Chapter Fourteen

Lessons Learned from the Implementation of Virtual Collaborative Learning Courses

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https://doi.org/10.53615/978-83-65020-54-3/227-243

Introduction

The COVID-19 pandemic of 2020 put a spotlight on the importance of virtual collaborative learning (VCL) theory and practice. Up until that point, technology had advanced to include a number of collaborative tools that made virtual learning accessible to numerous university students. Modern collaboration software such as Skype, Teams, MS OneDrive, Google Docs, quizzes, and other interactive exercises was used by educators when teaching and collaborating in groups and distance learning environments. With the restrictions on movement dictated by the pandemic, distance learning in the form of VCL became an essential tool in continuing the education of students and accomplishing teaching and learning objectives. Thankfully, many pilot courses using Collaborative Online International Learning (COIL) and VCL frameworks had taken place prior to the COVID-19 pandemic, thus allowing receptive educators the tools to smoothly transition and implement distance classes in the spring of 2020.

Dermol, V., Demaj, E., Nuka, D., & Altmann, M. (Eds.) (2025). *Higher education contemporary learning landscape: Virtual collaborative learning.* ToKnowPress.

Virtual collaborative learning (VCL) represents a transformative pedagogical approach that leverages technology to facilitate shared learning experiences among individuals irrespective of geographical boundaries. This method encompasses a spectrum of activities, from simple online discussions to complex, project-based collaborations involving participants from diverse backgrounds and locations (Kabanda, 2008). The implementation of virtual collaborative learning can be observed at various levels, including local, regional, and international, each presenting unique opportunities and challenges. Effective integration of technology into educational practices necessitates educators with interdisciplinary training, innovative methodological approaches, and proficiency in utilising information and communication technologies (Bernaola et al., 2020).

According to European Commission (2001), the European education and training system has to encourage the personal growth of European citizens in three aspects:

1. *Skills* – currently needed technical, social, and personal competencies, giving an individual a secure foundation for life and enabling him to work together in groups with specialists from other disciplines, intelligently using existing Information and Communication Technologies (ICT),
2. *Adaptability* – the ability to learn about and adjust to new situations, while staying independent and respecting others, and
3. *Mobility* – the skills required in today's international and multicultural society, especially the ability to work and communicate with others across national boundaries and by this to adapt to the challenges of a global economy.

The purpose of the chapter is to analyse lessons learned from implementing VCL courses in local and regional contexts. The chapter will cover two virtual collaborative learning case studies from modules implemented at International Burch University (IBU) in 2023 and with our partner, the University of Montenegro (UOM) in 2024. The VCL modules were in a local and regional structure and context. Included will be the scope of the courses, the local and regional case studies, key lessons learned, challenges and recommendations. In addition, a comparative analysis of local and regional contexts will be presented along with future directions of virtual collaborative learning.

Definitions of Key Terms in Virtual Collaborative Learning Context

In this section, we will build up to the definition of Virtual Collaborative Learning by looking at important terms that shape this theory.

Virtual Mobility

'The use of information and communication technologies (ICT) to obtain the same benefits as one would have with physical mobility but without the need to travel' (van Schaik et al., 2019). Focus on cooperation between higher education institutions and the recognition of achievements.

Virtual Exchange

The term 'Virtual Mobility' describes cross-border educational exchange that is organised not through time spent physically abroad but through participation in networks and communities, underpinned by flexible technologies and involving students and institutions from various countries (Villar-Onrubia & Rajpal, 2016). Hence, Virtual Mobility provides opportunities for students who, for some reason, are not able to participate in the physical intercultural exchange or travel extensively to benefit from internationalisation (Otto, 2018). VCL's purpose is to facilitate and enable 'Virtual Mobilities,' which promote internationalisation and sustainability. Another simplified definition is the interaction and communication of geographically separated participants with a focus on exchange, competence building and teamwork in small groups.

Importance of Virtual Collaborative Learning

Ruberg et al. (1996) found that using computer-based communication fostered innovation, idea exchange, broader and more inclusive participation, and collective thinking. But as a counterweight to this positive aspect, we found in our VCL modules that professors and e-tutors need to encourage student peers and create a comfortable yet structured environment for social interaction, with interaction rules clearly spelt out so student participants feel empowered to share their views.

Virtual Collaborative Learning in a Local Context

A local VCL module is run in a single institution or across multiple courses. The module is usually a project segment of a course(s). Each

VCL module has a kickoff, orientation, and registration on the technology platform. The course then takes the form of a blended learning teaching environment, incorporating both in-person meetings and technology-mediated class sessions using the technology platform.

The students of the local VCL were from the engineering faculty, specifically the Department of Information Technologies. This could account for their fast adaptation to and ease of use of the technology platform MS Teams. They designed logos for each group and were active on the platform during the local VCL.

In the planning phases of the local VCL, various proposals were made for a cover story or theme to increase student engagement. Eventually, the theme of Green Efficient Networks was chosen due to its applicability for the course topic, Wireless and Mobile Networking. The major work of the module was a research paper or a practical product design.

In addition, during planning, a ten-part structure was agreed upon for the structure of the local VCL module. Part 1 – Group formation (Team rules, meeting schedule, Team roles); Part 2 – Introduction to VCL methodology; Part 3 – Module deliverables and requirements; Part 4 – Project outline; Part 5 – Work in process presentation or demo; Part 6 – Final report submission; Part 7 – Peer feedback; Part 8 – Revised report submission; Part 9 – Final presentation of report; and Part 10 – VCL reflections.

Case Study: IBU Local VCL Implementation – Wireless and Mobile Networking

Course Description

The course explores mobile and wireless networks and how their characteristics impact the development of software and supporting protocols. We aim to understand how networking mobile and wireless devices at the link layer and the network layer work, and how that is different from traditional wired computer networks. By also looking at the relationship of wireless links and networks to the larger (wired) networks they connect to, we explore the challenges of wireless transmission and the challenges of mobility. Topics include wireless coding and modulation, signal propagation, IEEE 802.11 wireless local area networks, vehicular wireless networks, and Internet of Things (IOT). We also discuss cellular networks: 4G LTE-Advanced, 5G and the emerging 6G cellular technologies. The problems we will address include lo-

cating a mobile user, coverage planning, resource allocation, routing to the mobile user, handover, etc. Project work includes research and writing a survey paper on a selected networking topic and/or hands-on implementation (or measurement) on a selected IOT topic using Raspberry Pi. During the course, students will participate in a local VCL (Virtual Collaborative Learning) project, as part of the COWEB (www.cowebproject.eu) project. Students will implement in hardware and software the IOT environmental monitoring project, and conduct research on IOT protocols, techniques, and methods for green, energy-efficient IOT networks. Student teams will collaborate for 6–8 weeks using MS Teams as their main technical platform. It is expected that the VCL framework will provide a richer, hands-on learning experience, enhancing student engagement through interdisciplinary collaboration and real-time problem solving. The integration of digital tools for brainstorming, document collaboration, and peer review should further enhance the VCL environment. The approach is expected to support course objectives but also prepare students for real-world IOT challenges.

Two ECTS or 33% of the grade was allocated towards VCL activities from the overall 6 ECTS course.

The evaluation and assessment were mostly qualitative, with a major project or research paper delivered. Additionally, there were weekly course meetings and assignments to check students' progress. Group and peer evaluation were also important aspects of the final grade.

Implementation Details

As seen from Figure 14.1, local VCL implementation is centred around *didactic, social* and *technical* dimensions and their subcategories as established by Altmann and Clauss (2020), adapted to our local use case, ensuring it aligns with the conceptual model that emphasises learning, teaching, assessment and collaboration. Here is how we mapped the key categories and subcategories for effective VCL environments to the local VCL implementation, bridging theoretical research with practical application:

- *Learning, Education and Competencies:* The VCL module fostered technical (e.g., protocol implementation, hardware programming), social (e.g., teamwork, communication), and didactical (e.g., peer feedback, reflections) competencies. The focus on green networks

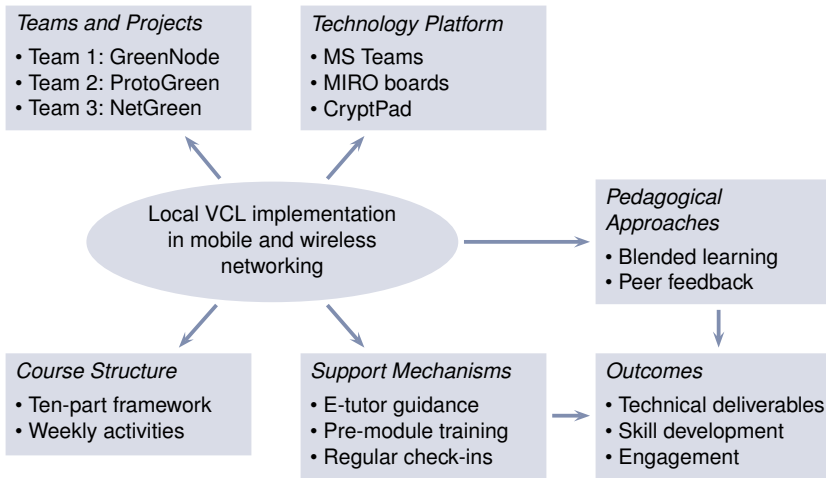

FIGURE 14.1 Local VCL Implementation in Introduction to Mobile and Wireless Networking Course

is aligned with the EU's emphasis on skills, adaptability, and mobility, preparing students for interdisciplinary and global challenges.

- *Collaboration and Teamwork:* The VCL module tasked students with collaborative projects themed around 'Green, Energy-Efficient IOT Networks.' Students were divided into three teams: Team 1 (GreenNode) developed a hardware-based IOT environmental monitoring system using Raspberry Pi; Team 2 (ProtoGreen) surveyed energy-efficient IOT protocols, which informed the final deployments of Team 1 project; Team 3 (NetGreen) explored green IOT network technologies through a survey, informing the communication and networking module of Team 1 as well. The distinct visual identities (e.g., team logos) fostered a sense of belonging, enhancing groupwork and motivation, as noted by van Schaik et al. (2019) in virtual mobility contexts.
- *Teaching and Instruction:* Spanning 6 weeks, the module followed a ten-phase structure: group formation, VCL methodology introduction, deliverable specification, project outline, work-in-progress presentation, final report submission, peer feedback, revised report submission, final presentation, and VCL reflections. The module progressed systematically: Week 1 introduced

project objectives via a webinar, with Team 1 sourcing hardware and Teams 2 and 3 compiling annotated bibliographies. In Week 2, teams finalised project outlines during virtual check-ins, with Team 1 beginning prototype development and Teams 2 and 3 refining research questions. Week 3 included a mid-project review, where Team 1 tested sensors and Teams 2 and 3 deepened their literature reviews. In Week 4, teams integrated findings – Team 1 analysed prototype data, while Teams 2 and 3 drafted survey papers. Week 5 featured final submissions and live presentations, with Team 1 showcasing an energy-efficient prototype and Teams 2 and 3 presenting actionable survey insights. The module concluded in Week 6 with peer reviews and reflective discussions, all supported by MS Teams and supplementary tools. The e-tutor's role was critical in facilitating user-friendly, interactive sessions.

- *Training and Support:* Pre-module training on MS Teams and supplementary tools (MIRO, CryptPad, etc.) ensured usability and accessibility. However, challenges with CryptPad highlight the need for robust, user-friendly tools to enhance engagement, as suggested by Bernaola et al. (2020).
- The *technology platform* over which the course was delivered consisted of MS Teams for communication and file sharing, augmented by tools like MIRO boards for brainstorming and CryptPad for collaborative writing and real-time editing.
- In terms of *pedagogical approaches,* for this blended learning environment, we decided to incorporate peer reviews and progress checks, curious about how authentic assessment will be and whether it will lead to better deliverables as teams engaged in peer review sessions, encouraged to critically analyse and fully trust the VCL concept. *Engagement and Motivation:* The theme of green networks and interactive tools like MIRO boards encouraged active participation, as well as the task breakdown structure.

Key Lessons Learned

The local VCL implementation led to several insights into effective pedagogical practices and technical integration:

- *Benefits of localised content and relevance for student engagement.* The theme of 'Green, Energy-Efficient Networks' resonated with students, given its relevance to sustainability and IOT applica-

tions. The structured weekly tasks and clear project goals maintained focus and motivation, particularly for engineering students familiar with technical platforms like MS Teams. Team 1's success in reducing power consumption by 20% compared to traditional monitoring systems was attributed to peer feedback and iterative improvements facilitated by the VCL structure.

- *Collaboration on the technical platform was a positive result.* The ability for teams to communicate and observe each other's presentations and demos led to additional feedback opportunities that improved final project outcomes. Team 1's hardware prototype benefited from insights shared by Teams 2 and 3 during online discussions, particularly on protocol selection (e.g., MQTT's low-power benefits). In the online course discussions, presentations and feedback sessions, some teams took cues from others' mistakes and suggestions to improve their deliverables. This facilitation of peer interaction by the professor and in other settings by the e-tutor was important to achieve breakthrough results. On the negative side team outcomes differed based on team cohesiveness and 'buy-in' to the VCL concept.
- *Tool efficacy.* MS Teams proved robust for communication, file sharing and meeting coordination. Challenges with CryptPad's high-security features caused frequent crashes, disrupting collaborative writing. MIRO boards were highly effective for brainstorming, enabling visual mapping of ideas.
- *Importance of structure and training.* The ten-part structure provided clarity and direction. This structure of topics from week to week was crucial for successful local VCL implementation (i.e., engagement, realistic cases, and work tasks, easier to report, with interconnected projects for greater collaboration). Pre-module training was important.
- *Diverse skill integration.* The projects required a blend of skills, including database systems, web programming, network protocols, hardware programming, data analysis, research, and writing.

Challenges

The implementation encountered obstacles, including unequal team contributions, mitigated partially by role definitions and check-ins. CryptPad's technical issues disrupted collaboration, suggesting a need

for alternatives like Overleaf. The six-week timeline proved intensive for hardware projects, requiring precise time management. Additionally, some students struggled with MS Teams, underscoring the importance of comprehensive training.

Recommendations

Based on the lessons learned, the following recommendations can enhance future local VCL implementations:

- *VCL project duration.* Limit VCL modules to 6–7 weeks to maintain focus while allowing sufficient time for complex tasks like hardware development.
- *Regular reporting & discussions are important for engagement and progress.* Weekly brainstorming sessions and presentations help a lot to get better results and achieve improved overall satisfaction of students. Incorporate incentives (e.g., bonus points for engagement).
- *Importance of training on the technological infrastructure* prior to the start of the VCL module.
- *Using the technical platform & tools.* Select tools fully compatible with MS Teams to ensure seamless collaboration. Provide training on all tools before the module begins. Minimise the number of tools used (decide in the initial planning stage while putting effort into planning the structure).
- *The E-tutor needs to be a student connected to the course/department;* the E-tutor should not be a part-time student or a full-time working student outside the University.
- *Come up with project topics that require a diverse set of skills* (e.g. GreenNode team students applied database systems, computer networks, web programming, programmable hardware knowledge & skills).

Conclusion

This VCL implementation underscores the potential of technology-driven pedagogy in engineering education. Team 1's energy-efficient prototype and Teams 2 and 3's insightful surveys demonstrate significant outcomes, despite challenges like tool instability and team dynamics. By aligning with a conceptual VCL framework, this case study

offers a replicable model for integrating collaborative learning into IT curricula, preparing students for sustainable technology challenges.

Virtual Collaborative Learning in a Regional Context

Definition and Scope

Explanation of regional collaboration (e.g., within a specific geographic or cultural region).

Case Study: Entrepreneurship and Innovation Regional VCL Module with University of Montenegro (UOM) and International Burch University (IBU) Students Participating

We created five diverse groups of students from our similar courses into teams of five students (three students from UOM and two students from IBU).

Course Description

This course will provide students with an understanding of issues facing entrepreneurs and an exposure to the skills involved in addressing them. We will explore how founders should approach making critical decisions during the different phases of an entrepreneurial company's life. Starting from the vantage point of the individual, we will put ourselves in the shoes of decision makers ranging from technology entrepreneurs to venture capitalists, from marketing, operations, developers, to inventors

Two ECTS or 40% of the grade was allocated towards VCL activities from the overall 5 ECTS course.

Three e-tutors joined students in their meetings. Two were from UOM and one was from IBU.

Module Schedule:

- Introduction to regional VCL module and Cover story;
- Overview of current issue with urban mobility;
- Business Model Canvas practical training and exercise;
- Market sizing and customer targeting workshop;
- Go to market marketing plan and financial plan;
- Practice pitch presentation;
- Final pitch presentation;
- VCL module reflection.

Key Lessons Learned

1. Positive and Negative Aspects of the VCL Experience
   - *Positive Aspects:* Diverse talents from different faculties (Economics and Social Sciences at IBU and Engineering at UOM), interactive learning, digital skill development, regional collaboration, improved teamwork and communication skills, and personal growth.
   - *Negative Aspects:* Limited face-to-face interaction, potential miscommunication, technical issues, uneven contribution leading to groups not living up to their full potential, and challenges in coordinating schedules.

   Suggestions for improvement:
   - *Interactive Elements:* Incorporating more live virtual discussions, group activities, and interactive sessions to foster a sense of community and reduce isolation.
   - *Feedback and Guidance:* More frequent feedback from instructors or peers, clearer instructions and guidelines, and better selection of team members to ensure active participation.
   - *Technical and Organisational Support:* Improved communication and organisation, better tools for teamwork, and more flexibility in deadlines to enhance participation.
2. Learning Outcomes and Recommendations for Course Enrichment
   - *Skills Developed:* Virtual collaboration, time management, cross-cultural communication, problem-solving, and project management.
   - *Recommendations:* More hands-on practice, better tech support, clearer instructions, more interactive sessions, and real-time activities to enhance engagement and practical learning.
   - *Desired Changes:* Clearer guidelines at the start, improved integration of communication tools, more structured tutor support, and better coordination across time zones.
3. Workflow and Workload in Group Tasks
   - *Workflow:* Tasks were divided based on roles, with clear communication about deadlines and expectations. Regular check-ins and collaboration were essential for progress.
   - *Workload:* The individual workload varied, with estimates ranging from 5 to 50 hours depending on the complexity of

tasks and roles. Effective time management and coordination were crucial for completing tasks.

4. Perception of Team Members' Roles
   - *Positive Perceptions:* Team members were generally seen as collaborative and supportive, contributing their expertise and maintaining clear communication. Roles such as project manager, researcher, and public relations manager were crucial for the organisation and its progress.
   - *Challenges:* Some members were less cooperative, leading to uneven workload distribution. Effective role assignment and active participation were key to successful collaboration.
5. Role of E-Tutor in the Activity
   - *Guidance and Support:* E-tutors provided valuable guidance, feedback, and motivation, helping teams stay on track and clarifying tasks. Their role was seen as crucial in education and professional settings for personalised learning and skill development.
   - *Suggestions for Improvement:* More frequent check-ins, clearer instructions, and proactive support in conflict resolution and tool usage could enhance the e-tutor's effectiveness.
6. Previous Experiences Using Social Media Tools for Virtual Collaboration
   - *Learning Outcomes:* Participants learned the importance of clear communication, self-management, and effective time coordination. Virtual collaboration provided flexibility and exposure to regional perspectives.
   - *Challenges:* Asynchronous communication and lack of face-to-face interaction were challenging. The most complex aspect was keeping everyone engaged, while the most beneficial was the ability to collaborate across different locations.
7. Feedback Received and Handling
   - *Sources of Feedback:* Feedback was received from e-tutors, professors, and team members. It was delivered through written comments, messages, and video chats.
   - *Implementation:* Feedback was generally accepted and implemented to improve work quality and team dynamics. More frequent and detailed feedback, especially during the early stages, was suggested to enhance progress.

8. Perception of Regional VCL Module and Virtual Mobility
   - *Positive Experience:* Virtual mobility was seen as enriching, offering flexibility, global networking, and exposure to different perspectives. It was recommended for gaining regional experience without the need for physical travel.
   - *Challenges:* Limited interaction and communication issues were noted. More diverse regional collaboration and structured support were suggested to improve the experience.
9. Suggestions for Improving Virtual Mobility Experience
   - *Interactive Sessions:* More live discussions, regular check-ins, and interactive activities with e-tutors and academic staff could enhance engagement.
   - *Clear Communication and Support:* Clearer guidelines, better tech support, and structured schedules were recommended to improve coordination and reduce confusion.
   - *Active Participation:* Encouraging active participation from all students and providing incentives for engagement were suggested to enhance the overall experience.
10. Learning Outcomes and Recommendations for Course Enrichment
    - *Skills Developed:* Participants gained skills in virtual collaboration, time management, cross-cultural communication, problem-solving, and project management.
    - *Recommendations:* The importance of cross-institutional alignment regarding course content and student evaluation criteria. Better tech support, clearer instructions, and more interactive sessions were recommended to enhance engagement and practical learning.
    - *Desired Changes:* Clearer guidelines at the start, improved integration of communication tools, more structured tutor support, and better coordination across time zones were suggested to improve the course for future participants.

Summary of Challenges and Recommendations

Technical Platform – Getting familiar with the technical platform prior to the VCL could help student engagement. Timely Registration of students by technical support would allow all team members to be engaged from the start of the module. This also pertained to e-tutor and

instructor accounts. We had a kick-off meeting separately at each campus to inform students about the module schedule and required tasks. In the future, it is recommended that multiple kickoff meetings (Orientations) be held, rather than just one, due to the number of new formats and technologies being implemented during the regional VCL module. Combining the kick-off was difficult due to regional logistical barriers such as course schedules.

It was the experience during our Entrepreneurship/Innovation regional VCL module that there were scheduling conflicts that affected full attendance of the regularly scheduled meetings. But the AI meeting notes taken by MS CoPilot saved us. Students had summaries of the meetings on the MS Teams platform for review after each meeting scheduled through the technology platform. This was another encouragement to use the platform for all scheduled meetings and toggle on the MS CoPilot for meeting summaries.

What are the best communication channels for students: Email? Technical platform? Or other (e.g. Instagram or WhatsApp)? Given the issues with student credentials and getting students to check their official university email accounts for information, there should be a plan B with regard to communication with students. One recommendation is to obtain multiple communication information details, such as IG handles, WhatsApp numbers, Signal or Telegram accounts, so that early MS Teams credentials can be broadcast to all messaging platforms, and students can use their preferred communication tool to sign up for MS Teams.

During the regional VCL, educators often found themselves asking How can we encourage more student meetings on a technical platform? In the future, demonstrating the full capabilities of MS Teams prior to the start of the regional VCL module can be a convincing argument to students for the time-saving features, not to mention the AI capabilities.

Comparative Analysis of Local and Regional Contexts

Similarities across contexts:

- Common technological and pedagogical challenges that students and instructors in the Western Balkans have a variety of experience using the MS Teams technical platform for online course implementation. Use of MS Teams is limited in the Balkans; thus, familiarity with the software is at a low level among current univer-

sity students. The future looks better as MS Teams is a standard due to projects like this one.
- There is a need for additional faculty training in VCL methodology and student support in all three VCL formats.

Differences across contexts:

- In a local VCL module is quite easy to control implementation given it is one course, and you set the structure and learning outcomes with students from the beginning. There is little coordination, given that everything is encapsulated within one course.
- This differs significantly from a regional VCL implementation, which needs coordination between partners on different campuses and or countries. The scale and complexity of collaboration between educators and students differ significantly. Diversity in participants and course evaluation methods, as well as learning outcomes, can conflict with implementation. Some of these issues can be worked out prior to the start of the VCL module, but some issues are unforeseen during implementation, such as scheduling, pedagogical style, skill level of participants, common language, and culture.

Conclusion

The potential of VCL to transform education globally is real. We need to encourage institutions to embrace VCL while addressing its challenges. Universities are often slow to invest in the latest collaboration technologies, instead relying on free versions that lack the ability to upgrade and stay current with new developments such as AI. This is even truer in the Western Balkans, where university investment budgets are even tighter. University leaders need to understand the enhanced productivity of workers and engagement of students as the reasons for their investment, which will lead to sustainability in their business module, increasing student retention in additional education cycles. This, coupled with improved instructor satisfaction, will create a virtuous cycle of student satisfaction.

We observed the expanded role of E-Tutors in the VCL context. Not only did they observe student teams, but they also provided personal and group-related support, as well as technical, organisational, and specialised support. E-Tutors also assisted in the evaluation of team collaboration using pre-formatted templates for consistent measure-

ment of important metrics. Student team roles and responsibilities were well defined and elaborated during the kick-off of the Regional VCL, which enhanced understanding and responsibilities for students during the module. This gave structure to the teams, which increased their engagement and long-term success.

Training on the technical platform, MS Teams, was performed, thus ensuring all participants were familiar with and knowledgeable about the features and functions available through MS Teams. This could be expanded in future VCL modules to ensure all stakeholders are adequately familiar with the technology platform.

The content of the modules was organised and posted on the technical platform weekly during the module. Scheduled meetings and announcements were created using the technical platform. These intentional efforts drove engagement on MS Teams, allowing for a robust collection of collaboration data, which could further allow e-tutors and educators to notice teams that were not engaged and assist them.

What was clear was the importance of proper planning and structuring for the VCL modules. It was one key to the success of the module due to the coordination needed between international partners. Knowing the backgrounds of the students, from which study area or major they are coming, is important for understanding the content requirements of the module. For example, with a majority of the partners, students are coming from business-oriented departments, but with noticeable gaps, so there is often a need to provide background information about the module topic.

Evaluation of the VCL teams was an important aspect of the success of the module. Establishing and communicating evaluation frameworks was highlighted as a critical step during the implementation of the VCL modules. Thus, it is important to discuss with international partners and agree on a common framework from the start.

Regarding the content of the module, it was stressed, and I agree that enthusiasm for the topic is needed from all participants. Choosing a popular and timely topic can make the difference in participation and engagement.

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