Open Virtual Mobility

O5 Open Credentials and Gamification:

O5-A1: Open Credentials Concept

MILESTONE 5: FINAL CONCEPT AND REPORT

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This paper is a public document produced as part of Outcome O5-A1 “Conceptual and Visual Design of Open Credentials ” and describes milestone 5 in O5-A1 (O5-A1.5), i. e. Final concept and report.

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Executive summary

This paper is the **final concept and report** (milestone 5) on OpenVM Credentials. The final concept is based on design iterations described in publications related to milestones 1, 2, 3 and 4 (see below). The report is based on the data from the online evaluation survey with n = 1412 learners in the OpenVM Learning Hub. This publication is the final document following the workflow in O5-A1:

Milestone 1: O5-A1.1: Definition of the design process and tools (February 2018)
Milestone 2: O5-A1.2: Design workshops with VM experts (May 2018)
Milestone 3: O5-A1.3: Set of open credentials to recognise VM skills (September 2018)
Milestone 4: O5-A1.4: Implementation in the VM Learning Hub and User-Testing (January 2019)
Milestone 5: O5-A1.5: Final concept and report (August 2020)

What are the objectives of this paper?

This paper presents the final concept of OpenVM credentials resulting from joint and iterative design, implementation and user-testing of OpenVM Credentials in the OpenVM Learning Hub: https://hub.openvirtualmobility.eu

The aim of this report is to:

A. Present the final concept of the two categories of OpenVM Credentials:

1. **Competence Credentials** used in OpenVM MOOCs at three levels
2. **Contributor Credential** used to recognise contributions to the OpenVM project

B. Present the results from the online survey with n = 1412 learners in OpenVM MOOCs.

Who is this paper for?

This paper addresses educators, students, international officers and higher education leaders as well as a wider academic audience interested in open digital credentials in context of international mobility in higher education in Europe and beyond. This paper also addresses the reviewers of the interim report for the Open Virtual Mobility project assigned by the National Agency DAAD.

What topics are addressed in this paper?

This paper addresses the following two key topics related to OpenVM Credentials: (1) final concept, and (2) report on evaluation results.

Contributors

Prof. Dr. Ilona Buchem

Ilona Buchem is Professor for Media and Communication at Beuth University of Applied Sciences Berlin, Faculty I Economics and Social Sciences. She is the coordinator of the Open Virtual Mobility Erasmus+ strategic partnership. Ilona Buchem has led a number of projects dedicated to Open Education and international exchanges in higher education, including Open Badge Network (Erasmus+, Strategic Partnership, KA2 2014-1-DE01-KA200-000675), BeuthBonus and CreditPoints (Qualification Programs for Migrant Academics, German Federal Program "Integration through Qualification") and Digital Future (Digital Strategies for Higher Education, Stifterverband - German Association of Foundations for Science). Her current research focuses on fostering diversity through educational technology and new media, and closing the digital divide. Ilona Buchem has extensive experience in designing and fostering national and international virtual mobility actions in higher education including: Seminar 2.0, iCollaborate, Future Social Learning Networks projects.

Chiara Carlino

Chiara Carlino works at CINECA, the main italian inter-university consortium, as consultant for Cineca's Business Unit dedicated to Universities. Chiara Carlino holds a Master Degree in Philosophy from the University of Bologna and a second level Master Degree in Web Technologies. Starting with semantic web, she developed competencies in digital communication, web analysis, user interface and experience design, functional requirements analysis for software applications and the communication of IT projects, products and activities. She has worked with Open Badges since Bestr startup in 2015, supporting public administration and companies in identifying which improvements the technology could add to their processes. She has participated in the organization of conferences (ePic 2016 and 2017) and presented at numerous events on the subject.

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1. Previous work

The main aim of Output 5 Activity 1 (O5-A1) was to design, develop, implement and test concepts for Open Credentials. O5-A1 focused on designing, implementing and testing of digital micro-/credentials for the recognition of virtual mobility skills of teachers and students in higher education. The concept of OpenVM Credentials was developed throughout the project lifetime following the workflow in O5-A1 (as described in the project application):

Milestone 1: O5-A1.1: Definition of the design process and tools (February 2018)
Milestone 2: O5-A1.2: Design workshops with VM experts (May 2018)
Milestone 3: O5-A1.3: Set of open credentials to recognise VM skills (September 2018)
Milestone 4: O5-A1.4: Implementation in the VM Learning Hub and User-Testing (January 2019)
Milestone 5: O5-A1.5: Final concept and report (August 2020)

The results from all milestone were published step by step on the project website and all publications are available on the web page dedicated to Output 5 at:
https://www.openvirtualmobility.eu/topics/outputs/o5-credentials-gamification/

The previous publications are listed below. Please refer to the listed documents for further details related to the specific milestones and topics related to OpenVM credentials:

Report on milestones 1, 2 and 3 (November 2018 / Quality Gate 2):
Buchem, I. & Carlino, Ch. (2018). Conceptual and Visual Design of Open Credentials to Recognise Virtual Mobility Skills. Open Virtual Mobility Erasmus+ (2017-2020). Retrieved from: https://www.openvirtualmobility.eu/wp-content/uploads/2018/11/OpenVM_O5-A1-publication2018.pdf

Reports on milestone 4 (November 2019 / Quality Gate 3 + update in May 2020 / Quality Gate 4):
Buchem, I. & Carlino, Ch. (2019). Milestone 4: Implementation and User-Testing of Open Credentials to Recognise Virtual Mobility Skills in the OpenVM Learning Hub. Open Virtual Mobility Erasmus+ (2017-2020). Retrieved from https://www.openvirtualmobility.eu/wp-content/uploads/2019/11/openVM_O5-A1-QG3_2019_CURRENT.docx.pdf

Buchem, I. & Carlino, Ch. (2019). Update of Milestone 4: Implementation and User-Testing of Open Credentials to Recognise Virtual Mobility Skills in the OpenVM Learning Hub. Open Virtual Mobility Erasmus+ (2017-2020). Retrieved from

https://www.openvirtualmobility.eu/wp-content/uploads/2020/05/OpenVM_O5-A1-Credentials_QG4_2020_CURRENT.docx.pdf

OpenVM Credentials in the OpenVM Brochure:
OpenVM Credentials were also portrayed in the OpenVM brochure:
https://www.openvirtualmobility.eu/wp-content/uploads/2020/04/OpenVM-Erasmus-brochure.pdf

Academic publications
Beside the above mentioned project reports and the brochure, the outcomes of O5-A1 were documented in the academic papers in journals and conference proceedings:

- Buchem, Ilona & Gené, Oriol Borrás (in review). Motivational Effects of Open Badges in MOOCs. A learner perception study in MOOC Platforms OpenVM Learning Hub and MiriadaX. E-mentor journal 85 (3), 2020.
- Buchem, I. (2018). Design patterns for digital competency credentials based on open badges in the context of virtual mobility. Development of generative design patterns for competency credentials. In D. Schiffner (Eds.): Proceedings of DeLFI Workshops 2018, co-located with 16th e-Learning Conference of the German Computer Society (DeLFI 2018), Frankfurt, Germany, September 10, 2018 Lecture Notes in Informatics (LNI), Gesellschaft für Informatik, Frankfurt 2018. Retrieved from: http://ceur-ws.org/Vol-2250/WS_DK_paper1.pdf
- Konert, J., Buchem, I, Stoye, J. (2019). Digital competence directory with semantic web technology linking digital proofs of competence with machine-readable competence definitions: A practical solution used in the Open Virtual Mobility project. In Sandra Schulz (Eds.): Proceedings of DELFI Workshops 2019 Berlin, Germany, September 16, 2019. Retrieved from: https://dl.gi.de/bitstream/handle/20.500.12116/27971/DELFI-Workshopband.pdf
- Buchem Ilona & Konert Johannes (2020). Semantic Competency Directory for Constructive Alignment in Digital Learning Designs and Systems. In: Popescu E., Hao T., Hsu TC., Xie H., Temperini M., Chen W. (eds) Emerging Technologies for Education. SETE 2019. Lecture Notes in Computer Science, vol 11984. Springer, Cham. Retrieved from: https://link.springer.com/chapter/10.1007/978-3-030-38778-5_11
- Rajagopal, K., Firssova, O., Op de Beeck, I., Van der Stappen, E., Stoyanov, S., Henderikx, P., & Buchem, I. (2020). Learner skills in open virtual mobility. Research in Learning Technology, 28. Retrieved from: https://doi.org/10.25304/rlt.v28.2254
- Buchem, I., Poce, A. & Tur, G. (2019) Microlearning in MOOCs. A case study on designing engaging micro-learning experiences in the Media and Digital Literacy MOOC. Comunicación

y Pedagogía, No. 315-316, Microlearning, pp. 7-12, Retrieved from: http://www.centrocp.com/comunicacion-y-pedagogia-315-316-microlearning

- Tur, G., Firssova, O., Rajagopal, K., Buchem, I. (2018). Open Virtual Mobility: A learning Design 4 SRL. Proceedings of the EDEN 2018 Research Workshop, Barcelona 2018. Retrieved from: https://research.ou.nl/en/publications/open-virtual-mobility-a-learning-design-4-srl
- Buchem, I., Tur, G., Urbina, S. (2018). Quality assurance for attainment, assessment and recognition of virtual mobility skills in context of open education. QA Framework in the Open Virtual Mobility project. Paper presented at Edulearn Conference 2-4 July 2018. Retrieved from: https://iated.org/concrete3/view_abstract.php?paper_id=65036
- Buchem, I.; Konert, J., Carlino, Ch., Casanova, G., Rajagopal, K., Firssova, O. & Andone, D. (2018). Designing a Collaborative Learning Hub for Virtual Mobility Skills – Insights from the European Project Open Virtual Mobility. In: P. Zaphiris and A. Ioannou (Eds.) Learning and Collaboration Technologies. Design, Development and Technological Innovation. Springer International Publishing AG, Lecture Notes in Computer Science, vol. 10924, pp. 350-376. ISBN 978-3-319-91742-9, Retrieved from: https://link.springer.com/chapter/10.1007/978-3-319-91743-6_27

2. Final Concept

The final concept of OpenVM credentials comprises altogether **25 credentials**:

- **24 Competency Credentials** (8 competency areas at 3 levels: foundations, intermediate and advanced) issued upon completion of OpenVM MOOCs, and
- **1 Contributor Credential** issued for contributions to the OpenVM project.

The design and implementation of OpenVM Credentials is based on open standards Mozilla **Open Badges 2.0** and **Blockcerts** and adjusted for the best fit to enhance the recognition and representation of virtual mobility skills in different competency areas and at different skill levels.

OpenVM Credentials were implemented on Bestr (CINECA's Digital Credential's platform) (O2) and connected to the OpenVM MOOCs (O6) hosted in the **OpenVM Learning Hub**: https://hub.openvirtualmobility.eu/login/index.php

All OpenVM Credentials are listed on the dedicated **Bestr website**: https://bestr.it/organization/show/99

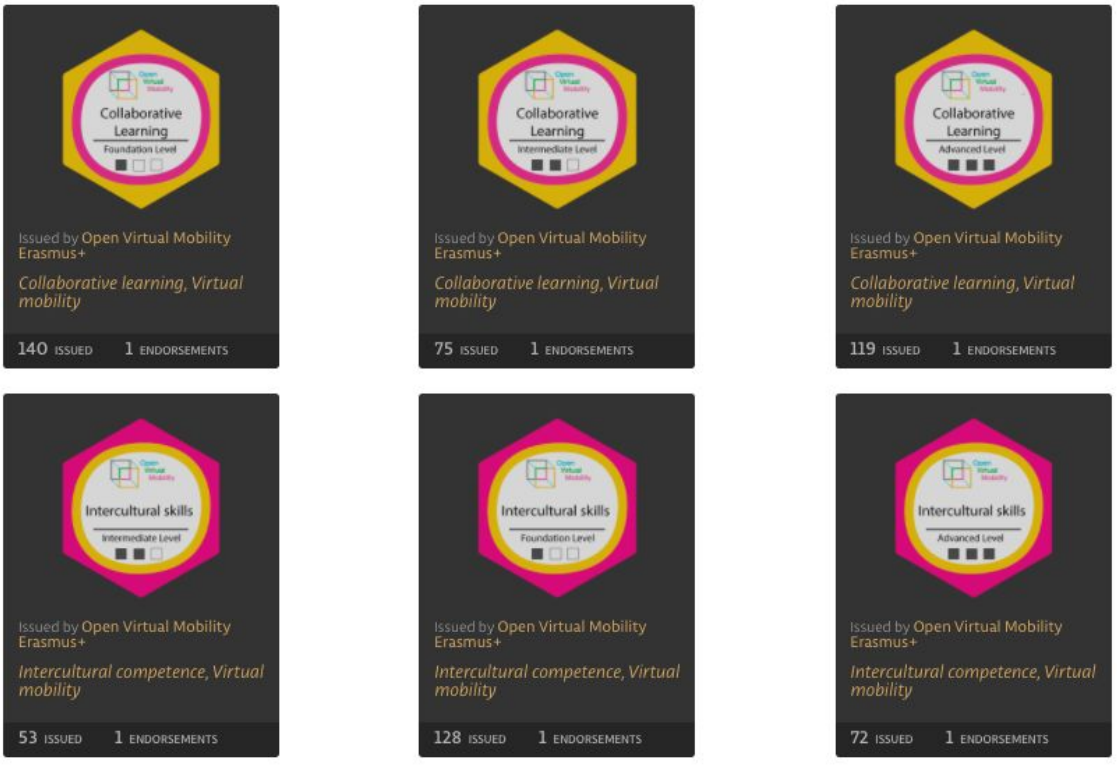

Figure 1: Example of OpenVM Badges presented on the Bestr website

2.1 Alignment with project objectives and outputs

One of the key objectives of the OpenVM project was to improve the achievement and recognition of virtual mobility skills. The methodology applied to implement the project in high quality combined the elements of distributed leadership and agile project management as described in the project application. One of the key principles in the project was: "The objectives of the project can be achieved only as a joint effort." The OpenVM Credentials in O5-A1 have been interlinked and fine-tuned to all other outputs in the OpenVM project, i. e.:

1. **O1 Framework and Guidelines:** OpenVM Credentials were developed in alignment with the conceptual framework of OpenVM competencies developed in O1 following the Group Concept Mapping methodology. The eight key areas of OpenVM competencies developed in O1 served as a groundwork to design the corresponding OpenVM Credentials for the eight competency areas.

2. **O2 OpenVM Learning Hub:** OpenVM Credentials were implemented in Bestr and connected for automatic assignment upon course completion to the MOODLE-based OpenVM Learning Hub leveraging the module Logstore-xapi plugin[1].

3. **O3 Competency Directory:** OpenVM Credentials link to competency descriptions stored in the semantic competency directory, which lists all skills listed in the metadata of OpenVM Credentials in human and machine-readable way.

4. **O4 E-Assessments:** OpenVM Credentials are issued upon successful completion of e-assessments in OpenVM MOOCs; passing e-assessment is the criteria for issuing each of the OpenVM Credentials, as described in the criteria metadata field in OpenVM Credentials.

5. **O6 OpenVM MOOCs:** OpenVM Credentials are embedded in each OpenVM MOOC and serve as orientation and visualisation of Learning Outcomes. Upon successful completion of each OpenVM MOOC, learners can claim an OpenVM Credential which recognises/certifies the skills developed at one of three levels.

6. **O7 Quality Assurance:** OpenVM Credentials have been aligned to the quality assurance criteria for issuing OpenVM Credentials with focus on open education and self-regulated learning in context of open education including MOOCs. The evaluation survey specifically addressed the question of how OpenVM Credentials supported self-regulated learning in MOOCs.

[1] https://github.com/CinecaElearning/moodle-logstore_xapi-cineca.

2.2 Design of OpenVM Credentials

2.2.1 OpenVM Competence Framework

The design of Open Credentials in the OpenVM project expresses the **OpenVM Competence Framework (O1)** with eight competence areas, each operationalised by a specific sub-set of skills. These eight competence clusters are the result of Group Concept Mapping (GCM) research conducted as part of research in O1 project with European experts in both Virtual Mobility and Open Education. Based on the outcomes of the GCM study, seven competence areas were identified including their constituent skills and subskills. Furthermore, an additional, eighth, competency area on the knowledge of the concept of (open) virtual mobility was added to the OpenVM competence framework.

The eight competency areas are:

1. **Media and digital literacy**
2. **Active self-regulated learning skills**
3. **Autonomy-driven learning**
4. **Networked learning**
5. **Intercultural skills and attitude**
6. **Interactive and collaborative learning in an authentic international environment**
7. **Open-mindedness**
8. **Open virtual mobility knowledge**

OpenVM Credentials can be earned upon successful completion of a MOOC level. Each MOOC level-course ends with an OpenVM Credential which recognizes a particular skill at **Foundation, Intermediate or Advanced Level**. Upon successful completion of each level-course, the learner can earn an OpenVM Credential which certifies the learner's competencies at this particular level.

OpenVM Credentials describe the OpenVM skillset coherently with the skills identified in the GCM research. OpenVM Credentials also link to the **competency directory**[2] in which competency descriptions are human- and machine-readable to allow exploration of relations between competencies. The criteria that need to be met to obtain a specific Open Badge are expressed transparently and have a specific connection with the activities required by the mini-MOOCs in the OpenVM Learning Hub.

[2] http://cd.openvirtualmobility.eu/

Moreover, OpenVM Competencies are mapped to the European Skills Competency and Occupation framework (ESCO)[3], which has been considered as a valuable reference for OpenVM skills and reflected in the design of the Competency Directory in Output 3.

Figure 2 below shows how the competency area "Intercultural skills and attitude" was operationalised by a set of sub-skills, which in turn are used in the description of OpenVM Credentials with links to the semantic competency directory (O3). Figure 3 shows how these links are expressed in the human-readable descriptions of Badges as hyperlinks; the same link is also expressed in a machine-readable format as will be explained in paragraph 2.2.4.1.

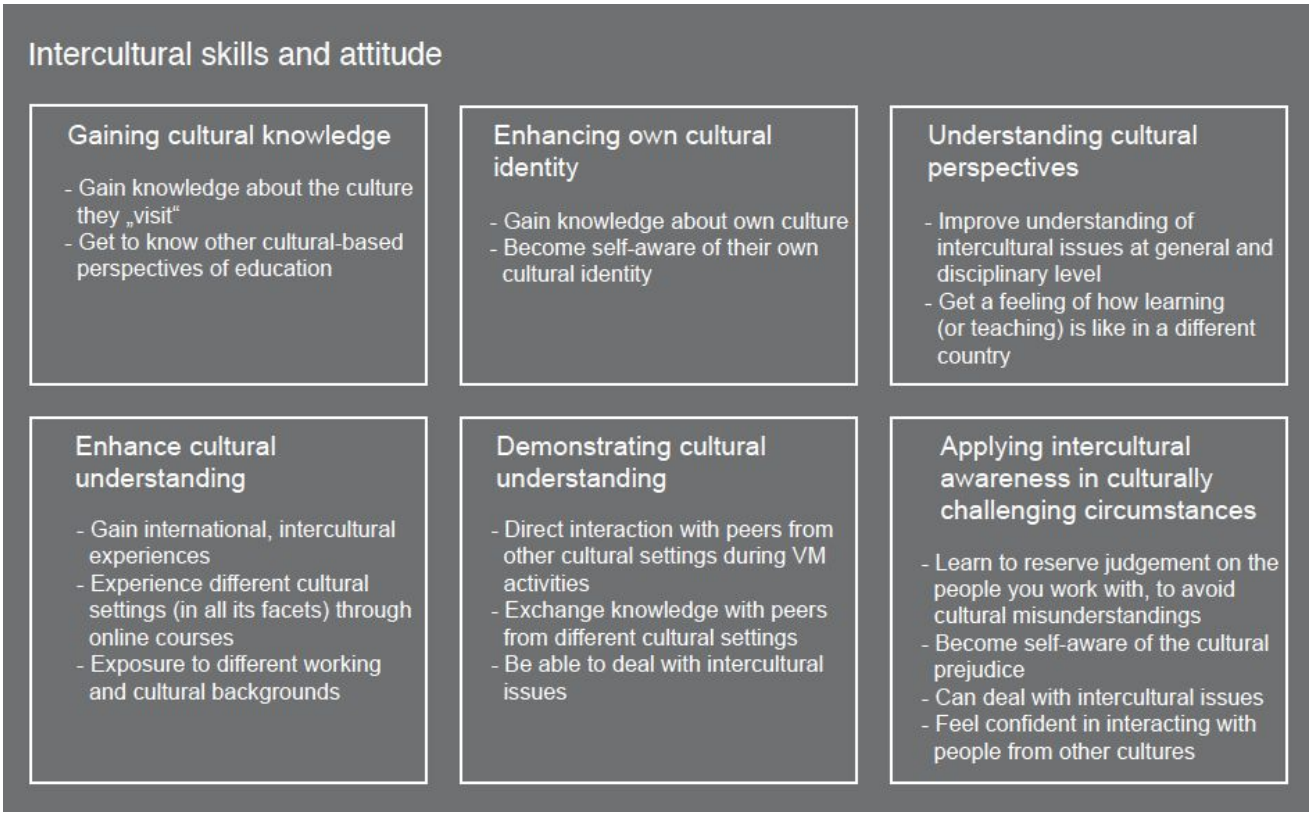

Figure 2: Example of how OpenVM Competencies were operationalized in O1.

[3] https://ec.europa.eu/esco/portal/home

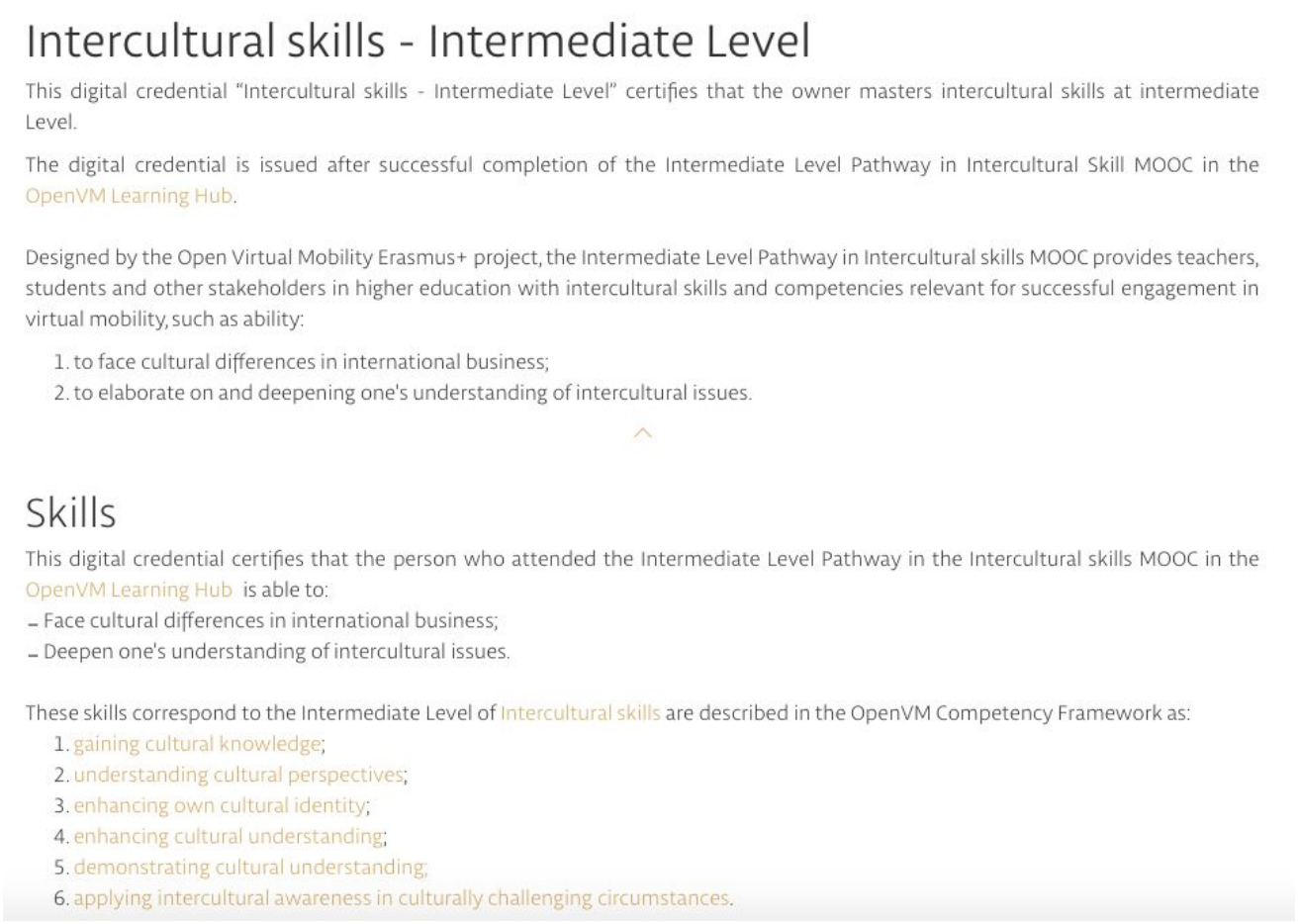

Figure 3: Example of how OpenVM Credentials expressed the competencies from O1, with textual links.

2.2.2 Badge prototypes and final designs

OpenVM Credential **prototypes** were created using a number of templates, such as: (a) Bestr template for creating a badge in Bestr, (b) Badging Toolkit[4] and (c) Badge Design Canvas.[5] First prototypes were built during the expert/stakeholder workshop in May 2018 (early-stage, low-fidelity prototypes) and refined as follow-up to the workshop from June until July 2018 (later-stage, high-fidelity prototypes). The prototypes were abstracted into **design patterns**, which served as a generic template for the design of a set of OpenVM Credentials. The generative design pattern for Open Credentials in the OpenVM project was described in the DeLFI 2018 research paper by Buchem (2018). The visual design of Open Credentials applied the four OpenVM **colors from the project's visual identity** scheme.

Table 1 below shows the design of the set of altogether 24 OpenVM Competence Credentials recognising OpenVM Competencies in the OpenVM project. Table 1 below shows the designs of all 24 Competency Credentials in the OpenVM project.

[4] https://canvas.instructure.com/courses/826612/files/26095979?module_item_id=5382496
[5] https://drive.google.com/file/d/0By9JfART0xQ8dVdXT3VxY2NnRFE/view

Table 1: Designs of the set of 24 OpenVM Competence Credentials (8 competence types x 3 levels)

LEVEL 1 FOUNDATION	LEVEL 2 INTERMEDIATE	LEVEL 3 ADVANCED
		
		
		


Networked Learning
Foundation Level
Networked Learning
Intermediate Level
Networked Learning
Advanced Level
Open Mindedness
Froundation Level
Open Mindedness
Intermediate Level
Open Mindedness
Advanced Level
Virtual Mobility Knowledge
Froundation Level
Virtual Mobility Knowledge
Intermediate Level
Virtual Mobility Knowledge
Advanced Level
Autonomy-driven Learning
Foundation Level
Autonomy-driven Learning
Intermediate Level
Autonomy-driven Learning
Advanced Level

Figure 4 below shows the design of the Contributor Badge and how is displayed at the Best website[6] . The figure shows that the Contributor Credential was issued 103 times and has 1 endorsement.

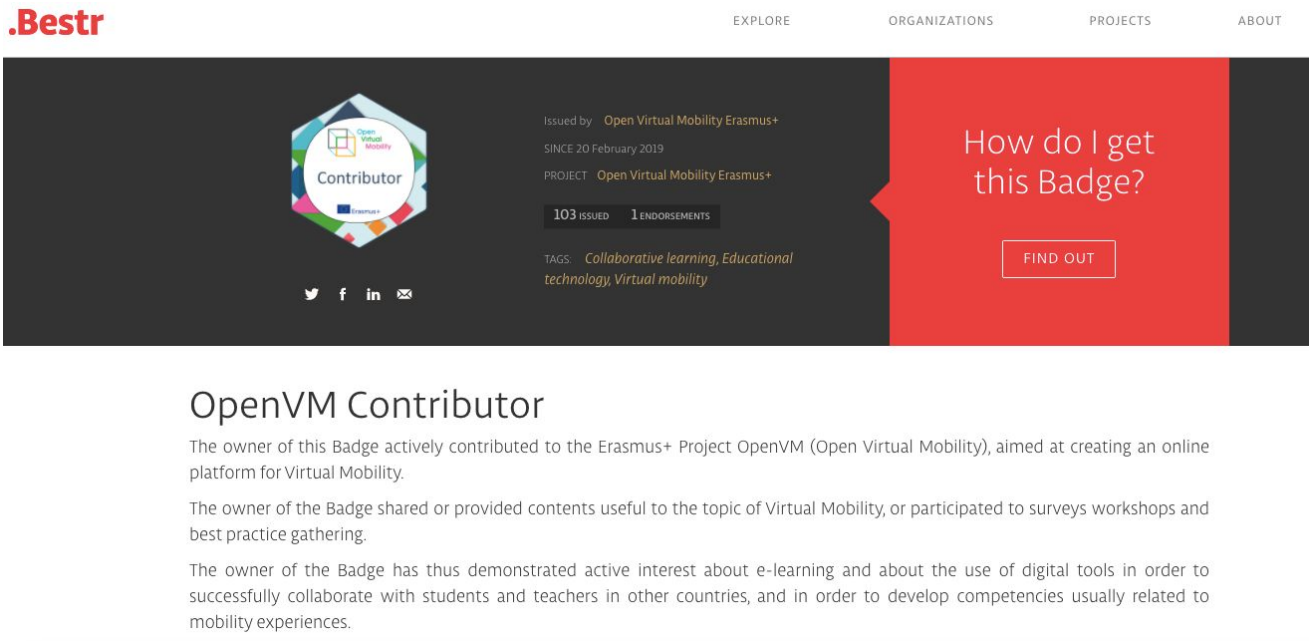

Figure 4: Design of the OpenVM Contributor Badge and display in Bestr website

2.2.3 Endorsement

The endorsement of Open Badges is associated with accreditation, where "third parties" review and verify the quality of the credential. All eight Open Badge classes for Competency Credentials were endorsed on behalf of the associated partner **EDEN** on the Bestr platform. EDEN endorsed 24

[6] https://bestr.it/badge/show/822

OpenVM Credentials with verifying statements. Figure 5 below shows an example of an endorsement for Collaborative Learning Intermediate Level Credential[7]:

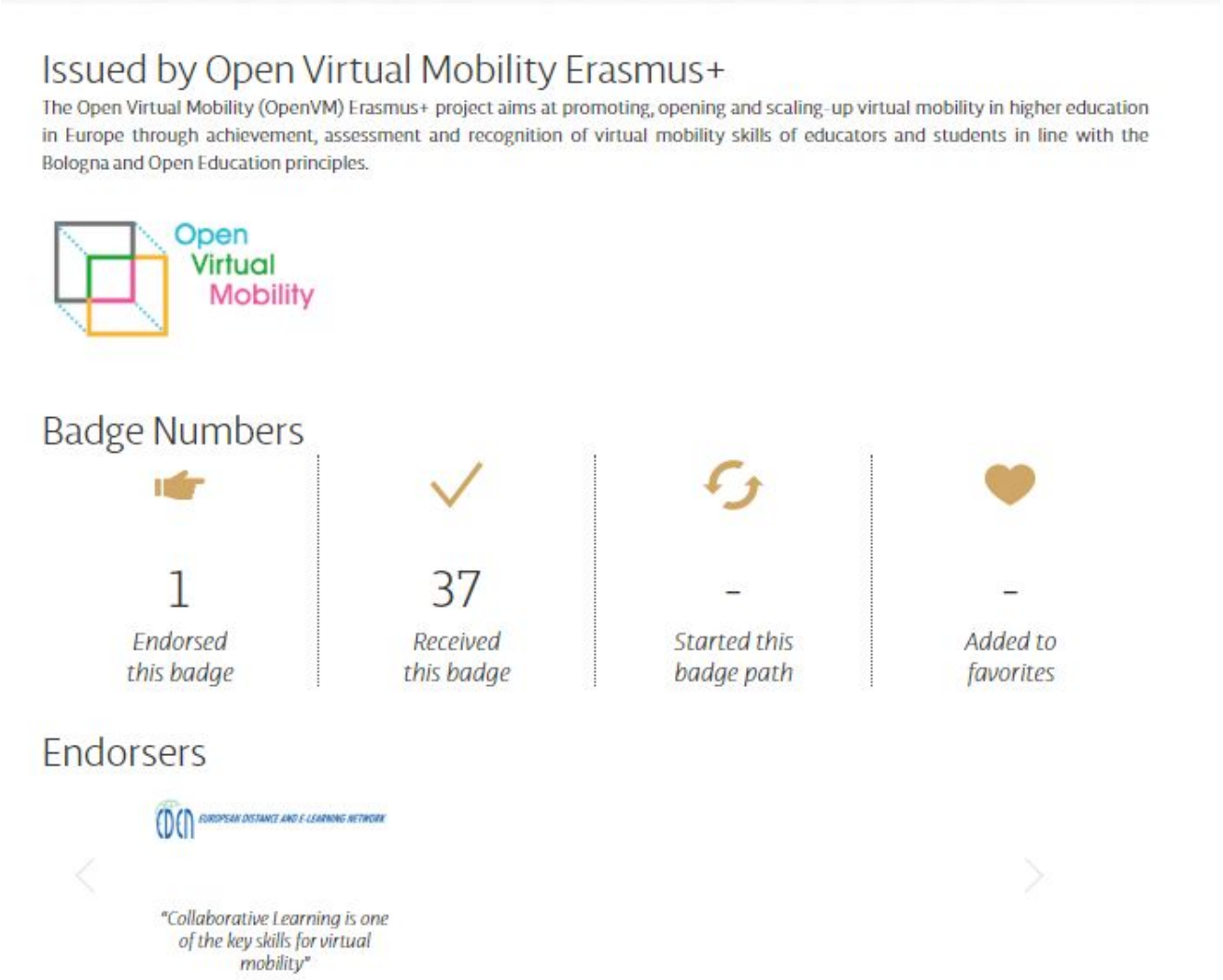

Figure 5: Example of an endorsement in OpenVM Credentials

2.2.4 Implementation

All 24 OpenVM Competence Credentials were connected to the respective MOOCs in the OpenVM Learning Hub. Each Competence Credential is issued upon course completion at three levels corresponding to the levels of the MOOCs, i. e. Foundation, Intermediate and Advanced.

[7] https://bestr.it/badge/show/1041

Figure 6 below shows how OpenVM Competence Credentials are integrated into the MOOC design and implemented in the OpenVM Learning Hub. OpenVM Competence Credentials are issued upon the completion of each level course, without the need to issue Competence Credentials after the completion of multiple learning statements. This implementation procedure simplifies both the design and the understanding of the connection between courses and credentials, according to a gamification logic.

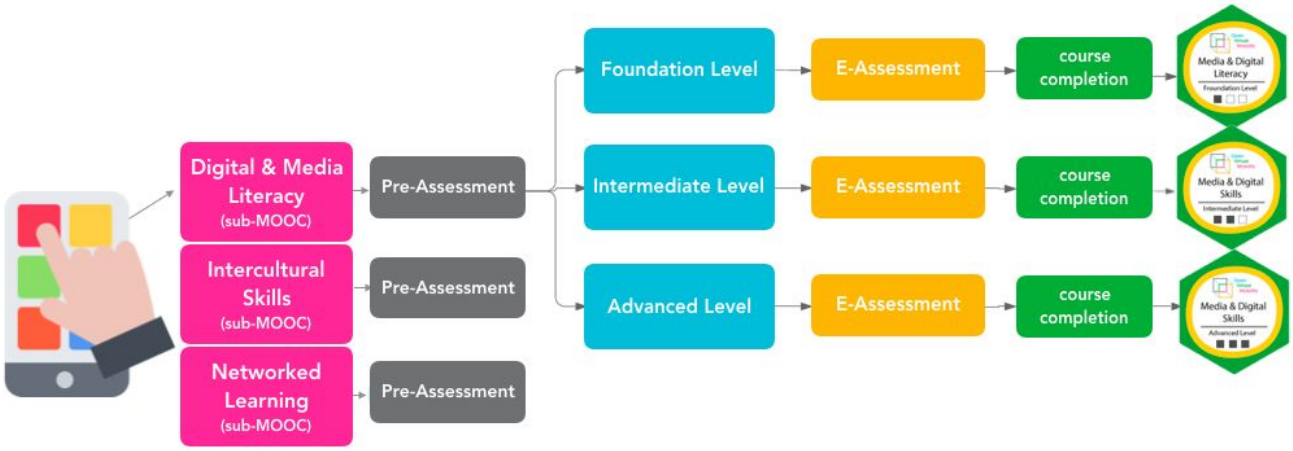

Figure 6: Implementation of Open Credentials in the MOOC

The sections below describe the implementation of OpenVM credentials as Open Badges and as Blockcerts in more detail.

2.2.4.1 OpenVM Competency Credentials

The full set of OpenVM Credentials has been implemented in the eight MOOCs in the OpenVM Learning Hub via the badging platform Bestr. Bestr, besides the credentials, has provided:

- a dedicated webpage for the issuer[8]
- a dedicated webpage for the project[9]

The issuer of all OpenVM Credentials is the OpenVM project. All OpenVM Credentials on the Bestr platform are available in English and Italian.

OpenVM project uses Bestr, the digital credentialing platform of the project partner Cineca, to recognize skills through Open Badges. The Bestr platform is used to store, issue and display Open Badges. Bestr has its own Learning Record Store and is capable of collecting xAPI statements from any platform integrated with it. When the Bestr platform identifies that in its Learning Record Store

[8] https://bestr.it/organization/show/99
[9] https://bestr.it/project/show/107

a set of statements for a given subject (the learner) is matching the criteria required for issuing/earning an Open Badge, this badge is issued to the learner (earner). Having obtained an Open Badge is a new learning statement (a new learning achievement), which can be tracked by the Learning Record Store and used as a starting point for issuing a new Open Badge. Leveraging this system based on open standards, the OpenVM Learning Hub would be able not only to express its own learning statements connected to learning activities provided by the OpenVM project, such as OpenVM MOOC and OER, but also - hypothetically - to capture learning statements from any other compliant and authorised platform towards the LRS, and use any set of such information to activate the automatic issuing of Open Badges.

Each MOOC course-level is connected to the specific OpenVM Credential to highlight the Learning Outcome, improve orientation, enhance motivation and focus the attention during the learning process on developing a given skill set. The completion of each of the MOOCs in the OpenVM Learning Hub generates a “completed” statement that triggers the issuing of the corresponding Open Badge. Figure 7 below shows an example of how Collaborative Learning Credential at Intermediate Level is embedded in the user interface for the corresponding OpenVM MOOC level-course.

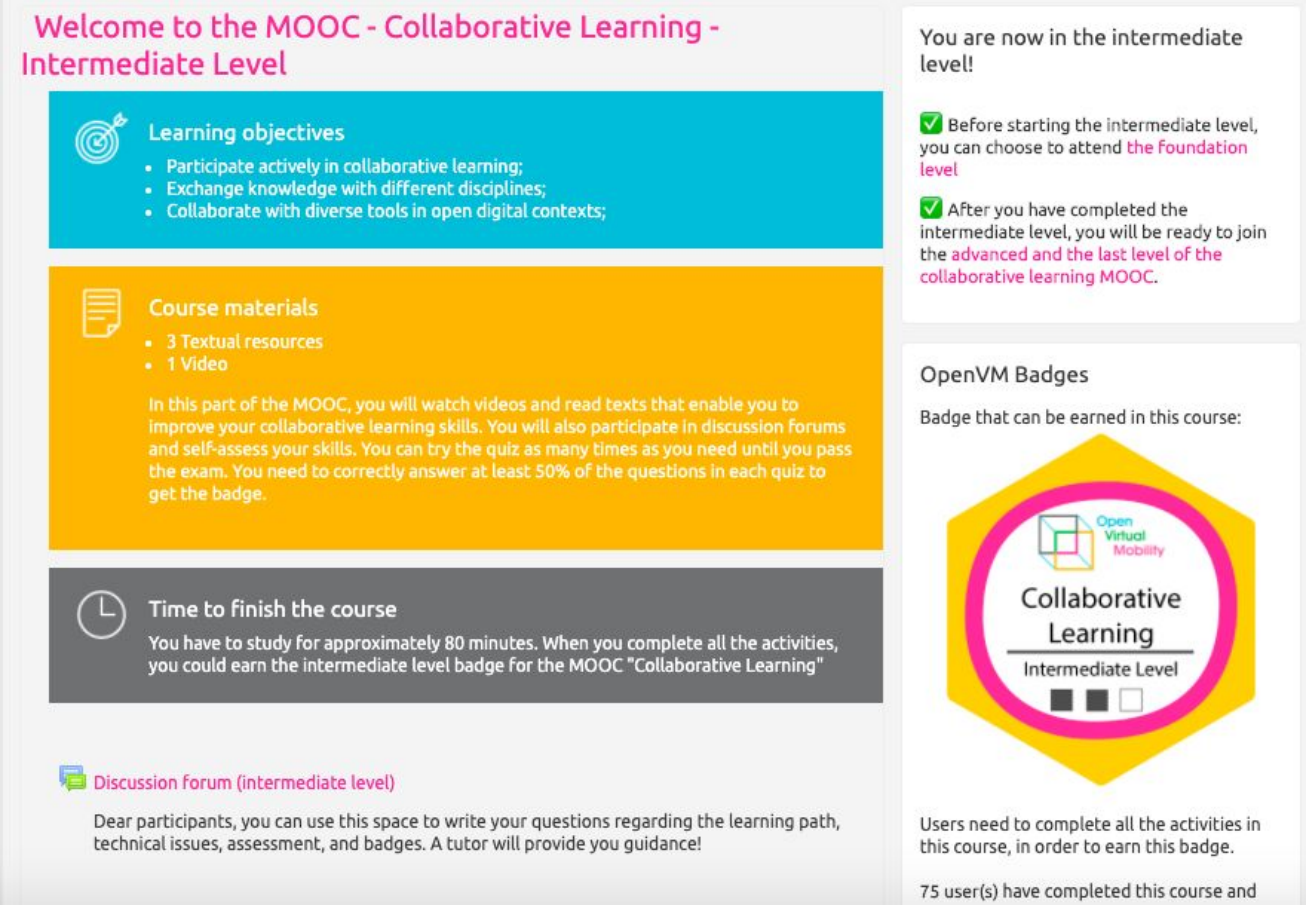

Figure 7: Example of the OpenVM Credential implemented in the MOOC

The upgrade of Bestr infrastructure to support Open Badges 2.0 has allowed the embedding of the alignment metadata field[10], so that links to the Competency Directory can be also expressed as metadata in a machine-readable way. Figure 8 below shows how an Open Badges 2.0 compliant platform can read such data[11].

[10] https://www.imsglobal.org/sites/default/files/Badges/OBv2p0Final/index.html#Alignment
[11] https://badgr.com/public/assertions/UX1vUDv6TfWILN46Kasn4A

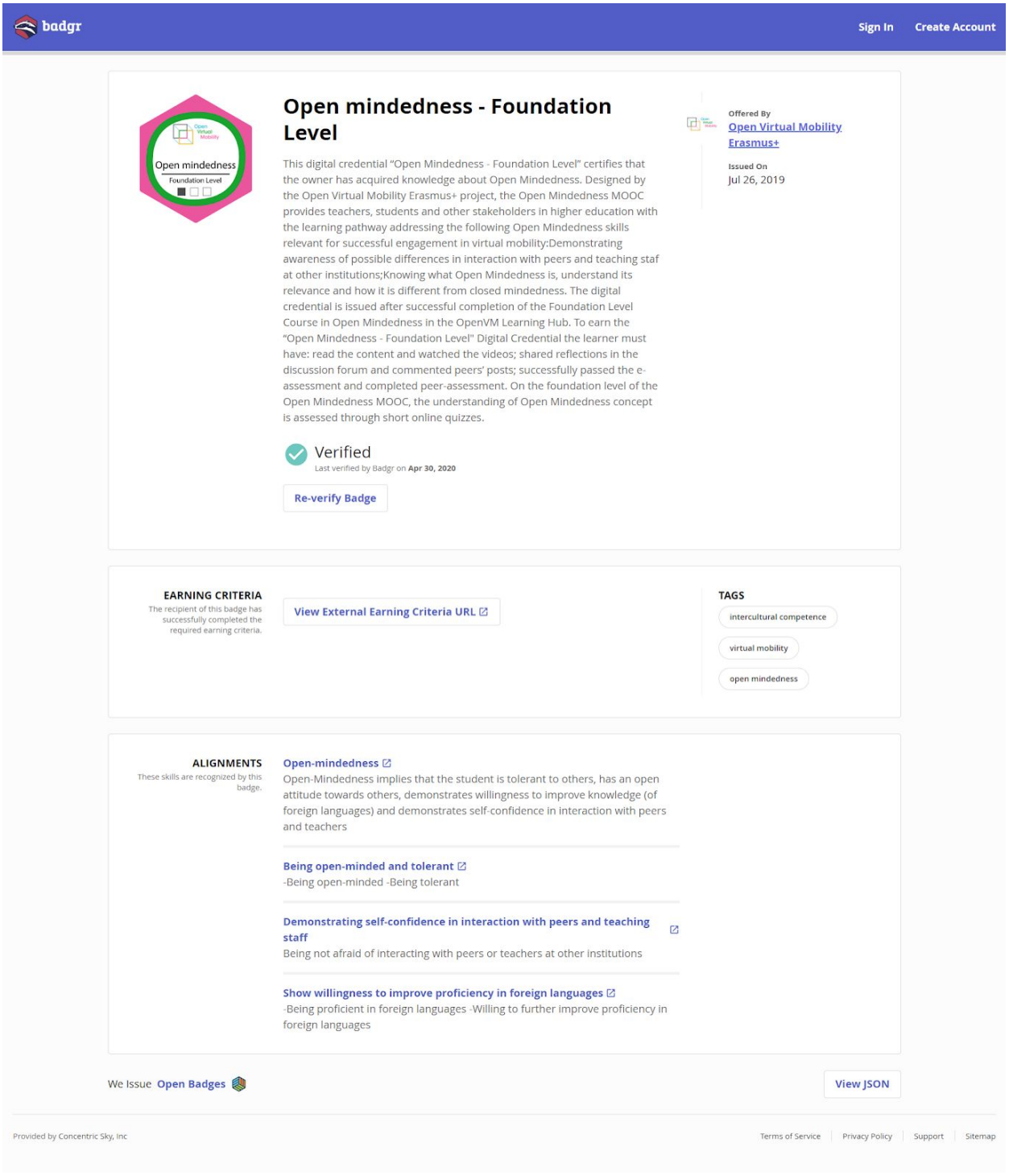

Figure 8: Example of the OpenVM Credential based on Open Badge 2.0 standard in Badgr

OpenVM Badges are connected to the Competency Directory produced by O3 not only via hyperlinks in the description of the Badge and its competencies, but also through this machine-readable format, which can be seen by users by uploading the Badge on any platform supporting the display of Open Badges 2.0 (cf. Figure 8).

The chosen implementation for the alignment field and the re-deployment of Open Badges in 2.0 format has been implemented for all OpenVM Badges - including the previously issued ones. This means that all OpenVM Badges are now enriched with alignment metadata: users only need to re-download the Badge from the platform to have the upgraded version.

2.2.4.2 OpenVM Contributor Credential

The OpenVM contributor credential – Contributor Badge[12] – was published in February 2019. The concept behind the Contributor Badge is that of recognizing not only the competencies developed by learners following the MOOCs offered by the project, but also active contribution to the project itself. The OpenVM Contributor Badge can be issued to students, teachers, peers and project members who provided valuable feedback or other contribution in different stages of the project. Such contributions include participation in the Group Concept Mapping, sharing of virtual mobility experiences and best practices in the OpenVM Learning Hub, co-/producing OERs for OpenVM[13], using OpenVM MOOCs in their own courses, providing feedback and participating in the MOOC evaluation.

The process for issuing of the Contributor Credential was modified in 2019 to make the process more straightforward and to better comply with the data protection regulations (GDPR). To reach these aims, a separate course in the OpenVM Learning Hub was created and specified a number of options expressing the ways in which anyone can contribute to the OpenVM project.
These options include:

1. I have created content for the OpenVM Learning Hub, available in the OpenVM OER Repository: https://hub.openvirtualmobility.eu/course/index.php?categoryid=5
2. I have contributed to the OpenVM Market: https://hub.openvirtualmobility.eu/course/view.php?id=52
3. I have participated in an OpenVM survey, e. g. MOOC evaluation survey.
4. I have created a MOOC related to virtual mobility in my own language.
5. I have participated in an OpenVM event.

Figure 9 below shows how OpenVM Contributor Credential has been implemented in the OpenVM Learning Hub.

[12] https://bestr.it/badge/show/822
[13] https://www.openvirtualmobility.eu/oer/

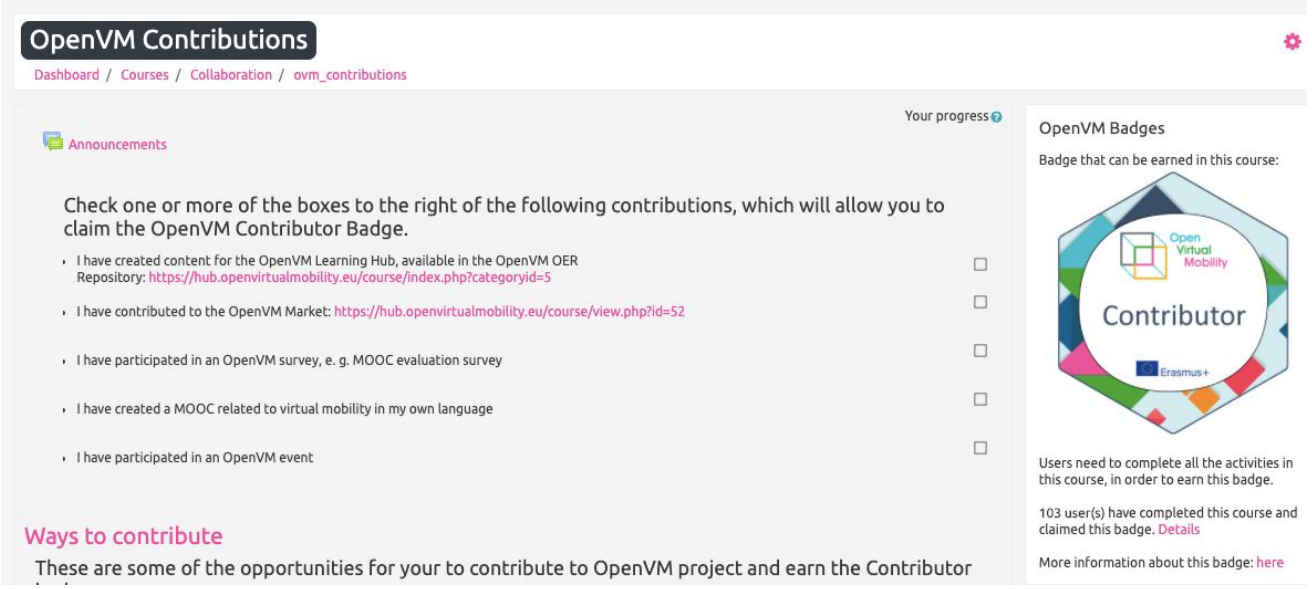

Figure 9: Implementation of the OpenVM Contributor Credential in the OpenVM Hub

2.2.4.3 Blockcerts for Competency Credentials

The OpenVM project has also evaluated the opportunity to introduce, besides Open Badges, the Blockcerts as a blockchain-based technology for digital certifications of skills. Valuable insights have been gained from expert consultations on Blockchain Credentials as described in the previous report. The Bestr platform provided by project partner Cineca has implemented a Blockcerts feature in 2019, allowing the project to experiment with this new technology, i .e. to permanently register selected digital credentials on the public Ethereum blockchain following the Blockcerts standard, so that learners will have a second - more secure and permanently verifiable - digital expression of their credential / achievement. As an adequate use case for the use of Blockcerts in the OpenVM project we identified the use of Blockcerts for high-level Competence Credentials, i. e. credentials certifying competencies at the highest level in OpenVM MOOCs (level 3: advanced).

The implementation of Blockcerts for OpenVM project leverages Bestr's expertise in using Blockcerts, which have been implemented by Bestr in 2019 and are currently used by two Italian universities (University of Milan-Bicocca, University of Padua) to issue digital credentials in form of Blockcerts for bachelor and master degrees. Blockcerts in Bestr are issued as a separate digital credential, independent from the Open Badge and usually containing a subset of the information present in the Open Badge. The learner is thus granted the possibility to choose which credentialing format to use according to the different use cases: while the Open Badge supports a more visual communication, Blockcerts allows for secure and permanent verifiability, without the need to rely on the issuing platform. Bestr's Blockcerts are recorded as merkle-tree on the public Ethereum Blockchain at pre-fixed intervals, in order to minimise the monetary cost of the operation.

The OpenVM implementation of Blockcerts has been the first case on Bestr to issue Blockcerts starting from learning statements sent from Moodle, therefore it has been necessary to update the Moodle module logstore-xAPI already installed in the OpenVM Hub for Badge issuing, so that the information format sent from Moodle to Bestr would include data required for Blockcerts issuing - namely Name and Surname.

The template for the visual rendering of the Blockcerts, which has also been developed together with project partners, is displayed in figure 10 below.

Figure 10: Template for the visual rendering of the Blockcerts in the OpenVM Hub

2.2.5 Sharing of OpenVM Credentials

Open Badges were developed as an open standard to digitally valorize learning outcomes and to communicate learning achievements by providing visual symbols of accomplishments accompanied by verifiable data and evidence that can be shared across the web (Mozilla Foundation, 2016).

Sharing and circulation of Open Badges in digital networks allows it to gain additional meaning (Hickey & Zuiker, 2005). OpenVM Credentials can be embedded in web-based systems like Content Management Systems (e. g. Wordpress) and E-Portfolio systems (e. g. Mahara). OpenVM Credentials can be displayed in such systems or platforms through basic HTML embedding[14], without the need of specific modules or plugins. Figure 11 below shows an example of an embedded OpenVM Contributor Credential in Mahara.

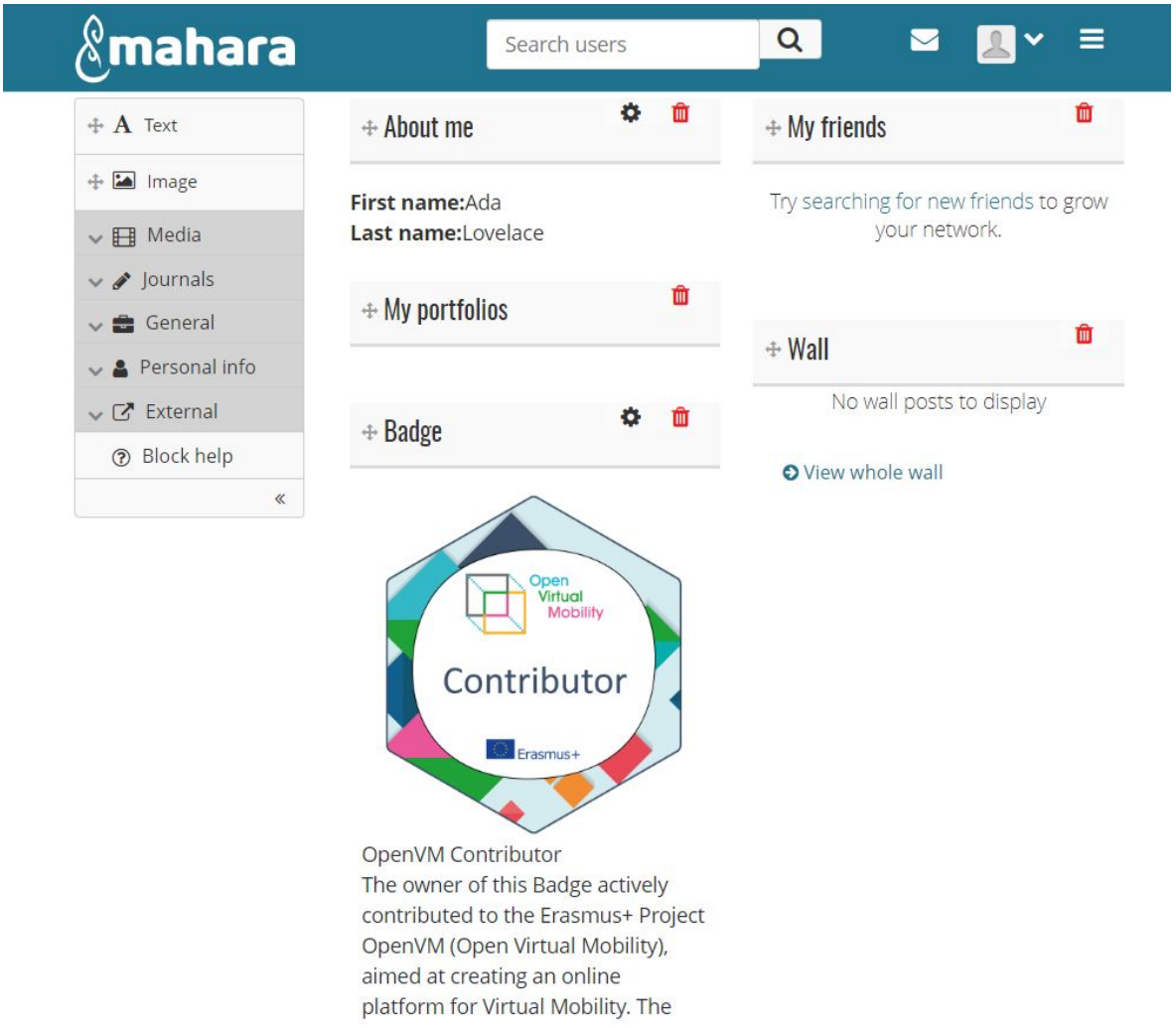

Figure 11: OpenVM Contributor Badge embedded in the E-Portfolio system Mahara

[14] https://blog.bestr.it/en/2017/07/31/add-your-badge-your-website

3. Evaluation report

To test the design and the implementation of OpenVM Competency Credentials in OpenVM MOOC, an aggregated online evaluation survey has been used in the project to evaluate various aspects of OpenVM MOOC. The aggregated online evaluation has included items specifically related to OpenVM Competency Credentials. Additional items were designed for in-depth surveys and were implemented in a separate survey with a smaller sample of MOOC participants from Germany and Italy in 2020. In August 2020, at the time of writing this report, a sample of n = 1412 learners participated in the online evaluation survey and submitted their evaluation of the design and implementation of Competency Credentials.

Procedure: Participants in all MOOCs were invited to participate in the online evaluation survey (in the English language), which was linked at the end of each level-course. The OpenVM online evaluation survey is organised in eight sections and participants are required to express their level of agreement with a set of statements on a Likert scale from 1 (strongly disagree) to 5 (totally agree). The survey encompasses a set of statements related to OpenVM Credentials. The evaluation took place on an ongoing basis within two waves of pilots in 2019 and 2020. This allowed for an iterative design and improvement of designs based on the evaluation results. The results presented in this report are aggregated results from 2019 and 2020.

Sample: The study sample was composed of the total of 1412 participants. The profile of participants was very diverse as shown in Table 2 below.

Table 2. Study sample (2019-2020)

Characteristics	OpenVM MOOC evaluation survey participants
Gender	69% female 30% male
Age	61% 19-24 years old
Role	96% university students 3% teachers/educators
Country	44% Romania 20% Italy 20% Germany 7% Spain

The largest group of OpenVM participants were students from 88 different higher education institutions in Europe and beyond, predominantly from the countries represented by project partners (Romania, Italy, Germany, Spain, Netherlands) and other European countries (UK, Lithuania, Sweden, Norway, Slovakia, Bulgaria, France, Switzerland). Enrolled participants also included students and teachers from outside of Europe, including the USA, Colombia, Ecuador, Chile, Mexico, Argentina, Turkey, Burkina Faso and New Zealand.

Enrollment: Approx. 1500 participants were enrolled in all eight OpenVM MOOCs at the beginning of 2020. Out of all 1412 MOOC participants, who filled in the survey, 20% participated in the Active Self-Regulated Learning, 17% Media and Digital Literacy, 15% Collaborative Learning, 14% Open-mindedness, 12% Intercultural Skills MOOCs (Fig. 12).

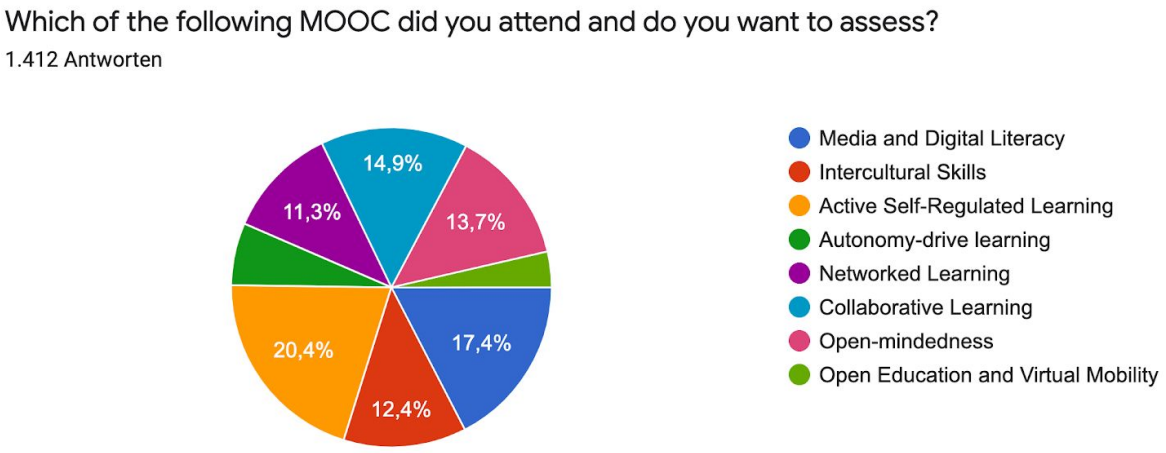

Figure 11: Participation in OpenVM MOOCs, n = 1412 (August 2020).

OpenVM Credentials: 1970 OpenVM Credentials in total were issued upon completion of MOOC level courses (altogether 24: 8 MOOCs x 3 levels). As of August 2020 62% of them have been claimed, with the detail shown in figure 12 below.

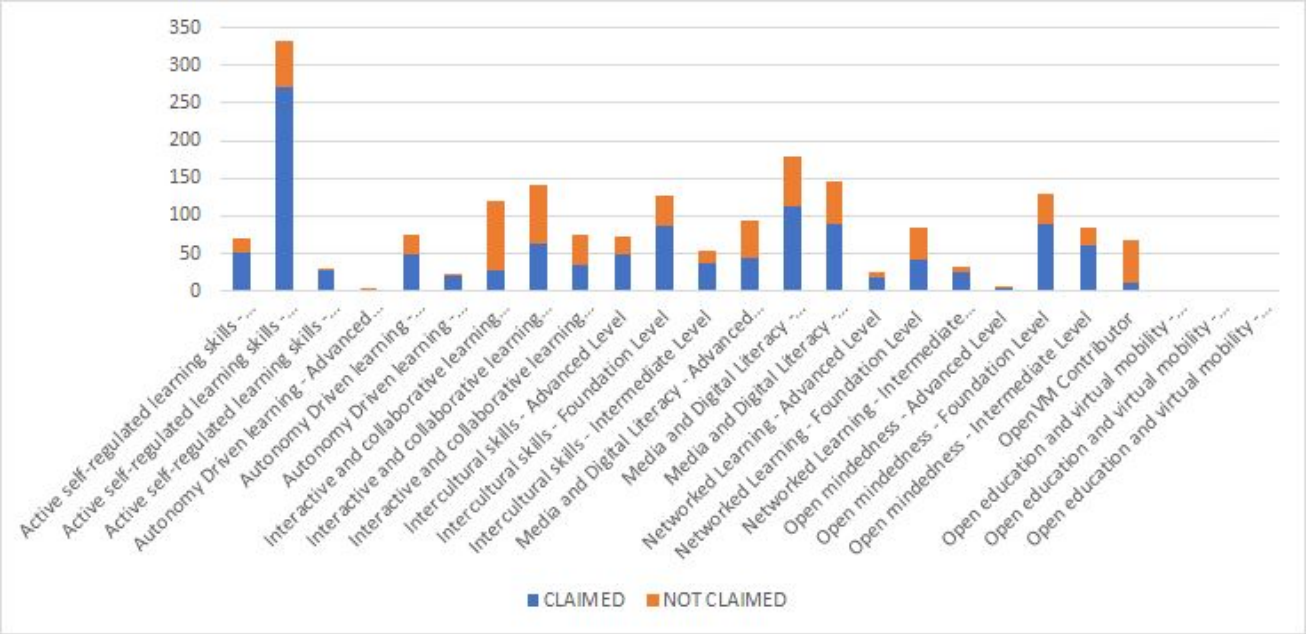

Figure 12. Number of issued and claimed Competence Credentials (August 2020).

Survey items: The participants evaluated a set of statements on the scale from 1 (totally disagree) to 5 (totally agree). The statements included:

1. Two statements about to learner preferences related to OpenVM Credentials,
2. Three statements related to motivation, i. e. motivation to learn and complete the MOOCs, motivation to further use OpenVM Competence Credentials, and
3. Six statements related to the impact of credentials on Self Regulated Learning (SRL).

The statements used in the evaluation survey are listed in Table 3 below.

Table 2. Items used in the online evaluation survey in relation to OpenVM Credentials

Focus	Statements
Preferences	I like the design of OpenVM Badges OpenVM Badges describe the skills I developed in a suitable way
Motivation	OpenVM Badges motivated me to learn in the MOOC OpenVM Badges motivated me to complete a MOOC level I will use OpenVM Badges outside of the OpenVM Learning Hub
Self-Regulated Learning	To what extent the OPEN BADGES helped me in the following SRL (self-regulated learning) skills (information on how to achieve them): 1. Task analysis 2. Self-motivation 3. Self-control 4. Self-observation 5. Self-judgement (self-evaluation) 6. Self-reaction

The results related to the three focus points of the online evaluation are discussed below. The statistical analysis was conducted using IBM SPSS Statistics version 27.

3.1 Badge design

The results related to the preferences of learners about the design of OpenVM Credentials are summarized in table 3 below. Since all questions were mandatory, the dataset included 1412 entries.

Table 3. Learner preferences. Scale 1 (totally disagree) to 5 (totally agree), n = 1412.

Survey item	M	SD
Badge design "I like the design of OpenVM Badges."	3.73	.99
Skill description "OpenVM Badges describe the skills I developed in a suitable way."	3.67	.95

Descriptive statistics summarised in Table 3 show that high average values, oscillating towards "strongly agree" (value 4 on the scale), were reached for the survey items including related to participants' perceptions of OpenVM Credentials, i. e. a. Badge design, and b. Skill description. The

results indicate that MOOC participants liked the design of OpenVM Credentials (badge design) and found that OpenVM Credentials described the skills they developed in the MOOCs in an adequate way (skill description).

3.2 Motivational effects

Through the online evaluation survey we gathered some data useful to understand how OpenVM Credentials motivated participants to: a. learn in MOOCs, b. complete the MOOCs, and c. use OpenVM Credentials outside of the OpenVM Learning Hub. The results about motivational effects of OpenVM Credentials are summarized in table 4 below. Since all questions were mandatory, the dataset included 1412 entries.

Table 4. Motivational effects. Scale 1 (totally disagree) to 5 (totally agree), n = 1412.

Survey item	M	SD
Motivation to learn "OpenVM Badges motivated me to learn in the MOOC."	3.61	1.01
Motivation to complete "OpenVM Badges motivated me to complete a MOOC level."	3.68	1.03
Further use "I will use OpenVM Badges outside of the OpenVM Learning Hub."	3.50	1.07

Descriptive statistics summarised in Table 4 show that high average values, oscillating towards "strongly agree" (value 4 on the scale), were reached for motivation to learn and motivation to complete the MOOCs. Somewhat lower values were reached in relation to the further use of OpenVM Credentials outside of the OpenVM Learning Hub. The results indicate that MOOC participants were motivated by OpenVM Credentials.

As described in the paper by Buchem & Gené (in review), the following hypothesis:

"Learners who liked the design of open badges and thought that badges described the skills they developed in an adequate way would be both more motivated to learn and to complete the MOOCs, and would be more inclined to use badges in further platforms."

was tested using correlation and regression analysis. The results showed that indeed both badge design and skill descriptions were good predictors for motivational variables. Specifically, the adequate skill descriptions in Open Badges were strongly correlated with motivational variables and proved to be good predictors for motivation to learn in MOOCs.

The question whether learners would use OpenVM Credentials outside the Learning Hub was looked into in more detail in a follow-up study with a sample of German and Italian students. The results of this study will be published in a journal article in 2020/2021.

3.3 Self-regulated learning

Following the aim of enhancing self-regulated learning (SRL) in OpenVM MOOCs, the evaluation survey included items related to the evaluation of learners of the extent to which OpenVM credentials helped MOOC learners with six SRL skills: 1. task analysis, 2. self-motivation, 3. self-control, 4. self-observation, 5. self-judgement (self-evaluation), and 6. self-reaction. These six SRL skills correspond to the six phases of SRL as proposed by Zimmerman (2002) and are aligned with the Quality Framework developed in O7.

The results are summarized in table 5 below and show that OpenVM credentials helped learners with the application of the six SRL skills in OpenVM MOOCs. High values were reached for all six items with an average of M = 3.70 across all SRL skills indicating substantial agreement of survey participants with all six statements. OpenVM credentials had especially positive effects on learners' self-motivation (M = 3.76), self-evaluation (M = 3.73) and self-observation (M = 3.71). The low values of the standard deviation show that the values across all six items are close to the mean. Since questions related to SRL were not mandatory, the dataset included a varying number of entries, which are indicated with n.

Table 4. To what extent the OPEN BADGES helped me with my SRL in OpenVM MOOCs. Scale 1 (totally disagree) to 5 (totally agree).

Survey item	n	M	SD
Open Badges and SRL: task analysis	789	3.67	.895
Open Badges and SRL: self-motivation	790	3.76	.882
Open Badges and SRL: self-control	793	3.65	.884
Open Badges and SRL: self-observation	791	3.71	.887
Open Badges and SRL: self-judgement (self-evaluation)	794	3.73	.869
Open Badges and SRL: self-reaction	791	3.69	.854

4. Further results

4.1 Contributor credential

To issue the OpenVM Contributor Credential to the contributors to the OpenVM project, a separate course in the OpenVM Learning Hub – OpenVM Contributions[15] – was created. In this course a number of options for contributing to the OpenVM project is detailed. The users have to check one or more of the boxes listing the different forms of contributions to claim the OpenVM Contributor Badge. At the end of the project in August 2020 the total of 103 users were issued the Contributor Credential. However, the claim rate of approx. 18% was rather low especially compared to the high claim rates of the Competence Credentials. This might be connected to a perceived lower value by the users compared to Competence Credentials, since it recognizes engagement but not specific achievements in relation to skills. The results of research summarised in the journal paper by Buchem and Gené (in review) seem to confirm this hypothesis (see below: Motivational effects).

4.2 Blockcerts

Blockerts were implemented alongside Open Badges in the OpenVM Learning Hub following the automatic xAPI based issuing process from Moodle.

Issuing of Blockcerts follows a data protection conform process: no data about any user is written on the Blockchain without the user's consent and specific action. Moreover it is relevant to note that no complete document is notarized on the Blockchain but only hashes combined in merkle trees, meaning that a user with access to the Blockcert document (because its owner - the learner - has provided it) can verify its integrity on the Blockchain, but no information is extractable from the Blockchain alone.

These features posed new challenges on the development team that required more development and agile testing, which is particularly critical in a production environment such as that of the OpenVM Learning Hub. Moreover, the completion of advanced level courses is only possible with teacher tutoring and therefore in specific tutored time windows. Due to the high programming workload combined with the unexpected increase of workload for most partners connected to the COVID-19 pandemic a late functioning implementation of Blockcerts (approx. June 19th 2020) was possible, resulting in only three issued Blockcerts, i. e. two for the *Active self-regulated learning skills - Advanced Level* course and one for the *Intercultural skills - Advanced Level* course. Claiming Blockcerts is also a more complex process than earning an Open Badge[16], that can be aborted by the

[15] https://hub.openvirtualmobility.eu/course/view.php?id=58
[16] See the tutorial: https://drive.google.com/file/d/1pFoGZjYKcNO43sgqAv_rn1pb8glpdWM8/view

user who might prefer to only have the Badge. However, the current numbers are not sufficient to test this hypothesis. This is an interesting research question that can be addressed in the future.

From a long-term perspective, the setup for Blockcerts in the OpenVM Learning Hub will remain active for the following years according to the sustainability plan developed in O7. We expect more Blockcerts issued in advanced level courses in the future and plan further research in this area.

5. Conclusions

Output 5 Activity 1 focused on designing, implementation and testing of open digital credentials for the recognition of virtual mobility skills of higher education teachers and students. As of project end in August 2020, altogether 1970 OpenVM Credentials were issued via the Bestr badging platform. This number substantially exceeds the number originally of planned in the application: KPI #5 in the application was estimated at 300 badges issued. This means five times more OpenVM Credentials were issued than planned in the application. This high number contributes to the success of the OpenVM project altogether as a large number of learners (students and teachers) from higher education in Europe were exposed to the virtual mobility skills and could earn digital credentials that certify different skills in that area. Although it was not possible to provide direct evidence about how assessment and credentialing of virtual mobility skills contributes to the uptake of virtual mobility (see objective 6 on page 106 in the application), it can be assumed that the project succeeded in enhancing the uptake of virtual mobility in higher education by improving virtual mobility skills and in consequence the readiness for virtual mobility in in higher education through recognition and visualisation of relevant skills (see objective 6 on page 106 in the application). While the uptake of virtual mobility may be a longer process, which can be enhanced by recognition and showcasing of virtual mobility skills with digital credentials, it is not a straight-forward process. Nevertheless, 1412 respondents to the evaluation survey agreed with the statement that they are likely to use OpenVM credentials (M = 3.50) outside of the OpenVM Learning Hub, which again shows further potential of OpenVM Credentials to make relevant virtual mobility skills visible in different media on the web.

In order to design, develop, implement and test OpenVM Credentials, the O5 team together with project partners applied an agile and iterative approach. The key conclusion from the iterative process of designing, implementation and user-testing of OpenVM Credentials has been that this has proved to be the right approach as it allowed to explore different options along learner preferences, to work in a collaborative way with different stakeholders and to adjust the prototypes to the developments in other outputs in the project. Through the evaluation of OpenVM MOOCs in the two waves of pilots in 2019 and 2020, the O5-A1 team could adjust the design and implementation of OpenVM Credentials continuously according to user feedback and insights from all other project outputs, especially:

- Output 1: inclusion of skills from the Competency Framework in badge descriptions,
- Output 2: technical implementation of the Bestr platform via xAPI,
- Output 3: alignment with the Competency Directory in badge metadata,
- Output 4: alignment of issuance criteria with E-Assessments in MOOCs,
- Output 6: alignment of badge descriptions with the design of the MOOCs, and
- Output 7: alignment with the Quality Framework, especially with SRL focus.

The iterative approach allowed to break down the design, development and deployment process into smaller chunks of activities which can be better aligned with other activities in the project, such as the MOOC design.

As for the Contributor Credential we could ascertain that engagement badges such as the Contributor Credential seem to be far less interesting for users. hypothesis: may it also be because people contributing to the project are mostly not students and are doing so for their own activity or interest, but do not feel particularly in need of recognition? could it be a "recognition culture" issue? for blockcerts we could wait for developments in the next years as monitored by the SIG.

The evaluation results with the large sample of n = 1412 MOOC participants are significant and confirm that the design of OpenVM Competency Credentials was positively received by MOOC learners and that MOOC learners perceived OpenVM Competency Credentials as motivating and supporting self-regulated learning. The statistics presented in this report indicate positive user experience related to OpenVM Competency Credentials as well as positive impact of OpenVM Competency Credentials on motivation to learn and to complete a MOOC level as well as positive effects on various aspects self-regulated learning (SRL) including self-motivation, self-evaluation and self-observation.

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