybe the European e-Competence Framework (e-CF) offers an idea: the e-CF provides a common language for skills and competences in the ICT workplace by identifying competences in five proficiency levels e-1 to e-5 which can be mapped to the EQF levels 3 to 8 (European Committee for Standardization, 2014, pp. 17, 42). Each competence within the e-CF is mapped to a corresponding e-CF level and can therefore be mapped to a certain EQF level (ibid, p. 10). However, this is not standardized and specialized only for the ICT sector, so the question of classification MCs within the EQF remains unsolved.

Besides that, the recommended size of MCs is globally widely discussed. According to a survey that was undertaken by the Consultation Group on micro-credentials of the European Union (European Commission et al., 2020b) the recommended number of ECTS for MCs varies. The group suggests that “3 and 5 ECTS seem to be ideal sizes for micro-credentials” (ibid, p. 19), although some respondents of the survey confer a minimum of 5 ECTS per MC (ibid, p. 9). The New Zealand Qualification Authority defines an upper and lower limit between 5 and 40 ECTS in size (ibid, p.11), but there are many others like 2-6 ECTS for single MCs.

These formal problems are at least partially solvable by formal means, for example by making information like EQF level optional in the description of MCs. There are harder problems, especially the definition of earned skills and outcomes.

Of course, there are several initiatives like ESCO [1] for standardizing skills on different levels but as ESCO refers to the skills requested on the European labour market it does not always entirely fit to the learning outcomes defined in higher education. Currently, there is (as far as known to the authors) no universally accepted skill framework which is widely used and leads to a broadly understandable skill set (there are some more detailed points about that in the section 0:

Existing Approaches). This impedes the process of defining standardized skill sets in MCs which is still an unsolved problem. However, much harder is the question, how to quantify skills and/or put them in a hierarchy to group related things together across different domains which will be discussed in detail in the next sections.

Currently, most universities do not follow common standards when describing competences and skills in module descriptions. "Traditionally higher education was relatively explicit about the knowledge (outcomes) to be achieved, or at least the knowledge covered by the curriculum. It was however somewhat less explicit on the skills or competences required for the award of a given qualification. Competences, such as those of critical evaluation, were and are embedded or implicit in the assessment values and practices." (Bologna Working Group, 2005, p. 63). The same goes for ethics, security, or sustainability and other transversal skills. These future skills are hard to get from one single module or MC but will be the result of a longer process acquiring them from several distinct activities in most cases. Therefore, these skills are often defined on the level of study programs, not individual modules. But how can we express that, when the students take (only, maybe in the far, bright future?) individual MCs?

But let's start with the simpler case of unbundling a module into several MCs, which are then rebundled into a MC stack. In our previous paper (Berkling et al., 2023) we used an introductory course on Software Engineering as an example. Out of this module we created three MCs (Specification, Design, Implementation) which can then be rebundled as a MC stack. There are skills like "organising, planning and scheduling work and activities" which clearly belong to one of the MCs inside the stack, in this case to the third (Implementation). But transversal skills like "using digital tools for collaboration, content creation and problem solving" are harder to attach to a single MC. Clearly, they are taught (and assessed) in the original module and taking part in the whole stack which will deliver the same outcome. But to which MC should they be assigned? Probably (in some kind) to all of them. But what quantity (or even quality, see Section 0:

[1]https://esco.ec.europa.eu

Existing Approaches) of this skill is gathered in each of the three MCs?

If one student (for example because he is not in the CS-program but in Health) completes only the first MC of the stack, another one all parts (see Figure 2 for an example), how can we identify the difference in skills acquired? Obviously, they should not have the same set of skills. If transversal skills are distributed over the MCs in the stack, it is necessary to define and certify all the skills of the original module to a learner. The interesting question is, if these (probably transversal) skills should be indicated at more than one MC. If not, then two students, one taking the course as a module will have more skills than the one, who takes it as a MC stack. The skills could be weighted in some way, for example proportional to the size of the course (see Section 0:

Skills Hours in UK QAA Project), but this brings its own problems, especially with interoperability (see Section 0: Discussion).

There is (as far as known to the authors) no standard way of handling this problem. Of course, different approaches would be possible: we could assign points or badges or some other semi-quantitative attributes to a skill for each MC. But that would be hard to get consistent across platforms/universities. Maybe that only makes sense in one ecosystem to express things like: "To get the skill 'using digital tools for collaboration, content creation and problem solving' you need to take all three parts together or maybe take only one of these but then you need other MCs which provide the missing amount of that skill."

So, we have to differentiate between the internal documentation of skills a student has and the external view. In the next chapters we will describe a way, which is simple enough to be understandable for external users but allows students to collect skills over the course of a number of MCs and get them certified as the outcome of a MC stack.

The following approaches of other universities solve part of that problem, but the question of consistency across universities or countries are basically unsolved.

Existing Approaches

The educational system of Ontario is currently presented with a similar problem: within the educational system, in particular the higher educational system, barriers towards the stackability of micro-credentials (MCs) have been identified. The major obstacle is the lack of standardized, comparable, transparent, and verified information about obtained competences and skills from accomplished MCs (Usher et al., 2023, p. III). Ontario's Higher Education Strategy Associates detected increasing inquiries concerning the stacking of MCs into diplomas and degrees, particularly stacking obtained MCs from several (two or even more) different institutions and educational providers.

Due to a lack of transparency concerning relevant data on e.g. prerequisites, learning outcomes, etc, certifying educational institutions are presented with difficulties comparing MCs to formal courses in order to assess equivalences. (ibid, p. III).

According to the European Commission's definition of MCs, stackability and portability of accomplished credentials are key characteristics of MCs. Therefore, transparency of key data of MCs is crucial to provide possibilities to build on prior certified learning experiences with incremental credentials to foster higher proficiency levels in respective learning areas and topics (ibid, p. 5). Detailed information on obtained competences and skills could reduce replication and foster inter-institutional recognition (of MCs). (ibid, p. 4).

With regard to portability and appraising obtained skills and competences, defining and designing interrelated MC stacks within one institution would usually be preferable. In particular, information about included and imported transversal skills within MCs is primarily available in the respective offering institution. Finding and researching for detailed information of learning-outcomes in MCs offered by other institutions would require a great amount of personal resources and time exposure at institutions given the fact of very limited credit value in order to integrate a single extra-institutional MC into a module or stack (ibid, p. 26). Their conclusion is that MC stacks should be preferably designed and defined within just one institution.

Obviously, this would eliminate most of the problems mentioned above. But it would unnecessarily limit the usability of MCs, especially for cross-domain and cross-university usage. This would limit the use of MC stacks to mostly internal use cases. So better ways should be defined. The only real solution to this problem would be to define and use standardized skill descriptors and quantifications (see Section 0:

LCAMP Knowledge Graph).

Skills Hours in UK QAA Project

In October 2022 the Quality Assurance Agency for Higher Education (QAA) published the project report "Collaborative Enhancement Project Report on badging and micro-credentialing within UK higher education through the use of skills profiles" (Ward et al., 2023, p. 2). This report included case studies from six UK universities concerning skills profiling approaches to granularize university courses and modules. The project pursued the objective to present solutions to reduce assessment workloads albeit increasing development of granular degree courses and opening recognition and accreditation pathways of LinkedIn Learning credits (ibid, p. 3).

The QAA project pursues the approach of translating learning outcomes into skills hours to develop skills profiles. The project uses six skills themes and 25 skills categories as a basis to define skills profiles within curricula. These six themes are classified alphabetically from A to F and imply understanding, context, solution, delivery and behaviour. The secondary skills categories refer either to subject-based or transferable skills and invoke one skills theme. In the curricula of university courses or modules each learning-outcome can be translated into or matched to the most appropriate one or several skills of the list of 25 subject specific and transferable skills categories. In order to obtain specific skill hours within a curriculum, the skills categories hours are calculated pro-rata from learning hours including assessment learning hours, its weighting, and referring learning outcomes hours (ibid, p. 5).

The contributing UK universities instance an example of a university module with 200 learning hours and two assessments with weighting 60:40. According to that example one assessment would require 120 learning assessment hours, the other one would require 80 learning assessment hours (ibid, p. 5). As subject specific skills categories can be matched quite distinctly to the learning outcomes of said university module and respective assessment, subsequently the required learning hours for each learning outcome and skills category can be estimated. As a result, the expenditure of each subject-based skills category can be calculated and displayed transparently.

Regarding the transferable skills categories, the estimated skills hours are calculated in a similar approach. However, transferable skills present a characteristic to apply to multiple learning outcomes. In the case study, the University of Bath pointed out this challenge while translating learning outcomes into skills. Therefore, the individual total hours of a transferable skills category need to be calculated as a function of the multitude of skills required for the learning outcome and thus a percentage of the respective learning outcome hours and summed up in a second step (ibid, p. 6). The researchers found that multiple skills could be identified for one learning outcome in a curriculum and therefore needed to split the skills hours among the associated transferable and subject-based skills (ibid, p. 24).

The approach provides specific information on required hours to obtain specific skills. Thereupon this approach by six UK universities of the QAA project could also be used to make apparent the extent to which the respective skills were imparted in the respective micro-credential as part of a stack with exactly calculated skills hours. This could clearly show if transversal and soft skills in particular have only been partially applied in a course due to granularization of university modules and greater courses.

For better illustration, the following skills hours approach is applied to the MC Specification from the MC stack Software Engineering with one assessment lasting 120 minutes.

First, the learning outcomes must be mapped to the skills categories of the QAA project, see Table 1.

Table 1. *Mapping from Learning Outcomes to Skills Categories of the QAA Project*

Learning Outcome	Skills category (QAA Project)
They know the methods of the respective project phases and can apply them. They can use tools for collaboration and problem-solving.	S4D - Subject Based Process & Production: Actions or steps taken to achieve a particular result
The students can competitively evaluate solution proposals for a given problem and justify their designs and solutions. They can competitively assess, select, and critically reflect upon solution proposals for a given problem.	T14E - Transferable Evaluation: Asssessing the amount, number or value of something
The students can engage with domain experts in discussions about problem analyses and solution proposals, as well as about the interconnections of individual phases. During the discussion, they can critically engage with various perspectives. They can orally and in writing present their designs and solutions. They can handle conflicts and resolve them constructively.	T19F - Transferable Communication: Conveying meaning to others
They can build and further develop teams. They can handle conflicts and resolve them constructively. They can pass on and support skills. They can provide each other with constructive feedback. They can effectively collaborate within a team in complex projects.	T18E - Transferable Collaboration: Processes where two or more people work together to complete tasks or goal

After mapping the learning outcomes of the MC curriculum to the skills categories of QAA, the calculation of skills hours referring to the respective described learning outcomes can be applied, as shown hereafter.

Table 2 shows the calculation for the subject-based skills categories which leads quite easy to the subject-based skills hours.

Table 2. *Mapping and Calculation of Subject-based Skills Hours*

Assess-ment	Assessment Learning Hours	Learning Outcomes	Learning Outcomes Hours	Subject-based skills categories	List of subject-based skills categories	Subject-based skills hours
1	120	1	30	S1A	S1A	30
		2	30	S4D	S4D	60
		3	30	S5E	S5E	30
		4	30	S4D		

The calculation of the transferable skills hours needs to follow the amount of learning outcomes for each skills category, so the calculation is more complicated (see Table 3 and Table 4).

Table 3. *Mapping Learning Outcomes to Transferable Skills Categories*

Assess-ment	Assessment Learning Hours	Learning Outcomes	Learning Outcomes Hours	Transferable skills categories
1	120	1	24	T14E, T7C, T15E
		2	24	T14E, T7C, T15E, T9D
		3	24	T19F, T8D
		4	24	T19F, T5B, T17E
		5	24	T18E, T19F

Table 4. *Calculation of Skills Hours for Transferable Skills Categories*

List of Transferable skills categories	Calculation	Transferable skills hours
T14E	24 x ⅓ + 24x ¼	14
T7C	24 x ⅓ + 24x ¼	14
T15E	24 x ⅓ + 24x ¼	14
T9D	24x ¼	6
T19F	24x ½ + 24x ⅓ + 24x ½	32
T8D	24x ½	12
T5B	24x ⅓	8
T17E	24x ⅓	8
T18E	24x ½	12

LCAMP Knowledge Graph

In the LCAMP research project, Learner Centric Advanced Manufacturing Platform, learning pathways for employees in advanced manufacturing are developed for effective re- and upskilling particularly in the advanced manufacturing sector. In this research project, the transition to higher levels of education as well as the reconciliation of academic and economic requirements of the labour market are important in the description of the MC for the development of learning skills, so that the greatest possible transparency is created for employers for the comparability of information in certificates and demanded skills in job profiles.

A three-axis knowledge graph is used as a basis for describing and classifying the existing competencies and skills of the learners presenting different educational backgrounds for better matching with regard to appropriate re- and upskilling pathways. In order to obtain the most accurate appraisal of available competencies from respective learners it is crucial to reflect on different influential factors for competencies. As a result, one axis of the matrix displays learners pertinent (work) experience of applying a certain competence or skill. Furthermore, the matrix implies one axis referring to classification based on certifications and qualifications, such as the EQF level. The third axis of the LCAMP knowledge graph matrix depends on proficiency levels as a sectoral and occupational axis regarding thematic depths of competencies and skills.

While relevant pertinent work experience can be depicted relatively clearly on the graph scale, the two other axes of the LCAMP knowledge graph are more difficult to appraise, but decisive in the assessment of the respective skill or competency maturity. Regarding the occupation and sectoral axis, it is important to distinguish how deep the learner's expertise is for a particular one, however the proficiency level does not always increase with a higher educational degree. For example, employees working in the mechanical engineering industry generally are required to present skills referring to the use of simulation technologies. Regarding possible working fields for above mentioned degree alumni, requirements to apply this skill or competency might be drastically different depending on the industry sector. For example, in a specialized industry such as pharmacy, you have the handling of a specific software in addition to the general skill, which e.g. are not used and needed in the same job description in the automotive industry with different product and safety requirements.

Laboratory skills can be even more diverse, which can be very specific within industries. Laboratory knowledge in the field of materials testing, e.g. in the metals industry are fundamentally different from the skills required for laboratory activities in biotechnology. Not only are there sectoral differences, but also qualifying ones, as certain qualifications and certificates have to be shown in each case, so that the proficiency of the respective learners also increases. With higher qualifications, competence profiles can also change.

The representation of all three matrix dimensions is therefore particularly important for mapping the interaction on the respective competency and skill maturity in the transition from Dublin Descriptor level DD1 to Dublin Descriptor level DD2 as well as for the determination of the expression of skills in the professional and academic environment for comparison and adaption. To illustrate this, here is an example for a warehouse logistics specialist:

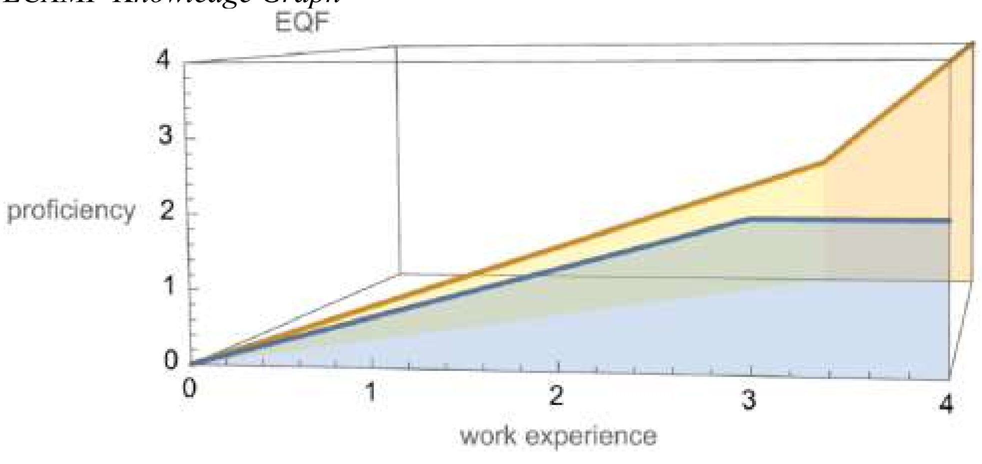
Starting with the work experience of an employee with this qualification, a learner is obliged to have a pertinent vocational education and training in a company for three years in order to obtain the qualification as a warehouse logistics specialist referring to EQF level 4. With this in mind, the appropriate figures on the temporal as well as on the classification axes can be declared. Regarding a specific competency required for this qualification e.g. supply chain management, several skills must be obtained by employees with said qualification including project management, problem solving, negotiation, time management, communication skills, adaptability, inventory management, logistics and analytical skills. The required project management and problem-solving skills are solely applied in the field of logistics, so there is a deep knowledge of applying and developing solutions and innovations to problems occurring in warehouses such as spatial capacity shortages or directives of lawful storage. The skills problem solving, project management and innovation management are also required in several other occupations and are directly linked to respective sectors or environments due to laws, regulations, and products specialities.

Although, a warehouse logistics specialist does not present a high EQF level, the employee holding this qualification can demonstrate a higher proficiency level of a respective skill or competence due to working experience and sectoral specifications where skills are required to be applied to on a regular basis. In order to determine a more precise figure to that specific skill proficiency level, a fuzzy calculation needs to be done in consideration of all three matrix dimensions affecting the value that needs to be calculated.

As shown in

Figure 1, the skill range can vary depending on the homogeneity of the working environment for warehouse logistics specialists with the same vocational education and training. The more varied the tasks and the associated skills required to perform them, the higher the proficiency level.

Figure 1. *Representation of Different Levels of a Warehouse Logistics in the LCAMP Knowledge Graph*



Partial Skills

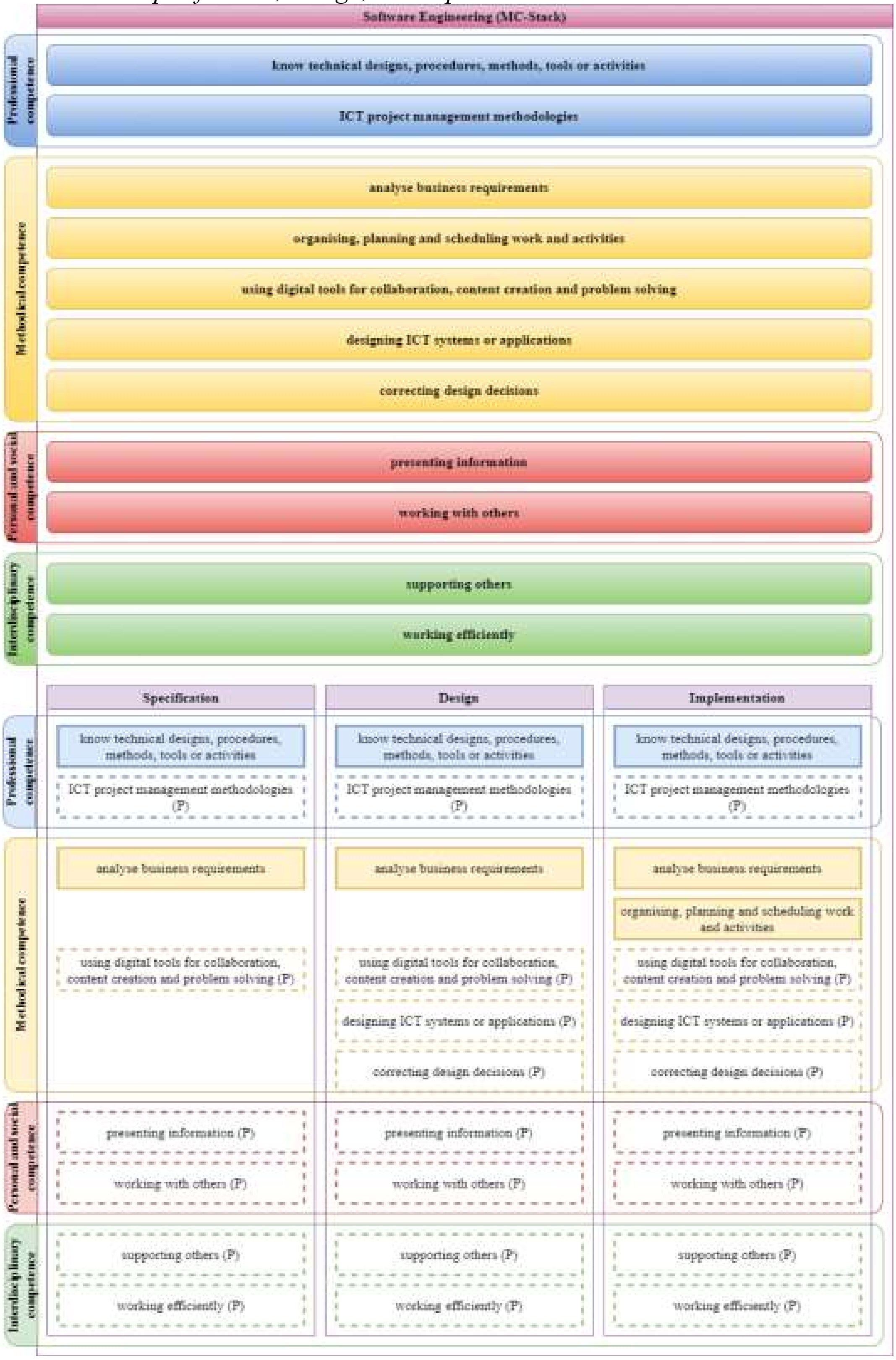
The main contribution of this paper is to define the concept of partial skills as a way to express the fact that aspects of a skill are taught in a certain micro-credential (MC) while not covering the whole breadth or depth of it. Only the combination with other MCs makes it possible to acquire the skill and get it certified. This can be done in the form of a MC stack.

As an example, let's consider our example module "Software Engineering". It consists of three units (MCs), covering a typical software engineering process: Specification, Design, and Implementation. In each of those, the students will gather phase specific knowledge like for example "analyse requirements" in the first phase, "designing ICT systems or applications" in the second and "continuous integration" or "correcting design decisions" in the third. The specific knowledges are easy to assign to the individual small MC most of the time. That's because the decomposition of the topic into these units typically depends on knowledge (DD level 1 and 2) rather than skills.

The problems start with the higher levels, like "presenting information“ or "working with others" (DD level 3 and 4). And this gets even worse with skills like "working efficiently“, "supporting others" or "thinking creatively and innovatively" (DD level 5). In these cases, the knowledges and skills are assigned to individual MCs, if they are covered only in this MC. If not, they are assigned as a "partial skill" with a special identifier (in this case "(P)") like "presenting information (P)". That means that they are not fully learned and/or explicitly assessed during this MC. Because of that, they are not shown on the external level on the MC certificate, but only defined on the internal level. The corresponding MC stack, in this case "Software Engineering" = {Specification, Design, Implementation} has all the original skills assigned to the module. Figure 2 shows the skills obtained by successfully completing the entire MC stack as well as the distribution of skills and partial skills in the individual MCs Specification, Design, and Implementation.

Typically, MC stacks are defined at the recognizing institution, so the information about the partial skills acquired through an individual MC is lost. To solve this, we propose the definition of a special kind of MC stack – skill-oriented MC – for this purpose. This stack is defined and assessed in full by the offeror of the MCs and can be recognized in full by any other institution. This process might need kind of a clearing house to finally decide if those future skills are given by a stack in the expected quality and quantity and defines, for what programs (at which EQF levels?) they can be recognized.

Figure 2. *MC stack Software Engineering with some of the obtained skills by completing the whole stack and distribution of the skills and partial skills between the three MCs Specification, Design, and Implementation*



Discussion

For external institutions as well as employers it is difficult to understand what skills have been obtained within a micro-credential (MC) and to what extent those imparted skills have been applied and assessed. The source of this problem of comprehension can be drawn to the description and phrasing of learning outcomes in curricula which are often depicted in academical or very generic terms instead of skills terms used within the labour market.

Using standardized terms to describe learning outcomes of MCs could present one solution to foster mutual transparency and understanding among academia and the labour market. A jointly used skills framework with common nomenclature to describe learning outcomes in skills and competences is crucial for this approach. At the moment, there are various skills frameworks to be found and used to describe and categorize competencies with different terms (Ward et al., 2023, p. 63). In each of the frameworks similar terms for competences and skills can be detected, however, the different competences and skills frameworks also demonstrate specific terms and descriptions of skills which are particularly used in the referring industry sector. With regard to Industry 4.0, most used and known skills and competence frameworks encompass the models of SFIA 8, KETs Skills framework and "A Competency Model for 'Industrie 4.0' Employees" by Prifti. The Prifti model and SFIA 8 model are competence-based frameworks with a similar target group. Whereas SFIA8 was developed for the ICT community, using terms well-known to business experts and technology experts (Seward, 2021), the "Competency Framework" by Prifti focuses on competences required from employees with degrees referring to either computer science, engineering, or information systems (cf. Prifti et. Al. 2017, p. 10). The KETs Initiative study by PricewaterhouseCooper focused on demanded skills for key enabling technologies and the developed framework addresses employees working in the industry sector of advanced manufacturing and key technology users (European Commission et al., 2016, p. 36). Regarding the competence "negotiation" you can find the same term for this competence in the framework by Prifti, the KETs model uses the skill "deal negotiation skill" whereas in SFIA8 the competence cannot be found.

The lack of a commonly used framework impedes the process because the terms used in the varying frameworks differ drastically and so skill terms to describe learning outcomes cannot be compared accurately among providers and employers. Furthermore, to use the approach of the QAA and exactly and transferable depict the skills hours in MCs, a unified scale needs to be developed and presented, a scale to demonstrate with which number of skills hours a transversal skills category is considered to have been acquired and not only taught as a partial skill, so other HEIs and educational providers can estimate ones proficiency or skills acquirements. Moreover, that approach can also be beneficial for learners to understand their own development better and make more informed choices on further required skill developments (Ward et al., 2023, p. 68).

Conclusion

If there is no commonly accepted scale to quantify the amount of transfer of a skill in one micro-credential, a less precise method - partial skills - can be used. Primarily intended for internal use or in a small alliance, it is easy enough to be understandable for external users as an indicator, that a certain skill has been imparted at least partially, whatever that means.

Maybe finding a method to describe the achievement of a partial skill is a more general problem than just in the context of micro-credentials: it is a general problem, if transversal skills are not taught separately in special modules about for example critical thinking, but are distributed over more than one, maybe even many modules.

For example, at DHBW many transversal skills (like project management or critical thinking) in technical programs are taught separately in a module called "Schlüsselqualifikationen" (key qualifications in English). They are only mentioned as soft skills in some other technical project-oriented modules like "Software Engineering" where students work on a project and learn for example project management by doing it.

Our anecdotal experience shows that the students learn these skills better in the technical context of their discipline. So, it might make sense, to abandon the special modules for transversal skills and integrate them into technical courses. Recent EU-projects indicate this trend as well, for example "Transversal skills cannot be learned on their own. In fact, the opposite is true, since they are skills that must be achieved in a social context with other people. For that reason, these skills are often taken for granted in the educational context in general, and there is evidence that more attention needs to be placed on these skills in the HE context specifically" (Carrió, 2022). Similar results can be seen in other projects, for example (Cimatti, 2016).

This change would mean that even when not using micro-credentials, a way to specify and collect partial skills in these areas is needed for the definition of transversal skills as outcomes of individual modules on the level of study programs.

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