Cross-Border Projects in Digital Education Ecosystems

Carsten Wolff[1(✉)], Galyna Tabunshchyk[2], Peter Arras[3], Jose Ramon Otegi[4], Sergey Bushuyev[5], Olena Verenych[5], Anatoly Sachenko[6], Christian Reimann[1], Bassam Hussein[7], Elena Vitkauskaite[8], Ekaterina Mikhaylova[1], Areej Aldaghamin[1], Anna Badasian[1], Olha Mikhieieva[1], Nargiza Mikhridinova[1], Natalya Myronova[2], Jasmin Hemmer[1], and Thorsten Ruben[1]

[1] Fachhochschule Dortmund, Otto-Hahn-Street 23, 44227 Dortmund, Germany
carsten.wolff@fh-dortmund.de
[2] National University Zaporizhzhia Polytechnic, Zaporizhia, Ukraine
[3] KU Leuven, Leuven, Belgium
[4] University of the Basque Country, Bilbao, Spain
[5] Kyiv National University of Construction and Architecture, Kiev, Ukraine
[6] West Ukrainian National University, Ternopil, Ukraine
[7] Norwegian University of Science and Technology, Trondheim, Norway
[8] Kaunas University of Technology, Kaunas, Lithuania

Abstract. Digital transformation and project orientation are defining trends in the future world of work. Relevant aspects for education include training for project work in the digital age, the project as a didactic format, (digitally transformed) project management, the workplace of the future, and the competence to drive the digital transformation with projects. Therefore, projects in the context of digital transformation are a relevant professional environment for many graduates and this should be reflected in higher education – especially if it is preparing for the job market. Project-based, problem-based, challenge-based and case-based learning are important didactic trends. Projects are inherently interdisciplinary, allow work on real tasks and train the competence area of practical skills. Nevertheless, most academic programmes hardly integrate these aspects. Often, a non-specialist lecturer offers a project management course that is not very well integrated into the curriculum. Interdisciplinary skills are not systematically addressed in the project work. This contribution proposes developing a Virtual Project Campus in the university that allows courses (and projects) to comprehensively integrate the "project competence" in a professional context and interlink it with the subject matter. The digital implementation increases the relevance for the professional field as well as the ability to multiply over different educational programmes and cooperate cross-border. The Virtual Project Campus bundles competences in an agile work environment, e.g., through specialist communities and project formats, as well as a digital education ecosystem (DEE).

Keywords: Project orientation · Digital education · Virtual collaboration

M. E. Auer et al. (Eds.): ICL 2021, LNNS 389, pp. 382–394, 2022.
https://doi.org/10.1007/978-3-030-93904-5_39

1 Introduction

Projects are a common tool and organisational pattern for many employees, having a big influence on their work performance, daily routine and career. Projects help organisations pursue their goals and project performance has a high impact on their success [1]. Therefore, higher education has to prepare graduates for the projectised world. Apart from the technical (or scientific, domain specific) competences, professional competences and global competences [2] are very important. Project competences are partly falling into the technical competences, mainly into professional competences and to an increasing degree into the global competences, since the projectised world of work becomes more globalised, too.

The scientific discussion on project management education in higher education is conducted intensively for at least two decades [3]. Key issues are:

- The practical relevance of project management education in universities is lacking, since the relevant competences are expected to be learned only in realistic projects.
- The scientific rigor and quality of project management education are too low, since – in many cases – project management is taught by scientists from other domains or – in some cases – project management isn't considered to be a scientific domain.
- Project management education isn't integrated with other curriculum elements while it would be necessary to integrate technical, professional, and global competences in a holistic learning experience. Therefore, project management education in universities isn't really authentic and realistic.
- Project management competences and project competences are considered to be two separate areas. Project management competences has been seen for some time as mainly technical competences (e.g., using certain tools), while project competences were associated with soft skills (e.g., teamwork) as part of the professional competences. Meanwhile, both areas are considered to be connected in a combination of technical (practical), professional and global competences (e.g., IPMA Individual Competence Baseline [4]).

For higher education, the challenge is to create learning experiences and learning situations that support the acquisition of such comprehensive sets of competences. In order to prepare graduates for the projectised world, the project management competences' and the project competences' acquisition has to be integrated with the do-main-specific competences of their educational programme in a holistic learning experience instead of being taught separately. This is addressed by creating learning situations that resemble realistic and authentic workplace situations (including project situations). The research on Work-integrated Learning (WIL) shows that such learning experiences have a very positive effect on the job-related readiness of graduates [5] if conducted with the right (scientific) quality [6].

This contribution presents an approach for the integration of realistic and authentic project situations into educational programmes. In the following section, the challenges and problems related to such an approach are investigated based on a state-of-the-art review. A *Virtual Project Campus* is proposed as a possible setup in order to create the required learning situations and experiences. In Sect. 3, it is described how such a

Virtual Project Campus is established and integrated into cross-border master education in the case study of the EuroPIM Virtual Master School [7]. Section 4 emphasises how this approach was digitally transformed (also due to COVID19) and conducted in a Digital Education Ecosystem (DEE) [8]. In Sect. 5, evaluation results are presented, which support the effectiveness of the approach while highlighting the current shortcomings and areas for further improvement.

2 Literature Review and Problem Statement

The preparation of graduates for project work in the digital age, the digitally transformed and projectised workplace of the future, and the competence to drive the digital transformation with projects are very relevant tasks for higher education. Such learning outcomes reflect the long-term move of scientific education from preparing the learners for a mainly academic career (focus on a specific scientific domain) to preparing the learners for the labour market [9]. The goal is to achieve a higher practical relevance of education and to close the theory-practice gap. The *European Commission's Renewed Agenda for Higher Education* states "Higher education should also allow students to acquire skills and experiences through activities based around real-world problems, include work-based learning and, where possible, offer international mobility." [10].

Combining practical relevance and scientific quality is one of the main challenges in project management education at universities. Following the Mode2 discussion about the application-oriented, transdisciplinary production of knowledge, with the *Rethinking project management education* process, deeper reasoning about integrating a formerly mainly professional education (driven by practitioners) into higher education and scientific research was launched [3]. In order to increase the practical relevance, educational programmes at universities are in many cases interlinked with professional associations, and their standards (e.g. IPMA [4]) and projects are used as a didactic tool [11]. In general, project-oriented didactics like problem-based learning (PBL) and project-based learning (PjBL) are used and investigated [12]. A positive effect on a student's project competences is confirmed if the didactic formats are applied properly [13]. Students' projects are a common element of curricula where a variety of project management methods are used, e.g. Scrum as a lightweight method in software development projects [14]. A typical curricular element are capstone projects at the end of a semester or a study programme that integrate a lot of competences in a more complex setup [8]. Vertically integrated projects (VIP) are embedded into the curriculum as a cooperative activity over several semesters where a number of disciplinary study modules focus on the same project to deliver a holistic learning experience [15]. Nevertheless, such projects as a didactic element quite often lack the use of project management methods [16], and the quality of the delivered project competences or even project management competences can suffer from this [17]. Larger projects can be conducted cross-programme or even cross-border to support a multidisciplinary learning

experience [18]. Again, with respect to the interdisciplinary learning experience, both problem-based learning (PBL) and project-based learning (PjBL) are used and investigated [12]. Recently, especially agile and lean project management approaches are of interest with respect to their effect on project-based learning and project competence [19]. One basic assumption is that practical relevance and job-related competences can be delivered by providing learning experiences similar to workplace situations [20]. This effect is amplified if such projects are conducted with companies [21, 22] which increases the authentic experience but also the effort and the challenges with respect to project management. The overarching concept is defined as Work-Integrated Learning (WIL) [5] which can range from work in a company as part of the curriculum to the use of case studies and examples from companies in the academic learning environment. The assessment of competence gained from project-oriented didactic formats is another area of research [23], including innovative approaches like peer-assessment of students [18]. In summary, using projects as a didactic and curricular element serves very well for delivering learning experiences with high practical relevance and job-related competences. But, it requires a very elaborated methodology, scientific rigour and quality, cooperation with practitioners and industry and a high level of project management competence. It is not a minor addendum in the curriculum but a core concept. Any student assignment, lab sessions (problem-based learning), bachelor and master thesis can obviously be projectised, even a degree study itself can be considered as a project in which it would be a matter of good practice to guide students through it with project management methodology. As such, all project management competences can be illustrated in a project which is of much concern to the student. A degree study has a clear goal (diploma), time frame with milestones, budget (in available working hours), and boundary conditions, so it meets the definition of the project as such. Using it day in day out as an example will show the actual context of a project, rather than stuffing projects in separate student tasks and assignment.

In Master's education, the concept of thematically focused, cross-university Master Schools is developed to deliver a high-quality learning experience with excellent scientific foundations and high practical relevance [8]. Such Master Schools define Overarching Learning Outcomes (OLOs) [24] stretching beyond academic topics and competences. Such transversal competences include project competence and elements from project management, especially in the soft skills domain. OLOs focus on professional and global competence [2] while being integrated with the technical competences in a holistic learning experience in one educational programme.

The workplaces and the projects have seen a dramatic shift from presence to virtual cooperation which was very much accelerated due the COVID pandemic [25]. In project management, this shift to agile and virtual methods and tools has transformed the working environment for many people and has led to the emergence of digital project environments. This should – of course – also be reflected in project-based learning in educational programmes. Higher education is – also accelerated by COVID – becoming more virtualised and digitally transformed. The EU Digital Education Action Plan [9] defines as one of the priorities the need to foster the "development of a

high-performing digital education ecosystems". Therefore, the integration of digital project ecosystems and digital education ecosystems (DEE) is a very much straightforward approach for the development of more relevant and authentic learning experiences.

Nevertheless, the new projectised and digitally transformed future of higher education faces a number of issues and deficits which are caused by the quality of the work-integrated learning (WIL) experience [6], the project management quality of the project-based learning [3], the quality of the interdisciplinary learning experience in cross-programme projects [12], the issues when involving industry [21], and – finally – the lack of competences and resources in the universities [20]. This cannot be solved with an activity within one single module or programme. We propose to set up a cross-faculty and even cross-university (or cross-border) cooperative community and platform which delivers the competences, tools and methods for a high-quality project-based education into the educational programmes and puts them into interaction. By doing this, the *Virtual Project Campus* (described in the following sections) addresses shortcomings in educational programmes in the following areas:

- Lack of networking and qualification of the teachers in project management (PM)
- Lack of high-quality teaching materials, modules and didactic concepts
- Inadequate quality and practical relevance of the curricula integration of projects (regarding project skills)
- Inadequate curricular integration in terms of overarching learning outcomes (OLO)
- Insufficient support with (digital) tools and cooperation platforms

3 The EuroPIM Virtual Master School

The development of such a *Virtual Project Campus* is currently conducted in several European cooperation projects of the European Partnership for Project and Innovation Management (EuroPIM), a consortium of 5 universities in the EU and a number of associated universities in EU partner countries [7]. The authors of this contribution are conducting Master's programmes with project-based elements, and they have connected these programmes with a cooperation pattern (see Fig. 1), which makes it a virtual, cross-border Master School. As a part of it, the project management competence of the consortium is mainly based on the European Master in Project Management (EuroMPM) network of 6 Master's programmes [26] which are connected with double degree agreements. The concept of this cross-border cooperation is undergoing a digital transformation into a virtual community (apart from the transformation projects also driven by the needs due to the COVID-19 pandemic). The main cooperation formats are aligned with the curriculum and student journey of the Master's programmes of the partner universities (see Fig. 1):

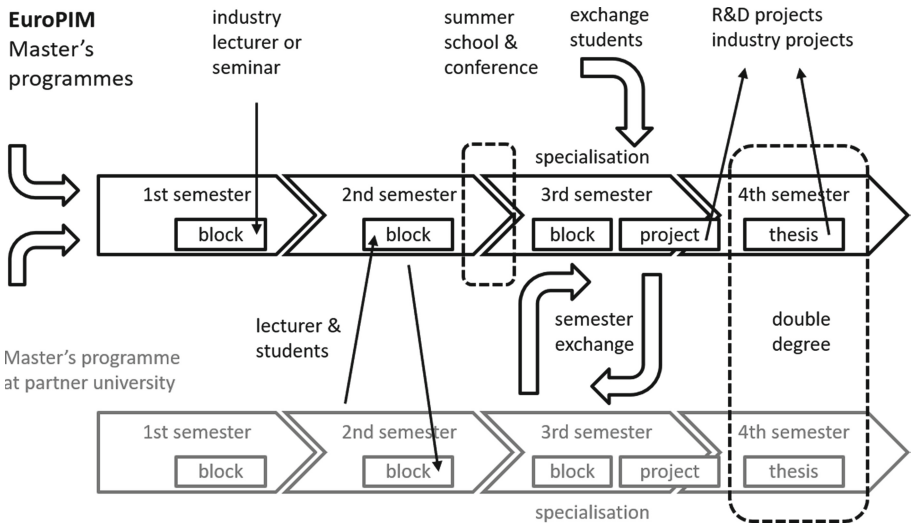

Fig. 1. Cooperation and exchange formats of the EuroPIM virtual master school [8].

- The first two semesters contain "classical" modules, which are composed out of formats for knowledge delivery (e.g., lectures, online courses, literature), delivery of practical skills (e.g. project assignments, workshops) and reflective parts (e.g., reports, presentations) for the training of abilities, attitudes and scientific methods. Especially the project assignments and workshops are used for mixing students from different programmes, universities and countries in teams that are inherently international, intercultural and interdisciplinary (3 × "i"). In combination with realistic tasks (e.g. involving industry partners), the first workplace-relevant learning experiences are created.
- A bigger 3 × "i" event is the summer school (there are also smaller spring and winter schools) with a number of parallel workshops containing professional training (and certificates), company involvement and a broader mix of teams.
- The 3rd and 4th semester allow vertically integrated projects (VIP, this is planned in the 1st and 2nd semester but not yet implemented). This can be combined with an internship in a company or participation in a research project in the university. Both projects and Master thesis in this phase can be done in teams, e.g., as a capstone project which can be conducted cross-border or cross-university.
- The 3rd semester can be done as a long-term stay at a partner university. The universities offer different specialisations (or minors), which increases the variety of choices for students. In combination with a jointly supervised Master thesis, this can lead to a double degree.

The EuroPIM Virtual Master School supports project-based learning (PjBL) and conducts project management education with a variety of formats [8]:

- A variety of project management modules with different depth and intensity are offered and can be shared cross-programme and cross-border.

- The EuroPIM consortium has experts for specific aspects of project management (e.g. agile, change management, quality management) at the different partner universities who teach cross-university.
- Students from project management are trained by IT students in using certain IT tools. On the other hand, students from project management are managing software development projects of IT students, for example.
- Lecturers from different programmes do co-teaching in a group of students, teaching data analytics for project management students, for example.
- Project assignments of different complexity, duration and competence requirements are designed based on real project cases or industry tasks.
- A variety of soft skills training (e.g. intercultural training, presentation training, languages) and training on scientific methodology and digital literacy complement the curriculum and are recognised for credits.

EuroPIM conducts a number of publicly funded projects in order to develop the consortium and the virtual Master School and to research in the respective field:

- The DAAD Strategic Partnership *European Partnership in Project and Innovation Management (EuroPIM)* is conducted since 2015 by Fachhochschule Dortmund (University of Applied Sciences and Arts), Germany, KU Leuven, Belgium, Kaunas University of Technology (KTU), Lithuania, University of the Basque Country (UPV/EHU), Bilbao, Spain, and Norwegian University of Science and Technology (NTNU), Trondheim, Norway. The funding is used to facilitate the exchange and the events (e.g., summer school, conferences) of the consortium.
- Within the DAAD programme *International Mobility and Cooperation Digital (IMKD),* the EuroPIM consortium conducts the project *Managing the Digital Transformation – Digital Education Ecosystem (ManDEE)* in order to facilitate the digital transformation of the cross-border Master School. This includes the provision of a digital platform and tools (DEE) and the development of joint eLearning modules. Furthermore, didactic formats for virtual learning are explored.
- The DAAD Ukraine/Digital Future project *Virtual Master Cooperation Data Science (ViMaCs)* involves the 3 Ukrainian partner universities, the West Ukrainian National University (WUNU), Ternopil, the Kyiv National University of Construction and Architecture (KNUCA) and the National University Zaporizhzhia Polytechnic (NUZP). It includes the extension of the Digital Education Ecosystem (DEE) to the 3 partners and the development of eLearning modules in data science.
- The Erasmus+Knowledge Alliance *Projects for the Digital Transformation (ProDiT)* is a core element of the industry-university-cooperation of the EuroPIM consortium with the 5 partner universities from EU and 16 business partners, including the International Project Management Association (IPMA/AEIPRO) and the IEEE Technology & Engineering Management Society (TEMS).

This project portfolio supports the development of a strong alliance in the field of projects and project management in the digital era.

4 Digital Education Ecosystem (DEE)

The core infrastructure for the virtual learning and teaching environment is a Digital Education Ecosystem (DEE) [8] which integrates digital tools seamlessly (see Fig. 2). The seamless integration of a comprehensive set of learning and teaching tools establishes an infrastructure where students can configure their individual student journey and navigate through the offers within one well-known environment [27]. A cross-university identity management allows a single-sign-on to the IT systems and platforms of the participating universities. The EuroPIM DEE uses Open Source software to a large extent and makes tools and infrastructure available cross-university in order to make it an Open Educational Ecosystem [28]. Apart from the virtual learning & teaching infrastructure, the EuroPIM DEE supports a number of applications and approaches which a useful for projects in particular:

- A web-/cloud-based portfolio of project management and collaboration tools (e.g., Atlassian Jira, Confluence) is provided to learners and teachers, similar to the *cloud-based project infrastructure* in a company. Combined with file sharing and databases (e.g., Nextcloud, Git) and web servers for project and community web portals, this forms an IT environment for project work. Cooperation and conferencing tools (e.g., Microsoft Teams, Discord) and the coupling to a Learning Management Systems (LMS, e.g., Moodle) complement the infrastructure.
- Digital *project case studies* with all relevant project data support the work with realistic industry cases. The adaptation and elaboration of the industry cases into usable and didactically refined learning cases is done with case study writing methods. One goal is to provide the cases as Open Educational Resources (OER).
- A set of *project management related eLearning modules* that can be tailored to different workload and learner competence levels are provided in the LMS.
- The teachers and experts form agile *Open Communities of Practice (OpenCoP),* which use the IT infrastructure to develop of learning content, case studies and for joint research and collaboration.
- At the universities, *rooms for teamwork* (similar to co-working spaces) equipped with the respective digital systems (laptops, tablets, visualisation equipment) support the work in physical presence.
- A *train-the-trainer programme* for the teachers helps to establish similar quality and educational standards cross-university.
- A *project management summer school* is added to the event portfolio of the EuroPIM consortium and delivered as a hybrid (online + presence) event.

Cooperation with *professional associations* (e.g. IPMA, IEEE) allows access to standards and guidelines, experts and (professional) certificates for achievements.

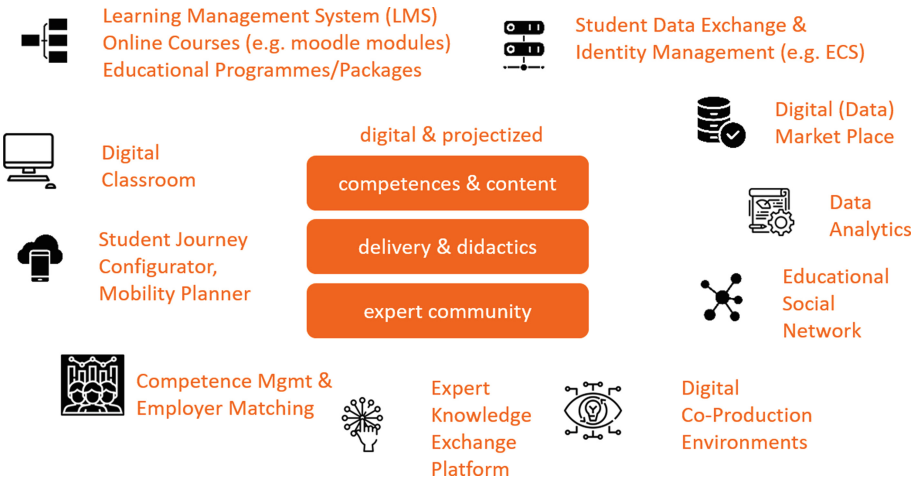

Fig. 2. Digital Education Ecosystem (DEE) of the EuroPIM virtual master school [8].

The support infrastructure for project-based learning and project management was a hybrid (online + physical presence) environment already before COVID-19. Nevertheless, with the beginning of the pandemic in March 2020, the complete operations were moved to fully online immediately. More or less, all planned activities were conducted online, and only a few got postponed. For the future, a return to the hybrid approach is planned by the partners. Anyway, it will certainly contain more online and virtual elements than before the pandemic.

5 Evaluation of the Virtual Project Campus

The operation of the learning and teaching activities of the EuroPIM consortium within the past 1.5 years has supported the development of some key assumptions about project-based learning (PjBL) and projects conducted cross-border and cross-university in a Digital Education Ecosystem (DEE):

A1: One key assumption is that the learning experience can be delivered in a largely digital and virtual setup without significant quality or competence delivery losses.

A2: The second relevant assumption is that learning situations that are close to a realistic and authentic workplace experience contribute positively to the experience.

A3: Projects and project-related learning situations deliver a learning experience with high relevance and close to the real workplace experience.

A4: The PjBL contributes positively both to the learners and teachers experience.

A5: Especially interdisciplinary, international and intercultural competences (3 × "i") are trained in a cross-border project-based learning experience.

A6: The 3 × "i" learning experience suffers but can still be delivered in a much more digital and virtual learning experience compared to the pre-COVID times.

For the evaluation, a survey was conducted, where the answers were collected from 67 (enrolled) Master's student and 30 involved teachers, coordinators and scientific staff from the EuroPIM partner universities (EU + Ukraine) which took part in project-based learning activities in 2020 and 2021. The students were asked almost 100 questions and the teachers/staff answered more than 70 questions. The survey is an intermediate evaluation since the projects are work-in-progress. Only selected answers are presented which should serve as first indications with respect to the assumption.

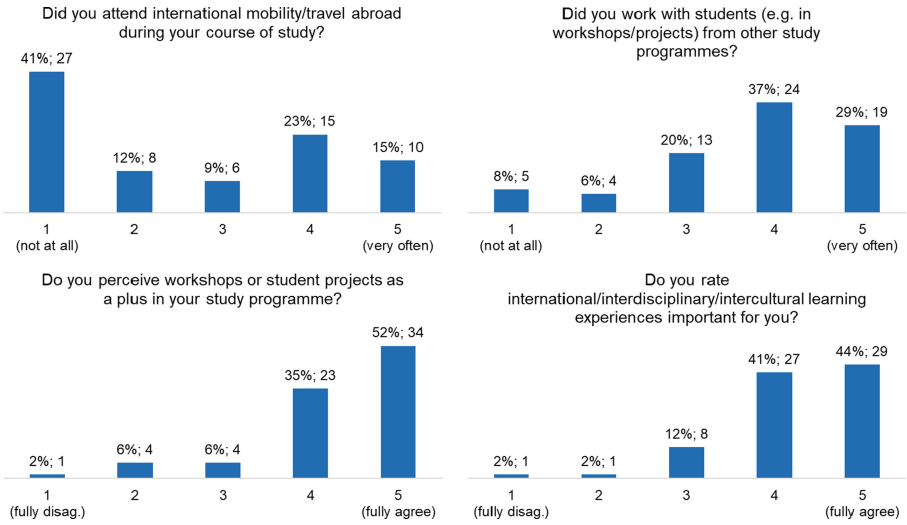

Fig. 3. Effect of missing physical mobility on the learning experience (students).

From the survey results presented in Fig. 3 it can be concluded that only a few students were able to travel to partner universities. Nevertheless, a considerable number attended joint events with international partners. Both the projects and the 3 × "i" experience are rated very positively, supporting the assumptions A4, A5 and A6.

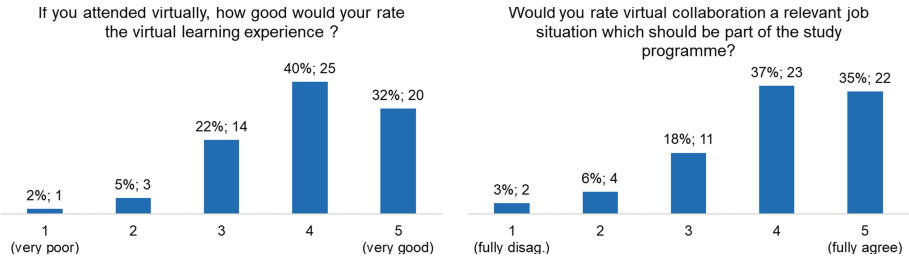

Fig. 4. Quality and (workplace) relevance of the virtual learning experience (students).

Figure 4 supports the assumptions 1–3 since students rate the virtual experience as good and support the idea that it is specifically relevant for the future job. Figure 5 shows that the teachers and academic staff agree to A2, A4 and A6, even more than the students.

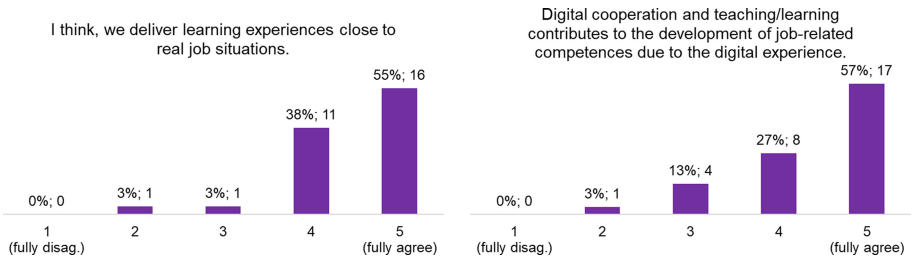

Fig. 5. Quality and (workplace) relevance of the virtual learning experience (teachers).

The survey results indicate that a virtual, project-based approach can deliver most aspects (evaluated in the other questions, not shown here) of the intended learning experience since it reflects the reality of many working situations in companies. Nevertheless, some aspects related to team experience and intercultural experience suffer if the formats are only conducted online. The comparison of the learning experience before COVID-19 (to a larger extent based on real mobility and workshops with the physical presence of the teams, based on evaluations from 2015–2019) and the virtual learning experience (2020–2021) suggests a combination into a blended format for the future. This again reflects workplace reality in many project-oriented organisations. Especially, it is relevant for project setups in such industries as IT and consulting industries, where often IT or senior consultant roles in the project are outsourced and, as a result, the project has to be managed remotely and virtually in an intercultural environment.

6 Conclusion and Outlook

The main conclusion is that project-related, international and interdisciplinary learning situations resemble job-relevant competences. Many educational programmes lack realistic learning experiences in terms of project work and virtual cooperation, both in terms of quantity and quality. The EuroPIM consortiums suggests establishing a cross-programme, cross-border Virtual Project Campus in order to support and facilitate such learning experiences in a way that is much similar to the workplace experience of future graduates. The conclusions are supported by the first evaluation results from ongoing cooperation and digital transformation projects. The focus of the future work is to develop and establish the Virtual Project Campus and the Digital Education Ecosystems (DEE) further and use it in learning and teaching. Furthermore, the evaluation will be continued in order to generate time-series of data that allow a detailed analysis of the effect on students' competences and the effectiveness of the approach.

Acknowledgements. This research is partly funded by the German Federal Ministry of Education and Research (BMBF) within the DAAD Strategic Partnership "European Partnership for Project and Innovation Management (EuroPIM)", (Project-ID 57172312), the DAAD IMKD project "ManDEE" (Project-ID: 57542858), the DAAD Ukraine project "ViMaCs" (Project-ID: 57513461), and the EU Erasmus+ programme within the Capacity Building Project "WORK4CE" (619034-EPP-1–2020-1-UA-EPPKA2-CFHE-JP) and the Knowledge Alliance "ProDiT" (621745-EPP-1–2020-1-DE-EPPKA2-KA).

References

1. Turner, R., Zolin, R.: Forecasting success on large projects: developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames. Proj. Manage. J. **43**(5), 87–99 (2012). https://doi.org/10.1002/pmj.21289
2. Rajala, S.A.: Beyond 2020: preparing engineers for the future. In: Proceedings of the IEEE, vol. 100, pp. 1376–1383, 13th, May 2012. https://doi.org/10.1109/JPROC.2012.2190169
3. Berggren, C., Söderlund, J.: Rethinking project management education: social twists and knowledge co-production. Intern. J. Proj. Manage. **26**(3), 286–296 (2008)
4. International Project Management Association (IPMA): Individual competence baseline 4th version (ICB4) (2015)
5. Ferns, S., Campbell, M., Zegwaard, K.E.: Work integrated learning. In: Work Integrated Learning in the Curriculum. HERDSA guide (2014)
6. Smith, C.: Evaluating the quality of work-integrated learning curricula: a comprehensive framework. High. Educ. Res. Dev. **31**(2), 247–262 (2012)
7. EuroPIM Homepage. http://www.go-study-europe.de. Accessed 08 Apr 2021
8. Wolff, C., Reimann, R., Mikhaylova, E., Aldaghamin, A., Pampus, S., Hermann, E.: Digital education ecosystem (dee) for a virtual master school. In: Proceedings of the 2021 IEEE Smart Information Systems and Technologies (SIST) Conference, IEEE Xplore (2021)
9. European Commission: Digital education action plan (2018)
10. European Commission: Renewed EU agenda for higher education (2017)
11. de los Ríos Carmenado, I., Rodríguez López, F., Pérez García, C.: Promoting professional project management skills in engineering higher education: project-based learning (pbl) strategy. Int. J. Eng. Educ. **31.1**, 184–198 (2015)
12. Brassler, M., Dettmers, J.: How to enhance interdisciplinary competence—interdisciplinary problem-based learning versus interdisciplinary project-based learning. Interdisc. J. Prob. Based Learn. **11**(2), 12 (2017)
13. Lin, C.L., Tsai, C.Y.: The effect of a pedagogical STEAM model on students' project competence and learning motivation. J. Sci. Educ. Technol. **30**, 112–124 (2021)
14. Mahnic, V.: A capstone course on agile software development using scrum. IEEE Trans. Educ. **55**(1), 99–106 (2012)
15. Marshall, S., Coyle, E., Krogmeier, J.V., Abler, R.T., Johnson, A., Gilchrist, B.E.: The vertically integrated projects (VIP) program: leveraging faculty research interests to transform undergraduate STEM education. In: Transforming Institutions: 21st Century Undergraduate STEM Education Conference (2014)
16. Moor, S.S., Drake, B.D.: Addressing common problems in engineering design projects: a project management approach. J. Eng. Educ. **90**(3), 389–395 (2001)
17. Keogh, K., Venables, A.: The importance of project management documentation in computing students' capstone projects. Int. J. Work Integr. Learn. **10**, 151 (2009)

18. Sonnenberg-Klein, J., Abler, R.T., Coyle, E.J.: Social network analysis: peer support and peer management in multidisciplinary, vertically integrated teams. In: Proceedings of the 2018 ASEE Annual Conference and Exposition (2018)
19. Mikhieieva, O.: Agile mindset competencies for project teams. In: Proceedings of the 3rd International Conference on Research and Education in Project Management – REPM 2020, Editors: Jose Ramón Otegi, Nerea Toledo and Ianire Taboada, Asociación Española de Dirección e Ingeniería de Proyectos (AEIPRO), Spain (2020)
20. de Los Rios, I., et al.: Project–based learning in engineering higher education: two decades of teaching competences in real environments. Procedia Soc. Behav. Sci. **2**(2), 1368–1378 (2010)
21. Baaken, T., Kiel, B., Kliewe, T.: Real world projects with companies supporting competence development in higher education. Int. J. High. Educ. **4**, 129–139 (2015)
22. Pollard, C.E.: Lessons learned from client projects in an undergraduate project management course. J. Inf. Syst. Educ. **23**, 271–282 (2012)
23. Shariff, S.M., Zaimy J.J., Norina, A.J.: Assessment of project management skills and learning outcomes in students' projects. Procedia Soc. Behav. Sci. **90**, 745–754 (2013)
24. European Institute of Innovation & Technology (EIT): EIT label. https://eit.europa.eu/our-activities/education/eit-label. Accessed 31 May 2021
25. Mancl, D., Fraser, S.D.: COVID-19's influence on the future of agile. In: Paasivaara, M., Kruchten, P. (eds.) XP 2020. LNBIP, vol. 396, pp. 309–316. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58858-8_32
26. Wolff, C., et al.: Master level education in project management – the EuroMPM model. In: 9th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems (2017)
27. Walcutt, J.J., Schatz, S. (eds.): Modernizing Learning: Building the Future Learning Ecosystem. Government Publishing Office, Washington (2019)
28. Poldoja, H.: The structure and components for the open education ecosystem - constructive design research of online learning tools, Aalto University publication series doctoral dissertations, 175/2016 (2016)