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6. Impact of Virtual Exchange on teachers' and student teachers' digital collaboration skills

Introduction

If there is a lesson that the COVID-19 pandemic has taught us it is that teachers have to be digitally competent to engage their students in online collaborative learning. This highly valuable lesson is here to stay, as some studies have emphasised (Educause Horizon Report, 2021). However, teachers are not always prepared to engage their students in innovative practices that foster the development of collaborative skills and digital competences (Hauck & Satar, 2018; Vinagre, 2017). One such practice is Virtual Exchange (VE), which has been increasingly integrated in teacher education programs because VE provides teachers with the opportunity to use technological tools, and to experience and reflect on their own techno-pedagogical skills in authentic intercultural contexts (Hauck & Kurek, 2017). Large-scale studies of student teachers who take part in VE have found that this pedagogical practice can indeed improve their digital collaborative skills (see for example The EVALUATE Group, 2019).

Even prior to the COVID-19 pandemic, calls for teacher training to include a focus on digital competences emerged alongside the growth and ubiquity of technology in teaching and learning (see, for example, Hubbard, 2008). What has transformed over time, however, is the specific focus of such training: instead of an emphasis on technology-specific skills, teachers and student teachers are now required to have the skills and knowledge encompassed by digital literacy.

In its simplest form, digital literacy can be defined as "the modes of reading, writing and communication made possible by digital media" (Hafner et al., 2015, p. 1). On a more nuanced level, these modes of reading and writing necessitate a range of skills and knowledge to manage

and make sense of information conveyed through digital media, which is integral to digital literacy/competence. Accordingly, digital literacy has been defined as "including competencies associated with assembling information, reading and understanding multimedia and hypermedia texts, finding and critically evaluating information, and working collaboratively to communicate information" (List, 2019, p. 147). In the context of VE as a pedagogical practice for bringing together teachers and student teachers, the skills of digital literacy also require the skills inherent to collaboration and interaction through digital means. Thus, the sub-competences of the Digital Competence Framework for Citizens (DigComp) 2.1 (Carretero et al., 2017), provide a useful lens for merging the digital skills, knowledge and attitudes required of teachers and student teachers collaborating through technologies. Although there is a specific DigComp framework for educators (DigCompEdu), the authors decided to use DigComp 2.1 for data analysis instead because the former focuses on educators' professional activities and, therefore, some of the framework's components were not applicable to participating student teachers. DigComp 2.1 represents an advancement on the previous model since it builds upon the conceptual model initially introduced in DigComp 2.0. The purpose of DigComp is to provide a reference framework for individuals, organisations, and policymakers to understand and assess digital competence. It aims to define the key competences required to use digital technologies effectively and confidently in various personal, social, and work-related contexts. DigComp 2.1 is designed to be applicable to all individuals, regardless of their level of digital proficiency, and across different domains, such as education, employment, and personal life. The conceptual reference model identifies key components of digital competences in 5 areas and 21 sub-competences that are pertinent to these areas (see Figure 6.1). The areas include Information and data literacy, Communication and collaboration, Digital content creation, Safety and Problem solving, and are summarised as follows:

1. Information and data literacy: To articulate information needs, to locate and retrieve digital data, information and content. To judge the relevance of the source and its content. To store, manage, and organise digital data, information and content.
2. Communication and collaboration: To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity. To participate in society through public and private digital services

and participatory citizenship. To manage one's digital presence, identity and reputation.

3. Digital content creation: To create and edit digital content. To improve and integrate information and content into an existing body of knowledge while understanding how copyright and licences are to be applied. To know how to give understandable instructions for a computer system.

4. Safety: To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion. To be aware of the environmental impact of digital technologies and their use.

5. Problem solving: To identify needs and problems, and to resolve conceptual problems and problem situations in digital environments. To use digital tools to innovate processes and products. To keep up-to-date with the digital evolution.
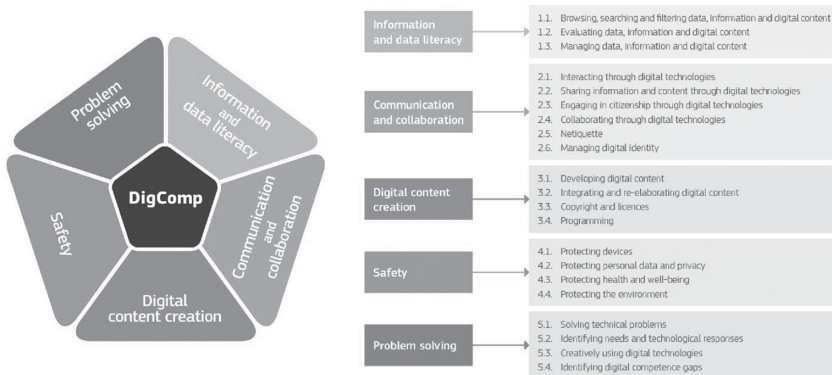

Figure 6.1: DigComp 2.1 framework

These 5 areas and their respective sub-competences compose the framework which served as the analytical tool for this portion of the VALIANT study (i.e., digital competence development) and further details about its application in this investigation will be provided in section 4. Although the entire framework was used as the tool for data analysis, given the nature of VE, the topics participants discussed, the tasks they carried out and the items and questions included in the pre-, mid- and post-VE surveys, a development in areas 2, 3 and 5 of the framework was expected with little or no development in areas 1 and 4.

Our research interest in this chapter extended beyond the exploration of participants' digital competence to also include their digital attitude. Digital competence and digital attitude are two distinct concepts related to

individuals' relationship with digital technologies. While they are interrelated, they concentrate on different aspects of a person's interaction with digital environments. In this study, we understand *digital competence* as the ability of individuals to effectively utilise digital technologies and resources to achieve specific goals, while *digital attitude* is understood as an individual's positive mindset towards adopting digital technologies, as well as motivation and willingness to engage with digital technologies. Both digital competence and digital attitude are central aspects in today's digital era, as they complement each other to empower individuals to fully participate in the digital world and cope with its challenges.

Research Questions

The following three research questions (RQs) guided our study:

RQ1. To what extent does engagement in Virtual Exchange contribute to teachers' and student teachers' perceived digital competence development?
RQ2. What areas and sub-competences are the most developed in VE according to participants' perceptions?
RQ3. Is there a perceived improvement in participants' attitudes towards digital competence?

To answer RQ1, close-ended items were included in the pre- and post-VE surveys as follows:

Digital Competence:

When it came to assessing digital competence, the study utilised closed-ended questions that specifically targeted participants' self-assessed skills in navigating online networks, collaborating with fellow educators to create digital resources, and adopting new digital pedagogical approaches as part of their continuous professional development:

> I can use online networks of teachers to collaboratively develop digital resources

I can use online networks to collaborate with other educators on innovative pedagogical practices
I can use professional collaborative networks as a source for my own professional development

To answer RQ2, the following open-ended questions were included in the pre-, mid- and post-VE surveys. These questions were also used to investigate aspects of the other areas in the VALIANT study (i.e., motivation, isolation, intercultural competence, self-efficacy and other transversal competences, as well as expectations about learning in VE):

What have you learned from taking part in this Virtual Exchange?
Did anything happen during this exchange which made a particular impact on you? If so, could you tell us about it?
If you were going to take part in a Virtual Exchange like this again in the future, is there anything you would like to be done differently?
Has your experience in the Virtual Exchange influenced how you approach your teaching/teaching career or your continued studies as a student teacher? If possible, give a concrete example to illustrate your answer.
Have your expectations about what you hoped to learn or achieve in the Virtual Exchange been fulfilled? Why/why not?
Did you have access to any particular networks and materials through this Virtual Exchange that you think will be especially useful for your professional development?
Do you think the collaboration with teachers helped you to gain a better understanding of your future profession?

Finally, to answer RQ3 close-ended items were included in the pre- and post-VE surveys as follows:

Digital Attitude:

In terms of digital attitude, the study employed closed-ended questions that specifically targeted teachers' positive or negative attitudes towards promoting online collaboration among colleagues and students. Furthermore, it aimed to assess their motivation to engage students in activities involving online collaboration within international contexts:

I believe in the value of promoting the use of online collaboration among my colleagues
I believe it is beneficial for my students to experience online collaboration
I plan to engage my students in projects and activities which involve online international collaborative learning

Data collected from the items and questions above were analysed following a mixed methods approach described in detail in Chap. 3. To answer RQ1 and RQ3 the data collected were analysed quantitatively (descriptive and inferential statistics), while to answer RQ2 the data collected were coded and analysed qualitatively. Findings from these analyses are presented and discussed below.

Main Quantitative Findings

RQ1. To what extent does engagement in Virtual Exchange contribute to teachers' and student teachers' perceived digital competence development?
RQ3. Is there a perceived improvement in participants' attitudes towards digital competence?

Overall results showed that there was no change in the control group in their digital competence or attitude. The VE participants, however, reported a significant moderate improvement in their perceived digital competence ($Md_{\text{pre-VE survey}} = 70.5$, $Md_{\text{post-VE survey}} = 83.3$, $z = -10.062$, $p < 0.001$, $r = -0.48$) and significant but negligible increase in their perceived digital attitude ($Md_{\text{pre-VE survey}} = 83.7$, $Md_{\text{post-VE survey}} = 87.5$, $z = -4.142$, $p < 0.001$, $r = -0.2$). The median for perception of digital competence and attitude development in the pre- and post-VE surveys is summarised in Figure 6.2.
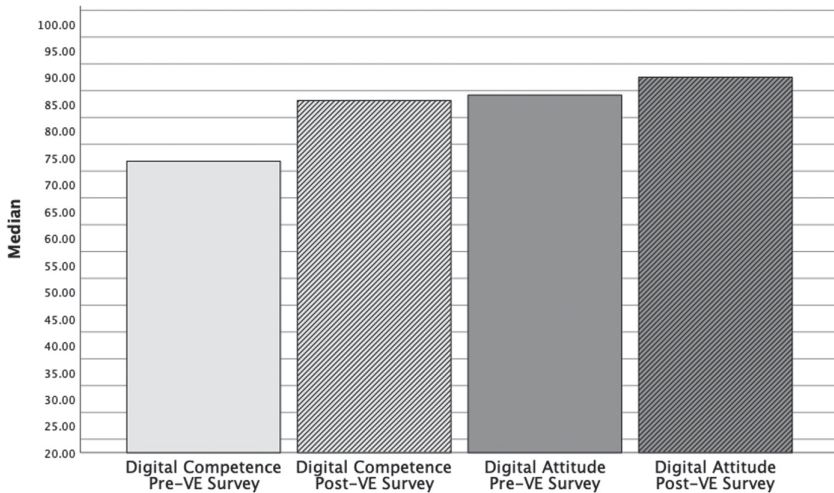
Figure 6.2: Median change in participants' perceptions of digital competence and digital attitude (pre- and post-VE surveys, 3 rounds)

In relation to the participants' occupation, both teachers and student teachers perceived a moderate and significant improvement across digital competences: teachers $Md_{\text{pre-VE survey}}$ = 73.7, $Md_{\text{post-VE survey}}$ = 86, z = -5.51, $p < 0.001$, r = -0.41; and student teachers $Md_{\text{pre-VE survey}}$ = 69.3, $Md_{\text{post-VE survey}}$ = 81.7, z = -8.447, $p < 0.001$, r = -0.53. Perceptions of digital attitude also changed significantly for both groups, but the magnitude of change was negligible: teachers $Md_{\text{pre-VE survey}}$ = 86.7, $Md_{\text{post-VE survey}}$ = 90, z = -2.857, $p < 0.01$, r = -0.21; student teachers $Md_{\text{pre-VE survey}}$ = 81.7, $Md_{\text{post-VE survey}}$ = 83.3, z = -3.03, $p < 0.01$, r = -0.19 (see Figure 6.3).
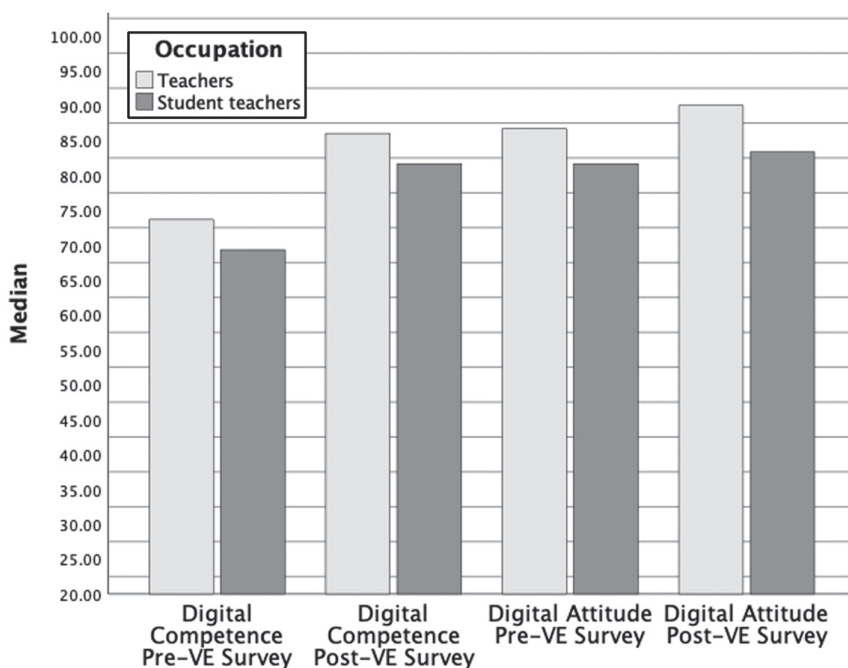
Figure 6.3: Total results of teachers' and student teachers' perceptions of digital compe-
tence and attitude according to participant occupation

In relation to the type of VE participants engaged in (teachers only, student teachers only, and mixed teachers with student teachers), there were some differences. The greatest improvement in digital competences was found in the VE type where student teachers collaborated with teachers ($Md_{\text{pre-VE survey}}$ = 72, $Md_{\text{post-VE survey}}$ = 86.3, z = -9.354, p < 0.001, r = -0.57). This type of exchange was also the one where participants most improved in their digital attitudes ($Md_{\text{pre-VE survey}}$ = 84.3, $Md_{\text{post-VE survey}}$ = 89.3, z = -4.119, p < 0.001, r = -0.25). The exchange where student teachers collaborated with other student teachers showed significant change only in digital competence ($Md_{\text{pre-VE survey}}$ = 66, $Md_{\text{post-VE survey}}$ = 79.3, z = -4.261, p < 0.001, r = -0.41) but not in attitude ($Md_{\text{pre-VE survey}}$ = 83.3, $Md_{\text{post-VE survey}}$ = 82.2, z = -0.836, p > 0.05, r = -0.08). Finally, there was no change observed in neither digital competence nor attitude in the VE type where teachers collaborated with other teachers.

Overall, the results of the quantitative analysis showed that VE helped to develop participants' digital competence and attitude quite consistently.

For both teachers and student teachers the main benefit was in developing their digital competence. It is also apparent that teachers and student teachers who signed up to take part in the VEs already scored quite high on those items related to positive digital attitude in the pre-VE survey. As a result, there was less room for improvement in digital attitude in the post-VE survey (ceiling effect). This ceiling effect was observed in other similar research projects e.g., EVOLVE (EVOLVE Project Team, 2020), EVALUATE (The Evaluate Group2019), and EVE (Hemp & van der Velden, 2021) and had less impact on digital competence. Nonetheless, quantitative measures enabled us to reliably measure digital attitudes and competences and results showed that participating in VE did help teachers and student teachers improve both.

However, quantitative results only provided a partial picture due to the limitations of the surveys used. One such limitation is the general character and small number of items that assessed digital competence. Therefore a qualitative analysis of the answers to the open-ended questions was conducted to gain a deeper understanding of the VE impact on the development of specific digital sub-competences.

Framework for Qualitative Analysis: Codebook

As already mentioned in the introduction, the Digital Competence Framework for Citizens 2.1 (DigComp, 2017) was used as the basis for coding and analysing qualitative data. The codebook included all 5 areas and all 21 sub-competences that are pertinent to these areas (see Table 6.1, areas correspond to codes 1–5 on the left column and their respective sub-competences are included in the middle column). In addition, another 6 areas (codes 6–11) which include other learning or achievements, general comments, denying any learning, suggestions, problems, and uncertain were added in order to cater for all observed data. The additional areas were utilised as follows:

> Other learning or achievements: When participants reported other learning gains that were not mentioned in the DigComp framework, such as intercultural learning, increased confidence, development of linguistic competence (e.g., "it helped me understand something about my knowledge of English language and that I have to read more")

General comments: When participants made comments describing their overall experiences with the VE (e.g., "positive impressions", "I learnt a lot", "interaction has been fun so far")

Denying any learning: When participants reported that they learned nothing new regarding the use of technologies or digital collaboration (e.g., "not yet")

Suggestions: When participants put forward ideas for improving the experience and learning in VE (e.g., "suggestions for improvement, maybe create a group on a social network so we can have a faster contact with each other. A kind of chat.")

Problems: When participants reported problems or challenges they faced during their participation in the VE (e.g., "I've found some difficulties with the schedule")

Uncertain: When coders were uncertain about where they should code a unit of data. In this case coders held discussions and either coded the segments into the existing codes or created new ones.

All 11 areas were introduced in NVivo as nodes and each of the participants' answers was analysed as a unit and coded in one or various nodes as applicable. The final codebook together with examples of data coding can be seen in Table 6.1. It should be noted that all examples from participants included in this chapter are in the original form; that is, no corrections have been made.

Table 6.1. Codebook and examples

Codes	Sub-Codes	Examples	Frequency
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content	As we have searched different webs, I realise to have more information and clear ideas about this issue.	4
	1.2 Evaluating data, information and digital content	Not so much that I have learned but made me think about applying it more than I already thought I should may become necessary rather than staying an option.	7
	1.3 Managing data, information and digital content	Creating, managing, recording and uploading zoom meetings was new for me.	13

Table 6.1.   Continued

Codes	Sub-Codes	Examples	Frequency
2. Communication and Collaboration	2.1 Interacting through digital technologies	I am thoroughly enjoying the Virtual Exchange experience, as interactions are proving to be extremely insightful and enriching. They help us see what language teaching an learning is like in other contexts and the different challenges that teachers face within the educational system	547
	2.2 Sharing through digital technologies	I have learnt the differences and similarities between the linguistic landscapes of Madrid and Gmünd. My German peers helped me understand this topic better since I have never been to Gmünd and I was not aware of how things work there. By sharing their own experiences, I could broaden my perspective about this topic and compare it to my experience	393
	2.3 Engaging in citizenship through digital technologies	It was very interesting to learn how the students with special needs are reacting to certain topics, what they enjoy and what is to difficult/overwhelming for them. We as a group definitely took this into consideration when creating our game.	2
	2.4 Collaborating through digital technologies	I have learned different negotiation strategies, effective team-building and collaborative working strategies. I have also learned how to build and sustain the group dynamics and effective monitoring skills.	342
	2.5 Netiquette	Definitely! For example, during our chatting in our whatsapp group, I used an exclamation mark which can easily be understood in a negative way.	16

Table 6.1.   Continued

Codes	Sub-Codes	Examples	Frequency
	2.6 Managing digital identity	I can't say I did, except for using Moodle. I already knew how to use it as we use the same platform for our university courses but I learned some features, such as putting details and media on your profile.	2
3. Digital content creation	3.1 Developing digital content	I found useful the procedure we have to follow to make a VE project (collaborative task etc.)	70
	3.2 Integrating and re-elaborating dig-ital content		0
	3.3 Copyright and licenses		0
	3.4 Programming		0
4. Safety	4.1 Protecting devices		0
	4.2 Protecting personal data and privacy	Google Site was new to me. However, I am very careful with Google&Co because of data privacy	2
	4.3 Protecting health and well-being		0
	4.4 Protecting the environment		0
5. Problem solving	5.1 Solving technical problems	sometimes it's hard to understand what they say because of bad inter-net connections, but it can be fixed with just asking them to repeat what they said.	2

Table 6.1.   Continued

Codes	Sub-Codes	Examples	Frequency
	5.2 Identifying needs and technological responses	I think I could start using iPads more in teaching English because there are more and more refugees coming from Ukraine and it would be nice to put them in pairs with their Slovenian peers – in this case they could use Google translate, especially in lower classes.	111
	5.3 Creatively using digital technologies	Yes, because we designed a great game to use later on in our on class. We get to know some great tool to create new games and can also use the games form the other groups as inspiration.	55
	5.4 Identifying digital compe-tence gaps	I'd love to be more skilled in game programming, so that I can imple-ment improvements in the outcomes by myself, without having to add "I don't know if it is possible, but can you make this/that?"	15
6. Other learning or achievements		I learned that I am able to collab-orate with teachers and student teachers from different European countries productively. I realized that my teaching experience could be valuable for someone.	1534
7. General comments		The final moment of presenting our part of the booklet was very touch-ing for me.	958
8. Denying any learning		I have not learned any new about technology, but I have confirmed that my choices are correct.	171
9. Suggestions		Each group is made up by two stu-dents and two teachers. In my group, both teachers have little experience. It would be interesting to combine newcomer teachers with ones with more experience.	342

Table 6.1.   Continued

Codes	Sub-Codes	Examples	Frequency
10. Problems		What is proving more difficult is keeping up with all of the tasks sent as part of the exchange, for we are sometimes asked to prepare or complete certain activities upon short notice and this clashes with other projects/activities from other subjects.	222
11. Uncertain		The students are working on the topic. We only asked them to work on a certain topic/content.	87

Main Qualitative Findings and Discussion

RQ2. What areas and sub-competences are the most developed in VE according to participants' perceptions?

In answer to RQ2, qualitative analysis of the data indicated that, according to participants' perceptions, six main themes or sub-competences within the DigComp 2.1 Framework were developed through engagement in VALIANT's VEs: (1) interacting through digital technologies, (2) sharing through digital technologies, (3) collaborating through digital technologies, (4) identifying needs and technological responses, (5) developing digital content, and (6) creatively using digital technologies. Table 6.2 depicts the frequency with which these competences were referenced by participants' responses to the open-ended questions.

Table 6.2. Most frequently referenced sub-competences

Theme (Sub-Competence)	Number of times referenced by participants
Interacting through digital technologies	547
Sharing through digital technologies	393
Collaborating through digital technologies	342
Identifying needs and technological responses	111
Developing digital content	70
Creatively using digital technologies	55

The frequencies referenced by participants above indicate that the VALIANT VEs primarily supported those sub-competences associated with communication and collaboration in area 2 in the DigComp 2.1 framework (i.e., interacting, sharing and collaborating) as well as sub-competences associated with problem solving (area 5) and digital content creation (area 3). In contrast, and as expected, the VEs proved less likely to support development of sub-competences associated with safety (area 4) such as protecting personal identity and privacy, managing digital identity or those associated to information and data literacy (area 1) such as managing data, information and digital content. This outcome stems in part from the focus of the VEs themselves, none of which included specific tasks on digital identity, internet privacy, or data management. In contrast, many VALIANT VEs did incorporate tasks that were designed to have participants interact, share and collaborate on the development of materials or to reflect on how these materials and technologies could be integrated into their teaching.

VEs with a specific emphasis on learning to use technologies in the classroom were also found to account for the perceived development of one of the sub-competences in particular (i.e., creatively using digital technologies). These three VEs (i.e., Setting up a Virtual Exchange for your pupils; Using Gamification in Foreign Language Teaching; and Integrating Technologies in the Foreign Language Classroom) involved tasks and learning outcomes that required creative development of teaching materials or lessons using technology or digitally mediated practices. In contrast, in VEs in which technology was incidental and not integral to the topic (i.e., Defining Professional Spaces in Different Educational

Contexts), creatively using digital technologies was not identified at all as a sub-competence that had been developed by participants.

The analysis of the qualitative data also revealed that participants demonstrated they could interact effectively through a variety of digital technologies which led to a perceived increase in their understanding of how to use appropriate digital communication methods within diverse contexts. This overarching theme is also manifested in their familiarity with new tools and their ability in navigating multiple platforms. Notably, participants highlighted their improvement in utilising various tools effectively for addressing specific pedagogical objectives, such as triggering engaging class discussions and facilitating active learning experiences that pertained to the students' interests, as exemplified by this comment from one of the VE participants:

> *I have realized that tools like Etherpad that are simple can be used to get an overview of discussed topics and to get everyone active at the same time. I also go to know open, creative, interactive and stimulating virtual tool such as Nearpod and Gather.town that seem useful and interesting for classes.*

Another outstanding theme that emerged in the analysis was the participants' enhanced capability to share effectively using digital technologies. By sharing we refer not only to the exchange of data, information, and digital content (such as websites) but also of ideas, perspectives, knowledge, and experiences with others through suitable digital media. This opportunity to share in the VEs was proven to be highly beneficial, as it did not only enhance the participants' perceptions of their digital competence but also their motivation to engage their own students (present and future) in using digital tools. The importance of having the opportunity to share is illustrated in the following quote from one of the participants:

> *Since taking part in the Virtual Exchange I tried many different technologies that I learnt about from other students and teachers. It is very useful to share ideas and apps we use because students are more motivated for work when they see something new.*

Another important finding had to do with collaboration mediated by digital technologies. As with sharing, the participants' abilities to collaborate using digital technologies were also significantly developed. This specific sub-competence encompasses the ability to effectively utilise digital tools

and technologies to engage in collaborative processes, as well as to jointly construct and create resources and knowledge. This is particularly noticeable in the participants' ability to engage in online interactions with individuals from diverse cultural backgrounds, as well as in their ability to co-create digital artefacts such as an e-booklet or a digital lesson plan. The following two quotes illustrate participants' perceptions regarding this aspect:

> *I have learned how to collaborate with people from other countries using different online tools.*
> *As a teacher educator, I was amazed at how professionally pre-service teachers produced the e-booklet. The collaboration between pre-service and teachers in the study was quite efficient. Their engagement in the e-booklet preparation was a rewarding professional experiential learning experience for the pre-service teachers as they had a chance to co-construct pedagogical knowledge as a joint endeavor with their peers and their mentors (teachers).*

An unexpected theme in the participants' perceived development of digital competence was their enhanced ability to identify needs and technological responses. This sub-competence was not initially a targeted objective in the surveys but emerged in the analysis as an interesting outcome. It refers to the ability to assess needs, evaluate and select digital tools, and identify appropriate technological solutions to address them effectively. After engaging in VE, participants acknowledged their personal limitations and recognised the importance of acquiring specific digital skills, such as recording and editing digital media products. They also acknowledged the significance of selecting suitable digital tools to achieve specific pedagogical objectives, such as motivating students and facilitating learning. This finding is illustrated in these two quotes:

> *I'm totally aware that I need training about recording and editing videos.*
> *This Virtual Exchange has made me realise how important it is to improve my digital skills in order to know how to apply technology in class in a proper way since technology can be a really powerful tool to motivate students and help them in their learning process.*

Furthermore, another important theme that emerged was the participants' perceived development in creating digital content. Creating digital content includes an ability to effectively create and edit digital content in various formats, as well as an ability to express oneself effectively through

digital means. The participants perceived that their competence and their positive attitude towards utilising digital tools had developed when carrying out tasks such as developing lesson plans that integrated technologies or when incorporating emerging technologies such as gamification into their instructional processes. The following quotes exemplify their positive attitudes towards this competence and perceptions of competence development:

> *Yes, I enjoyed the idea of creating a lesson with technological devices, gadgets, etc. …we saw how to create a game completely online with unity which made it really interesting and I would like to try that out in the future.*

A final noteworthy theme revolves around the participants perceived development in their ability to creatively use digital technologies. More specifically, this ability encompassed their ability to employ digital tools and technologies for knowledge creation and process or product innovation. An example of this finding is a shift from relying on printed materials to utilising digital media for collaborative projects with students, which are then shared within the school community. This quote demonstrates this aspect:

> *I have given this example far too many times, but for a teacher who has gone paperless in her classrooms, learning new tools to use in my classes is always a plus. My experience using gentil.la was nonexistent and now I can work with it in my classes and with my students. This year, from a different project I learned about two websites and I used them to publish my students' work and publicize it among the school community.*

The aforementioned examples demonstrate that participation in VEs has proven beneficial for both teachers and student teachers. Both groups have shown noticeable development in most of the sub-competences included in the DigComp 2.1 framework, along with an enhanced digital attitude and motivation to engage with digital tools and navigate various online platforms to achieve their pedagogical goals.

In addition to digital competence development, we aimed to capture additional learning gains related to technology that are not explicitly mentioned in the DigComp 2.1 framework (see these additional codes in Section 4 of this chapter). These gains included participants acquiring knowledge and engaging in a process of reflection on technology in the current era. For instance, participants reflected on the terms *digital native*

and *digital immigrant*, challenging the notion and recognising that anyone can learn to use technology tools irrespective of their age. They acknowledged the importance of providing guidance to students, even if they had prior experience with technology. These reflective discussions were facilitated by the interactions between teachers, student teachers, teacher educators, and invited educational experts during the VEs. The following quotes highlight how the participants actively engaged in insightful reflective discussions regarding current technology-related topics:

> *"Digital natives" and "multitaskin" are myths that have a great impact on how we concieve education. Digital competency needs to be developed like any other and it has nothing to do with the individual's age. Such conceptual determinism generates a vicious cycle in the educational system that results in teachers not being prepared to integrate technology in a purposeful and contextualized manner in their lesson planning. Moreover, it implies that students are not recieving the training that they need in order to use digital tools and devices essential to their future academic and professional lives.*
> *I enjoyed reading the article about digital natives and digital immigrants which made me realise that both terms are a myth and that it is ok if you cannot multitask or that everybody, regardless of their age, can learn how to use digital tools.*

Furthermore, participants also reflected on the lasting effects of the COVID-19 pandemic and how it has affected their perception of the benefits of technology in teaching. They realised that these benefits should be sustained beyond the COVID-19 pandemic rather than be considered as obsolete and therefore discarded. One of the participants mentions:

> *As aforementioned, it helped me become much more aware of my role as a teacher. Furthermore, it convinced me that a mixture of online and offline methods could be highly desirable, even in a post-pandemic world. This has been quite the shift for me since I originally thought that after COVID-19 these methods would just be abandoned since they were more replacements for their face-to-face counterparts than active improvements on our teaching methods.*

Several comments from participants highlighted their acknowledgement of enhanced digital competence as a result of their participation in the VEs. While a few participants mentioned that they did not learn anything new specifically related to their digital literacy, it is important to note that even in those rare cases, participants still found value in their participation. They discovered new features of the tools they were already familiar with or benefited from the theoretical perspectives covered in the VE.

These instances demonstrate that participants were able to deepen their understanding and make meaningful connections between prior and newly acquired knowledge, thus further enhancing their digital competence. The following quotes illustrate these instances:

> *So far we have not used many online tools and the ones we used I was already famil-iar with. Nevertheless, I was able to get to know some more features such as record-ing a Zoom session.*
> *I thought I was going to learn something new, instead, I ended up sharing things I already know. The theoretical part was of utmost interest though!*

Overall, the examples provided in this chapter suggest the positive impact of VEs on the development of digital competences and digital attitudes among teachers and student teachers, while also fostering knowledge acquisition and critical reflection on technology and its role in education in the 21st century. Certain findings also suggest an influence of the focus of the VE and the specific type of digital sub-competences that are likely to develop.

Conclusion

In conclusion, this study strongly supports that VE is an effective practice for promoting the development of digital competence and digital attitude in the contexts of Initial Teacher Education and Continuous Professional Development. Through its interactive nature, VE programs can provide individuals with valuable opportunities to engage in cross-cultural com-munication, collaborate on digital projects using a wide range of tools, and navigate diverse online platforms. This study highlights and illustrates numerous of such positive effects.

Firstly, participants perceived notable improvements in their ability to navigate online networks, enabling them to effectively collaborate with other educators, develop digital resources and knowledge, and advance professionally. Additionally, engagement in VE appeared to enhance the digital attitude of both teachers and student teachers, even among those who initially held a positive mindset toward digital technologies. This

enhanced digital attitude was evident through the participants' increased value placed on digital technologies and their willingness to employ them, as well as their eagerness to involve their students in online collaborative projects.

Furthermore, VE played a significant role in developing specific sub-competences, primarily related to interacting, sharing, and collaborating in digital spaces, identifying needs and appropriate digital responses, as well as creating digital content and creatively using technology. These outcomes can be attributed to the integration of tasks within the different VEs which focused on providing participants with opportunities to engage in meaningful interaction and collaboration.

Overall, VE has demonstrated its effectiveness in fostering digital competence through online international communication and collaboration, and in promoting a positive digital attitude. These findings underscore the significance of incorporating VE programs into educational settings to equip both teachers and student teachers with the necessary skills set and mindset for success in the current educational context.

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