www.ijte.net

Higher Education Students' Experiences of Game-Based Learning - Fostering and Hampering Aspects in Virtual Teamwork

Kirsi Syynimaa
University of Jyväskylä, Finland

Kirsi Lainema
University of Turku, Finland

Timo Lainema
Magisys Ltd, Finland

To cite this article:

Syynimaa, K., Lainema, K., & Lainema, T. (2024). Higher education students' experiences of game-based learning - fostering and hampering aspects in virtual teamwork. *International Journal of Technology in Education (IJTE), 7*(4), 754-780. https://doi.org/10.46328/ijte.860

International Journal of Technology in Education
2024, Vol. 7, No. 4, 754-780 https://doi.org/10.46328/ijte.860

Higher Education Students' Experiences of Game-Based Learning - Fostering and Hampering Aspects in Virtual Teamwork

Kirsi Syynimaa, Kirsi Lainema, Timo Lainema

Article Info

Article History

Received:
15 May 2024
Accepted:
07 September 2024

Keywords

Computer-supported collaborative learning
Business gaming
Higher education
Collaboration
Virtual teams

Abstract

The application of digital game-based learning (GBL) methods has lately received more attention in higher education (HE). An extensive body of previous investigations has recognised the potential of instructional games to advance the learning of appropriate work life skills. However, there seems to be a lack of understanding in the current literature regarding the students' views towards meaningful ways to collaborate in virtual teams during educational activities. The current study is contextualised by a business simulation game and examines university students' experiences through working collaboratively in multi-site teams. In that context, the focus is on the fostering and hampering aspects of virtual collaboration as experienced by the students during the simulation sessions. The study was executed among 66 undergraduate university students in Finland. The data were collected from the students' reflection papers and were then analysed using a qualitative content analysis approach. The evidence shows that students experienced fostering and hampering aspects in relation to communication, collaboration, organising, and technology during the simulated sessions. As these are all very typical to modern distributed collaborative work, we may conclude that the GBL course presented in this study provided students with opportunities to experience and rehearse collaborative virtual teamwork in an authentic work context. Our findings highlight the importance of allowing students to practice 21st century skills in an authentic, safe and stimulating environment. Simulation games provide a feasible context for doing so.

Introduction

Digitalisation has an increasingly powerful impact on all dimensions of our lives, from our daily routines to our working environments and the conditions in which academic institutions operate. COVID-19 pandemic (de Wit & Altbach, 2023) and the rapid advancement of digital technology (Spöttl & Windelband, 2021) have made virtual work commonplace. At the same time the nature of work has become more dynamic, and challenges are increasingly unpredictable and difficult to prepare for. Modern professionals work in virtual digital teams, where collaborating and solving joint problems is a priority (Kilcullen et al., 2022; Klostermann et al., 2021). This implies that working in the 21st century requires a whole new assortment of skills, and therefore, higher education (HE) is challenged to equip their students with these skills (Gretter & Yadav, 2016). In this regard, the application

of collaborative game-based learning (GBL) approaches for teaching and learning in HE offers a solution to meet these 21st century skills development needs.

As digital technology plays a crucial part in contemporary society, the necessary skills for employment are heavily technology-filled. The concept "technology-filled" does not necessarily refer only to the ability to use digital tools i.e., technological know-how, but the phenomenon is more multifaceted. This is exemplified in the work undertaken by Van Laar et al. (2017) who have identified seven digital skills, namely communication, collaboration, problem-solving, critical thinking, creative thinking, technical and information literacy to more explicitly describe the seven essential technology-focused skills for the 21st century digital workplace. At the same time, there is a growing recognition in the literature of the potential of educational games to enhance the acquisition of skills and competences necessary for employment in contemporary workplaces (Bodnar & Clark, 2017; Martínez-Cerdá et al., 2018; Pivec & Pivec, 2011; Qian & Clark, 2016).

Meanwhile, however, higher education (HE) has been criticised for failing to equip students with the appropriate skills needed to thrive in the fast-changing work life (Thornhill-Miller et al., 2023). Moreover, considerable evidence has accumulated to show that traditional teaching and learning methods no longer guarantee the desired outcomes (see e.g. Abdigapbarova & Zhiyenbayeva, 2023). Hence, a major challenge facing HE institutions is the need to shape their teaching methods to meet these demands (Salmon, 2019) and to bridge the skill gap between the occupational sector and HE. Taking this into account, several studies have assessed the potential of the GBL as a highly efficacious and inspiring approach for learning. It has fulfilled its promise by offering novel instructional opportunities, and educators have successfully integrated GBL approach in different settings both in educational and professional life (Chang et al., 2022; Dahalan et al., 2023; Prensky, 2003; Riemer, 2007; Syynimaa et al., 2021).

Developing relevant work life skills via GBL in HE has been a topic of growing interest in recent years (see e.g., Priyaadharshini et al., 2020; Jääskä & Aaltonen, 2022; Lengyel, 2020). However, studies investigating student's experiences on aspects that affect their collaboration in the GBL environment remain scarce. In addition, while GBL is increasingly being adopted as a viable learning method in HE and universities seek efficiency by offering courses online, it is vital to gain a better understanding of how participants of social groups employ technologies (Leonardi, 2013) and how collaborative learning and teamwork in virtual GBL can be fostered.

Consequently, this study aims to understand, what aspects students regard meaningful for collaborative learning in multi-site virtual simulation-based GBL environments. In this light, the following research question is raised: How do students experience the fostering and hampering aspects of collaboration in virtual teamwork in an educational business simulation game?

Literature Review

Game-Based Learning

A heightened degree of curiosity about the application of GBL in HE has been observed in previous years

(Vlachopoulos & Makri, 2017). As a result, it has been studied from various perspectives (see e.g., Garris et al., 2002; Gee, 2005; Lainema & Nurmi, 2006; Lainema et al., 2021; Prensky, 2003; Syynimaa et al., 2021). According to simplified definition provided by Becker (2021) GBL "is the use of games in a learning context" (p. 3). Many researchers in the field have accepted this view, including Prensky (2003), who viewed that the central idea of GBL is the blending of educational content and technology-enhanced games, and the use of this combination in educational settings. For Rieber (2005), GBL means the interaction of people and technology, in particular, the ability of participants to manage dynamic game elements that shape their learning experience.

Educational games are specifically designed for learning and incorporate a goal-directed learning procedure (Daniela, 2021). The literature in this field has proposed the notion of 'serious games' that tend to be associated with educational games (Abt, 1970). Other researchers in this field have identified various types of digital games, such as "puzzles, action, role-playing games, strategy, and simulations" (Udeozor et al., 2023, p.322), as well as virtual reality (VR) games (Oyelere et al., 2020).

In addition, a broad debate about the essential design principles of educational games is ongoing. Plass et al. (2015) have listed the basic principles of game design as follows: mechanics, visual appearance, musical elements, narrative, stimulus, objective(s), content and skills. By contrast, Alaswad and Nadolny (2015) have identified three crucial characteristics of instructional games that may help maximise students' performance and inner drive when learning in a GBL environment, and have for this reason underlined feedback, interaction and clear objective being central elements of meaningful game design. In the same way, Kucher (2021) has accentuated the importance of interactivity and feedback as key features of an advantageous game in GBL context. Moreover, he has recognised that incorporating the design elements such as adjustable problem-solving, free exploration and immersive game environment all contribute to flourishing GBL settings. Likewise, Yang and Lu (2021) established those specific properties of games, such as fascinating storyline, an explicitly designed goal, and a problem to be solved, make them more efficient in comparison to traditional lecture-based teaching in HE.

In the current literature, the positive outcomes associated with the use of digital GBL methods are extensively discussed in three distinguished views: learning outcomes (e.g., Yang, 2012); motivational and emotional outcomes (Prensky, 2003); and behavioural outcomes, such as acquiring new skills (Krath et al., 2021; Ronimus et al., 2014; Karagiannis & Magkos, 2021) or divergent combinations of these. The implementation of GBL in educational settings enables opportunities for learning by doing (Garris et al., 2002), thereby triggering students' active participation in the learning process (Knight, 2023).

Erhel and Jamet (2013) characterise digital GBL as an educational approach that focuses on supporting students' learning with the aim of obtaining new knowledge, cognitive abilities or exercising skills in a simulated virtual environment. GBL has proven to be powerful in this regard, promoting collaborative learning and providing interactive, student-centred learning experiences (Chung & Paredes, 2015; Gee, 2005; Papastergiou 2009; de Freitas & Oliver, 2006; Romero et al., 2012). Research on GBL has also recognised that game-based procedures enhance learning by giving participants the chance to exercise, improve and critically evaluate their decision-making processes (Linehan et al., 2009).

Simulation Games as a Context for Collaborative Learning in Virtual Teams

In the literature, simulations refer to "artificial environments that are carefully created to manage individuals' experiences of reality" (Bell et al., 2008, p. 1417). Simulation games as a particular example of GBL illustrate dynamic and authentic decision-making situations, and they have been presented as a solution for learning collaborative digital work skills already during education (Gonzalez-Perez et al., 2014; Martínez-Cerdá et al., 2018). Recent evidence demonstrates that simulation games are immersive learning environments that are based on experiential learning, and they have achieved promising results, especially when combined to collaborative learning approach to enable learning of complex and dynamic phenomena (Papastergiou, 2009; Seethamraju, 2011; Palmunen et al., 2021). Therefore, simulation games within educational contexts allow students, for example, to experience different roles or professional tasks and hence to face sophisticated problem-based scenarios (Peterson, 2023). Accordingly, Harviainen et al. (2014) note that simulation games can be used to develop learners' reflective and interpretative skills. Moreover, Bodnar and Clark (2017) demonstrated that GBL is a successful approach for advancing students' communication abilities. Hence, simulation games, as representatives of technology-enhanced learning, have the proven potential to advance 21st skills by providing an active student-centred method to learning (Gurbuz & Celik, 2022) in an environment that mirrors the real world (Davids et al., 2017; Schartel Dunn et al., 2020).

Business simulation games, in turn, are GBL environments founded on a realistic description of business phenomena and their causalities. The aim for the learners is to pursue a good outcome according to a predefined criterion. Oftentimes participants or teams of participants compete against each other or against other teams.
In the context of multiplayer simulation games, current research points out that collaboration within teams offers considerable opportunities for learning compared to working alone (Hao et al., 2015). Taking into account the pedagogical foundation of digital multiplayer games, the approach is anchored in the idea of computer-supported collaborative learning (CSCL) (Dillenbourg et al., 2009; Romero et al., 2012). At the same time, recent evidence suggests that the educational significance of CSCL rests in the successful integration of individual and social factors (Dillenbourg et al., 2009) and is therefore influenced by the social context in which collaboration occurs (Syynimaa et al., 2021). Taking this into account, to perform well in multiplayer games involves both team interaction and collaboration through successful activities, such as negotiation, decision making, receiving and processing appropriate information (Caputo et al., 2019; Lipponen, 2002; Qian & Clark, 2016; Wuertz et al., 2018) and therefore collaborative knowledge production plays a key role (Oksanen et al., 2017). The intensity and quality of interaction amongst participants matters significantly to the overall effectiveness of learning in GBL environments. Through collaboration, students can benefit by learning from each other, combine their efforts towards a common goal and achieve a solution that might not have been achievable on their own (Jeong & Hmelo-Silver, 2012).

In the present study, the concept of game-based learning (GBL) is used to refer to an approach to teaching and learning in which learning and skill development arise through students' social activities in the context of a digital simulation game (Chang et al., 2020; Prensky, 2003). Accordingly, collaboration in the game context of this study entails joint decisions to attain a common goal, thereby optimising the conditions for examining essential aspects

of collaborative learning.

Methodology

Context of the Study

The study was conducted in Autumn 2021. Data for the study was obtained from a university course. The course was a capstone course, bridging together other courses in a business study program arranged for university students not majoring in business studies. The aim of the course was to provide an overall picture of business dynamics and explain how the different fields of business studies are related to it. The course was based on the application of a real-time processed business simulation game called RealGame (Lainema, 2003) (see Figure 1).

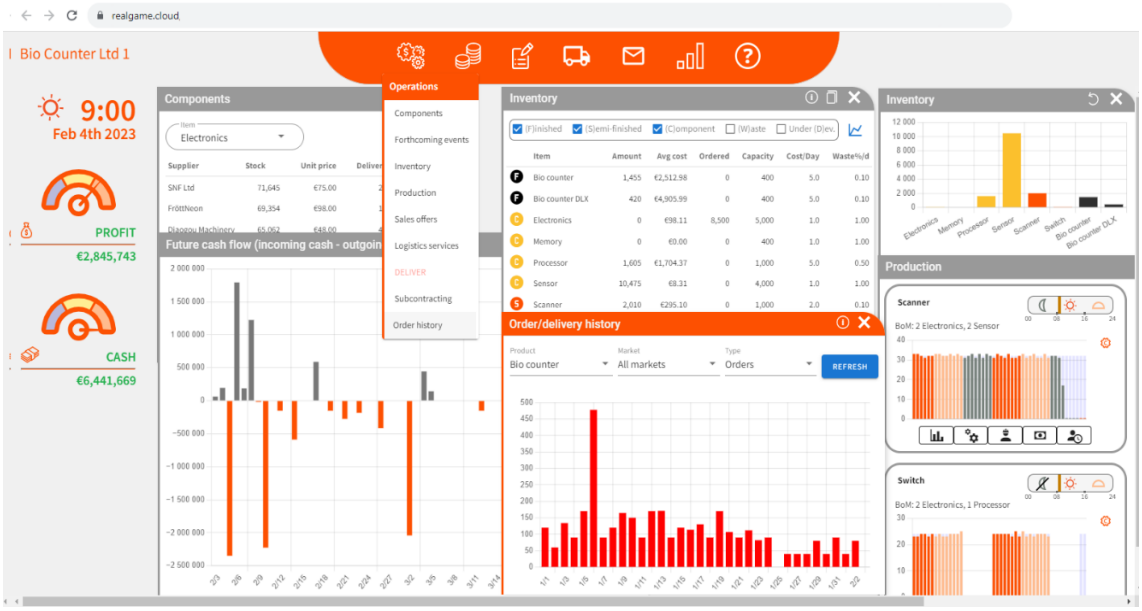

Figure 1. RealGame student Company User Interface

The course was delivered under a virtual business studies programme. All course modules were offered by the business faculties of European universities for students majoring in non-business disciplines, such as natural sciences and humanities, for example. Therefore, the participants were novices in the field of business studies but possessed basic-level business knowledge, having completed a minimum of study modules before this course.

During the course, students were divided into 12 teams of 5-7 participants in each. There were two kinds of simulation companies in the simulation, both run by student teams (see Figure 2). Supplier companies manufactured components which were sold to Manufacturers, who in turn had their own manufacturing operations. Overall, the course aimed to enhance participants' awareness and teamwork skills in a simulated business environment. Through simulation sessions, participants were provided with an improved understanding of how one's own work contributes to team performance in a virtual team and how this new knowledge can be used for the benefit of team collaboration. Additionally, the simulation game aimed at providing a broader view on business and demonstrating how different functions interact and contribute to the organisation's overall performance. In this study, we focused predominantly on analysing teamwork within teams.

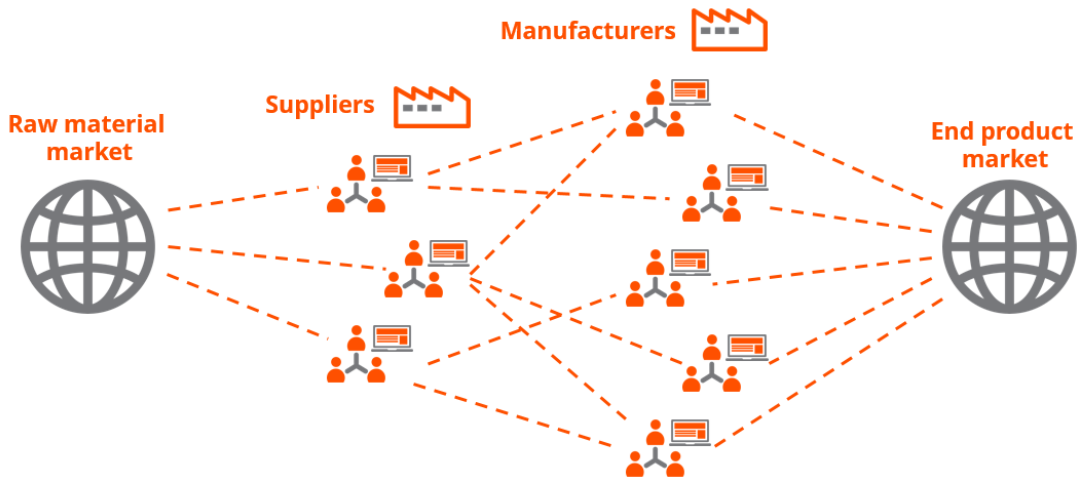

Figure 2. RealGame Learning Environment

Students from eight different universities in Europe took part in the course from different locations. They were both local students and exchange students. For the duration of the course, every team took part in three simulation sessions ranging in duration from six to twelve hours, with each student spending a minimum of four hours per session. The game sessions simulated a contemporary working practice of a geographically dispersed team that operated in shifts and needed to hand over tasks and responsibilities from one team member to another. This setup heightened the importance of seamless collaboration, frequent communication, and prompt problem recognition.

RealGame business simulation game provides an authentic learning experience, in which practical real-world challenges and circumstances emerge. It models the supply chain process of a real organisation in real time (Lainema, 2003). In RealGame student teams manage their simulation company's supply chain by purchasing components, monitoring inventory levels, ramping up production, steering production, maintaining sales offers, and delivering incoming customer orders. These are typical actions in a real-world manufacturing organisation aiming at running an efficient supply chain from component purchases to customer deliveries.

Students access RealGame with their personal username. The interface of RealGame resembles an Enterprise Resource Planning (ERP) system that is commonly used by companies for supply chain management. Operational functions, different reports and the income statement and balance sheet can be accessed by clicking with the mouse, and purchases and new sales offers can be made by inserting numbers in the respective fields. Each RealGame session can accommodate dozens of teams that all operate on the same computer-simulated markets. Consequently, teams compete for the best performance based on the Key Performance Indicators (KPIs) chosen by the teacher to reflect the course's learning topics and aims. KPIs can include, for example, results, return on investment (ROS), delivery accuracy, sales margin, and other metrics demonstrating the companies' operative efficiency.

The teacher turns on the simulation clock at the beginning of the simulation session, and it starts to advance hour by hour. This is when the student teams start managing their simulation companies by making decisions. Typically, one simulation day is processed in 6-10 minutes. All processes in the companies advance when the

clock is on and every decision that the students make becomes immediately visible in the game. It is, therefore, vital that the team members work together simultaneously and make decisions continuously.

Data Collection

After each game session, the students were requested to individually compose a written reflection on their experiences of working collaboratively in their virtual teams. As mandatory part of the course, the students composed in total seven reflection papers of at least 200 words. Students were instructed to write their reflection papers in the light of guiding questions on different topics and vantage points. As such, their writing was guided by giving the reflection task a specific topic and a minimum word count. For this study, two assignments on different topics were selected for further analysis, in which students were asked to reflect on their experiences regarding smooth and well-functioning collaboration, as well as malfunctions and challenges in collaboration within their virtual teams.

A total of 66 university students submitted their reflections digitally, writing in English or Finnish as they preferred. Despite the minimum word count requirements, most students wrote longer written descriptions of their experiences of the collaborative simulation-based sessions. As this study included reflective assignments on two different topics, the total number of reflection papers was 132. The entire data set was processed in compliance with appropriate principles of data protection. At the very beginning of the course, students were informed that the reflection papers they were going to write would be used for research purposes, and that the results would be reported anonymously to exclude the possibility of identification in the final report. However, participation to the study was voluntary, and an informed consent was gained from each participant for the use of their reflection papers as research data.

Analysis

To address the research question, a qualitative content analysis was conducted inductively to analyse the textual data of the students' reflection papers (Patton 2001; Krippendorff, 2018) as it provided a data-rich approach to the experiences of university students. The main inspiration for our analysis process has been the approach presented by Elo and Kyngäs in 2008. Typically for content analysis, we made our methodological choices from the perspective of our textual research data, the purpose of the study and the research problem (Elo & Kyngäs, 2008). Content analysis was chosen as an analytical method because it represents a valuable tool for studying human experience and the ways in which people perceive things (Kyngäs, 2020). In this light, we adopted an inductive approach as the basis for our analysis because there is limited and scattered prior research data available (Elo & Kyngäs, 2008; Hsieh & Shannnon, 2005) on students' experiences of collaboration in virtual teams during simulation-based educational tasks. Moreover, content analysis is considered a flexible, but simultaneously a systematic and data-sensitive method (Kyngäs, 2020), which allowed to carefully capture the participants´ experiences in the way they described and gave meanings to those experiences. To allow the respondents' voices to be heard rather than quantifying the occurrence of different categories, sub-categories, or codes in our analysis, we have chosen to highlight the qualitative richness of students' experiences.

To gain a broader and more intensive understanding of the written data, the two researchers independently read through the data several times before actual analysis, paying particular attention to the content as a whole and writing down their initial thoughts. This helped to gain a holistic understanding of the students' experiences towards collaboration in multi-site virtual teams during simulation game-based learning activities. After reading the entire data several times, the researchers met to discuss their initial insights and to decide how to proceed with the actual analysis. The section below describes in more detail our qualitative inductive content analysis procedure encompassing the interconnected and iterative phases of *preparation*, *organisation*, and *reporting* (Elo & Kyngäs, 2008).

First, in the *preparation phase*, we concentrated on choosing the *unit of analysis*. This decision was critical as it set the foundation for further analysis in carrying out the qualitative analysis and was shaped by the purpose of our study along with the research question. As our aim was to study individual students' experiences of collaborative virtual teamwork, we found that the most appropriate unit of analysis was on the individual level, and so we chose the entire reflection papers written by each student. Thus, we considered that our unit of analysis needed to be "large enough to be considered a whole and small enough to be possible to keep in mind as a context for the meaning unit, during the analysis process" (Graneheim & Lundman, 2004, 106). We also decided that our analysis would orient towards the *manifest meanings* of the content textual data, addressing the explicit and literal meanings of specific words and phrases within the textual data (Elo & Kyngäs, 2008). This meant, specifically, that we simply focused on identifying and analysing ostensive content of the textual data without inferring students' underlying meanings (White & Marsh, 2006). Once these decisions had been taken, the preparation phase also involved the selection of *meaning units*, that is. paragraphs, sentences, or singular words that share a common meaning through their content and the context in which they occur (Graneheim & Lundman, 2004). We therefore decided to focus our analysis on set of students' notions, which could consist of several sentences. Due to the iterative qualitative research process, it still was possible to refine the research question at this stage (Busetto et al., 2020). After carefully and repeatedly re-reading our data, we decided to refine our research question to provide as comprehensive a description as was achievable of the students' experiences of virtual collaborative teamwork. Therefore, our analysis focused on the students' descriptions of both aspects that fostered and/or hampered their virtual teamwork in simulation-based GBL settings.

Second, in the *organisation phase*, the researchers worked independently by reading the students' reflection papers repeatedly, noting all information relevant to the research question, and proceeded to break down the pieces of the reflections into smaller chunks. The iterative process then focused on a systematic and open coding of the entire data set, which meant tagging the collapsed units of meaning with content codes (Elo & Kyngäs, 2008). During the analysis, the two researchers shared a common file where they compiled the initial code list drawn from the textual data and related textual quotes that gradually emerged from the data. The researchers discussed their findings regularly during the iterative analysis process. In cases of any discrepancy arising, the researchers debated their views until a common understanding was achieved. This was followed by the organisation of the codes by looking for similarities within and differences between the parts of the text. The researchers first individually grouped initial codes according to their similarities and through this process formulated boarder content categories of similar meanings (Moretti et al., 2011). To guarantee transparency, the researchers worked

in a shared online environment where they could see each other's edits in real-time. They also used chat to communicate and discuss their ideas in more detail, when necessary, by using the MS Teams meeting software. The analysis was further deepened by exploring the nuances of the content categories, both independently and by jointly discussing them, leading the researchers to identify sub-categories within the evolving main categories. Finally, through a series of repeated cycles of reclassifying categories, the researchers progressed to writing their analytical descriptions and synthesising data excerpts to generate a *report* that presented their findings in a uniform and persuasive way. To ensure the rigour of the analytical process, the following techniques were adopted: (1) data were captured from students of different nationalities studying at different universities, (2) researcher triangulation, where first and second author were closely entwined in the analysis process, and (3) rich data representations of students' reflections were assembled to underpin the findings.

Results

The results of our analyses suggest that the main aspects that fostered or hampered students' joint effort in virtual teams were the following: 1) communication, 2) collaboration, 3) organising and 4) technology. Table 1 presents the key results of this study by bringing together the identified main categories, and their sub-categories.

Table 1. The Key Results of the Study

Aspects of virtual teamwork	Fostering aspects	Hampering aspects
1. Communication	• Frequent communication • Sharing information • Explaining reasons and causalities • Identifying and solving problems • Mitigating potential conflicts through negotiation • Shared native language	• Lack of communication • Failure to disseminate appropriate information • Poor communication between shifts • Insufficient language skills
2. Collaboration	• Commitment to a common goal • Goal-oriented joint efforts • Positive and encouraging atmosphere • Balanced decision-making	• Lack of collaboration • Collaboration conflict • Low commitment to joint task • Dominant team member
3. Organising	• Clear division of tasks and roles in teams • Fitting leadership and decision-making practices • Enough participants in shifts • Well-managed handovers	• Inadequate organisation of tasks • Lack of participants in shift • Inadequate handovers
4. Technology	• Technology as an enabler • Advanced digital skills	• Technology malfunctions • Lack of digital skills

The four main categories are presented in the order of their frequency in the data. Furthermore, analysis of the data shows that the more often the students emphasised a particular aspect of their joint effort, the richer and more detailed their descriptions were, revealing elaborate nuances of their perception of the teams' virtual collaboration. These descriptions resulted in a variety of sub-categories, as illustrated in the following table (see Table 1). Thus, working collaboratively in virtual teams was most significantly associated with aspects of communication, then with collaboration and organising while technological aspects played a less significant role.

Communication

Analyses of the data highlighted various communication aspects that fostered collective performance in the virtual teams. Considering the student reports, *frequent communication* was one of the key aspects that contributed to successful joint efforts in the teams. Students experienced that it was essential to say out loud all possible aspects of the game so that all team members could get a grip on their mutual task. One student described this as follows:

> *Our team communicated well during production, and everyone always said out loud what they were doing, and it increased everyone's awareness.*

Frequent communication entailed not only *sharing information* but also explaining reasons and causalities, i.e., the rationale behind certain actions. Detailing why certain actions were taken and how this impacted the game processes fostered collaborative knowledge creation and allowed the other team members to develop a more comprehensive understanding of the simulation game and its dynamics. These aspects were illustrated in the following student account:

> *Especially team members, who assumed responsibility for production and purchases would communicate efficiently to everyone else what they were about to do. The person responsible for production reported in detail when they opened or closed a production shift or invested in machinery to boost production. The person responsible for purchases would, in turn, calculate the raw material needs, update the numbers and efficiently communicate these data to the others.*

Analysis of the students' reports shows that versatile communication also served the purpose of *identifying and solving problems*, the areas the problems would affect, and the people who needed to be involved in discussing and generating a solution to the problems. This is illustrated by the following data example:

> *After the 2nd simulation day, I realised that sub-contractor management in our team was poor, and we therefore paid more for the raw materials, which, in turn, negatively affected our result. I discussed this issue, and the purchases and raw material needs with Mila and John, and we agreed that I will try to make contracts with the suppliers. John employed an excel calculation to inform me which raw materials were needed and when. Based on this I requested the suppliers for quotations for long-term deliveries, and we were able to make contracts that helped us to push the prices of raw materials down, and to optimize the stock for finished goods and raw materials.*

When people work together for a common goal, and express their differing views, the prospect of conflict is always present. Considering this view, students reported aspects that fostered their virtual teamwork by *mitigating*

potential conflicts through negotiation. One such aspect was to negotiate a potentially controversial issue to reach a consensus, as described by one student:

> *There were disagreements about certain things from time to time, but my teammates were very willing to discuss everything. One time me and Olivia disagreed about using other shifts for production than the day shift. We agreed to test out both of our suggestions and go with the more effective solution for the situation. Immediately not disregarding the other when they do not agree with you goes a long way.*

Furthermore, our findings suggest that the students' joint performance in virtual teams was also fostered by shared native language. A common native language was an important success factor in achieving the joint task during the simulation-based activity:

> *I think working together was helped by the fact that we were all* Finnish*, which meant we could communicate with each other with our native tongues and the cultural understanding we were all familiar with.*

Students brought up that also many aspects that hampered their virtual teamwork were related to communication. Decisive communication aspects that hampered their joint efforts were, firstly, related to *a lack of communication manifested as a lack of contribution to joint discussions or a* lack of responsiveness to the other team members' communication.

> *Perhaps the biggest single problem that I saw the first time around was the lack of communication on the part of my own group.*

Lack of communication was identified as a risk factor even in well-functioning teams. Furthermore, it had a deteriorating effect on the team spirit and caused frustration among team members. In the worst cases, lack of communication would also lead to confusion, conflicts, mistakes, suboptimal decisions, and ultimately to unfavourable outcomes in the game:

> *Major error on the first day was lack of communication between team members. There was confusion on what everyone was doing and what kind of information they needed to be able to make the best decisions.*

Another communication difficulty that had similar negative effects was connected to *not disseminating relevant information* to the other members of the team. Students reported instances where multiple team members worked on the same tasks in the game, resulting in reversed decisions due to the lack of relevant information. One student expressed his view as follows:

> *… during the first simulation day when a few people were doing the same task without communicating [to] each other one of them was pricing our products higher and the other person lower and after a few minutes they both were like "Is someone else pricing our products at the same time or is this simulation broken.*

Moreover, students highlighted that *lack of communication between shifts* significantly affected the team's ability to carry out activities together. They provided examples of their experiences with deficient inter-shift communication, and expressed the need for more effective communication during the simulation:

> *I would put more effort into communication between shifts. Now the person coming to the new shift was largely left without any kind of briefing and started his work actually from zero. Likewise, I would communicate among all team members the biggest events even in every couple of hours so that individuals who were not at the scene would be aware of what happened.*

As many of the teams included exchange students, teams needed to communicate in English. Students expressed that *insufficient language skills* proved a challenge for some of their team members. Balancing between the varying linguistic competencies of team members induced challenges to teamwork, as teams struggled to find a solution that would allow for working together:

> *I think one major situation of poor communication and collaboration happened at the start of the simulation, when we still had one foreign team member Elias. There seemed to be quite a big language barrier between us. During the first simulation, which was also the only he ended up participating, he almost didn't say a word unless directly addressed.*

Our analysis revealed that communication in a collaborative digital context requires a variety of interactional and linguistic resources. Students' investment in reasoning their views, explaining the causalities of specific phenomena and problem-solving came out as aspects that fostered their collective action. The rich and detailed student reflections paint a vivid picture of the aspects that are critical for fruitful communication in digital teamwork. On the other hand, the students also identified multiple communication aspects that hampered their teamwork. Thus, communication's elementary role in all the student teams' joint action was painstakingly evidenced in the data.

Collaboration

Results of the study indicate that one of the most salient aspects fostering collaboration in virtual student teams was *commitment to the common goal*. Students demonstrated their commitment through their eagerness, proactiveness and sense of shared purpose in working collaboratively with their team. This aspect was reflected as follows:

> *There were many smoothly operating functions in our team. The first and definitely the most important thing was that everybody in our team was committed to the tasks. It was easy to collaborate with each other when everyone had the same eagerness to "make profit" in the game.*

Results of the study indicate that one of the most salient aspects fostering collaboration in teams was *goal-oriented joint efforts*. This implies working together to attain a common goal, coordinating, and aligning one's own contribution with the actions of other team members. These aspects were emphasised in the students' reflections in the following way:

> *As an example of a well-functioning collaboration situation, I could take up a situation where two customers wanted long-term contracts for processors at the same time. With Lisa who was the other person responsible for sales I made a Skype call to production to enquire whether these quantities of deliveries were possible. This spurred a discussion among production Lidia, Kia and Paul about*

> *production capacity, raw material stock and daily production output. Having made quick excel calculations production gave us a green light and we were able to finalise long-term contracts with both customers.*

Furthermore, students emphasised *positive and encouraging atmosphere* towards teamwork, and thus characterised it as a fostering aspect in the following way:

> *I don't know if we were lucky, but in our team, all were very collaborative, flexible, and friendly. I think everyone had the right attitude towards the game and the whole course. It depends a lot on the attitude of the team members, how the team works.*

Analysis of the student essays brings out the positive impact of *balanced decision-making* in potentially controversial situations during the simulation play. Engaging everyone in solving an issue and reserving everyone an opportunity to have their say in the matter contributed positively to collaboration in teams:

> *We also did some voting if people were divided with some topics and things. Voting was done via Skype chat everyone saying yay or nay. We had a lot of discussions about investing in different continents and where we should put money and where not, and we handled some of these situations by voting.*

Aspects that contributed to less fruitful collaboration included, first, *lack of collaboration* that hampered students' joint GBL experience:

> *One example of poor collaboration could be when Irmeli and I practically didn't collaborate at all during the first game.*

At worst, students reported remarkable *collaboration conflicts* in their team, which noticeably rendered difficulties in performing activities together. Under these circumstances, students saw that due to these serious and continuous collaboration problems within their teams they were required to put extra effort into the accomplishment of the GBL activities.

When describing their approach to collaboration challenges, the students noticed that *low commitment* to the joint task, such as group activities and processes appeared during the simulation course:

> *It was also noticed that the further the simulation course progressed, the members of the group no longer took the agreed times for video conferencing or joint tasks. Also, during the simulation, the start and finish began to stretch slightly in the wrong direction. So, simulation days were reached late and stopped a little ahead of time.*

According to the students' reflections, another aspect hampering collaboration was a highly dominant member of the team. These individuals assumed an overly active role in the simulation tasks leading to restraining the other participants' contribution to the game activities. Eventually, this imbalance resulted in unequal contributions to teamwork:

> *(--) one individual team member has expressed harsh views without considering the opinions of others in the team.*

Considering our findings, the most important aspects that fostered collaboration in teamwork were related to active input to joint pursuits manifested as explicit commitment to the common goal, joint team efforts and aligning one's contribution to what others are doing and maintaining a positive and encouraging atmosphere in the team. An additional aspect that fostered teamwork was balanced decision-making in the team. On the other hand, lack of collaboration and low commitment to the joint task and unresolved conflicts and a dominant team member had a negative impact on the collective performance of the team.

Organising

Our results indicate that the three main aspects that fostered the organising in teams were: *a clear division of tasks and roles, having enough participants in shifts* and *the careful management of handovers between shifts*. In this regard, clear division of tasks was critical for the flourishing functioning of the team. The next student reflection appropriately sums up the benefits of having clear responsibilities in the team:

> *Things went smoothly when everyone involved had a clear role and everyone knew what to do.*

Many students observed that as neither of the students were business majors, it was not critical who did what. They expressed that the most significant aspect was to allow everyone to have a say in distributing the tasks and roles. As one student stated:

> *No one had a clear understanding about which role would be the most suitable for them, but one by one everyone expressed which role they could take. (---) we agreed that we would in any case help each other and could switch tasks and roles, when needed. We discussed this in the beginning of every simulation session, but everyone felt comfortable doing what they'd done before.*

Students also identified the importance of having each task managed by a person who genuinely assumed responsibility for the task. This was illustrated in the following remark:

> *... Alica took over the sales and communicating in the marketplace, Liz was making calculations for the production, and I was helping both of them and watching over our financial development. --- We made a quick game plan and managed to get our profits back to good side and our cash flow back to positive.*

Unsurprisingly, students identified that in addition to having a positive impact on organising, clear division of tasks also contributed to other key aspects of virtual teamwork, and advanced fluid communication and collaboration in the team, as evidenced by the following student reflections:

> *To sum it up, the most important aspect fostering smooth collaboration in our team was how the tasks were organised among team members. In order to communicate and collaborate most efficiently, it is paramount to know who is responsible of each task.*

Considering our findings, we can assert that teams with adequate organisation tended to plan thoughtfully for the staffing of each shift as well as to plan how to *manage the handovers between shifts*. Thus, besides always having a sufficient number of participants online, an equally important aspect was to manage the handovers between shifts in a diligent fashion. Overall, students expressed that their teams benefitted from working in shifts due to

the 5-7 members in attendance. Successful teams established handover plans to ensure a smooth transition between departing and incoming members during the game. Allowing for an overlap would enable new students to grasp the current state of the game as well as the joint plan or strategy for subsequent game phases. Sufficient time to comprehend what is transpiring and how to proceed would promote a more seamless handover. This was reflected in the following observation:

> *I think the switch happened really smoothly due to well-functioning collaboration. A few minutes before it was time for me to leave, I asked who wanted to take over my position for the rest of the day. Jill volunteered quickly. I sent her a WhatsApp message, with all the information of our customers. After that we spoke about when the next shipments needed to be sent forward. We went through the next few days so that he could catch up on all the customers.*

In certain teams, however, students faced constraints resulting from *inadequate organisation of tasks and roles*. They explained how this resulted in one team member being left out of the joint task, or time and energy being wasted by several people performing the same actions:

> *I believe it would have been easier if the roles were clearer. This led to some individuals performing multiple tasks simultaneously, while others were unsure of what to do and had to stand by.*

In addition, many students also identified incidents in which their teams failed to pay attention to sufficient occupation of participants in the shifts and the handovers between shifts. Due to the continuous processing of simulation game events the student teams had to continually control all facets of the game, making decisions about purchasing, production, sales and deliveries, as well as interacting frequently with the other teams. Consequently, *having too few participants in the game shift* was an unsuccessful collaboration practice, leading to an overwhelming experience and multiple challenges for the teams:

> *When we were short-handed, especially with only the two of us - that caused problems. The worst situation always took place when (just) the two of us were working and the other one left, and two new (persons) came in as a replacement and they needed to be introduced (to the game). One had to change one's way of working to introduce the situation quickly and switch to a new task on the go. That created the most challenging situations during the game.*

Other students highlighted that their teams had not planned how to manage the handovers, and hence experienced challenges in these situations:

> *Our 12 to 16 pm sales shift ended and our 14 to 18 pm sales shift continued. The problem was that our main salesperson who was making most of the sales was in the earlier shift. Knowledge about sales didn't transfer the way it should have. This caused a dramatic drop in sales, and we started the third simulation day with nearly zero orders.*

To conclude, teamwork in the simulation game benefited from the unanimous division of tasks and roles between the team members. Managing the workforce and the handovers in and between shifts were identified as other significant aspects that fostered fruitful collective action. Conversely, failure to unambiguously determine who was responsible for which task and role hampered effective teamwork. Having too few team members in the game

and poor handovers were also important factors contributing to difficulties in teamwork.

Technology

Technology played a significant role in the simulation game since all activities in the course took place in technology-mediated environments. The computer-based simulation game was accessed remotely by the students, all course materials, information and assignments were managed via a cloud-based learning platform and all communication in student teams took place via communication technologies. In this respect, the students saw *technology as an enabler* of their virtual teamwork and as a support for their joint efforts:

> *Technology of course had a vital impact to our collaboration success. Since everything was done remotely, we basically couldn't have worked together without our computers and collaboration software. The most vital software we used were Skype, WhatsApp and Google Drive.*

Moreover, advanced *digital skills were identified as an important contributor to fluent teamwork*. In this light, in polymedia environments with a variety of different modes and platforms for joint action and communication it is critical to understand how to employ them to foster efficient teamwork (Madianou & Miller, 2013, Lee et al., 2021). In many of the students' view technology was a self-evident and incremental element in their team's activities. Students described the variety and combinations of technologies employed by their teams, ranging from RealGame business simulation game to MS Teams and Zoom and from Google Drive to social media applications such as WhatsApp and Discord. Accordingly, students reported examples of their simultaneous fluent use of the simulation game and MS Teams:

> *We use Microsoft Teams in our team. Our meetings take place in Teams, where it is easy to communicate and share files, share the screen and organise the following events and meetings. Technology had a huge impact on our teamwork. If this course was not organised virtually, it would have made things complicated in many ways. However, during the past couple of years students have become accustomed to this way of organising courses.*

Some students pointed out that technology-enabled communication tools had benefits compared to communicating in face-to-face settings. Not being able to sense tensions as clearly was perceived as a factor that contributed to a straightforward collective action in the teams:

> *Through Teams, you can't create or feel the tensions caused by conflicts between others. Tensions may negatively impact on the collaboration of the whole team. I also believe that it would be easier to solve problems through Teams, because it is easier for everyone to say things directly.*

However, some of the virtual teams were not as comfortable with technology and the participants experienced that their teamwork was hampered by aspects associated with technology. For example, students reported that *lack of digital skills* in their team members hindered the start of learning activities in the simulation and therefore limited their team performance:

> *Many of the tools and platforms (like MS Teams) were completely new to some of the team members and it took a little while to get to know each other and the overall team practices and "policies" that started*

to form later on in the course.

Similarly, as technology played such a vital role, *technology malfunctions* had a critical influence on teamwork. The most severe technology failure on a virtual course would naturally be internet breakdown, of which some students gained some experience during their teamwork:

> *The only way technology contributed to collaboration malfunction during the simulation days was when my internet connection was really bad and almost gone at times. Nobody was able to understand what I was saying and that was frustrating. I did start to wonder what alternative communication method I would have to come up with. If my internet would have been down for a long time, I would not have been able to contribute at all, so my internet was an essential part in me being able to collaborate with the others.*

While some students found technology-mediated communication beneficial for teamwork, others felt that sometimes it did not advance joint action in teams. Missing the interactional cues provided in face-to-face settings was identified as an aspect that hampered the team's performance.

> *Virtual work allows a lot, but also takes a lot off compared to on-site communication. When using virtual communication tools, the other person's body language and the interpretation of the other person is often left out of the conversation, so that people who are silent are easily completely excluded from the virtual conversation involving many people.*

All joint activities in the teams were dependent on technology both in terms of its functionality as well as the students' technological capabilities. Technology was perceived as an enabler for the collective actions, and advanced technological skills greatly fostered the teams' performance. Skilful use of technology was shown, for example as the fluent combination and simultaneous use of various technology tools. Understandably, technology malfunction was perceived as the ultimate hampering aspect for teamwork. Lack of sufficient technological skills was another factor that contributed to hampering the team's joint efforts.

Discussion and Conclusion

This study sets out to gain a better understanding of HE students' insights into virtual teamwork in a simulation-game environment. Extensive evidence has demonstrated that GBL methods offer numerous benefits in developing key skills in HE students, such as communication, collaboration and critical thinking, which are essential for success in the modern workplace (Bodnar & Clark, 2017; Martínez-Cerdá et al., 2018; Plass et al., 2015; Qian & Clark, 2016). So far, research on GBL has not adequately considered HE students' views on the aspects that foster or hamper virtual teamwork in collaborative GBL settings. To fill this gap, this paper examined HE students' experiences of aspects that foster or hamper virtual teamwork in an educational simulation game. Overall, this study strengthens the idea that at best, research-based instructional simulation games can provide HE students with a versatile and effective CSCL experience that supports the acquisition of 21st century's work life skills in many ways. Within the context of a simulation-based business game, four broad categories of aspects related to teamwork were identified: 1) *communication*, 2) *collaboration*, 3) *organising*, and 4) *technology*. Our

detailed analysis yielded in identifying unique fostering and hampering aspects within this broad phenomenon.

Data of this study affirms that frequent and abundant *communication* is a key element that drives teamwork in virtual teams. These results corroborate the findings of various previous studies on factors that foster collaboration in virtual teams in GBL environments (e.g., Papastergiou, 2009; Ceschi et al., 2014). This study also found that successful digital communication is a demanding function, that does not arise by itself but implies that the participants take an active role as well adopt a range of advancing interaction methods and language aptitudes, such as sharing of relevant information, explaining, negotiation, problem solving and sharing a common language. Additionally, our study brings up students' communication issues that were linked both to the regularity and content of communication, along with language barriers. Therefore, in light of our findings, insufficient communication, mismanagement of crucial information sharing, or ineffective interaction across shifts reduced teams' ability to collaborate during the simulation. This also accords with earlier observations in that for virtual teams to function well in the context of a multiplayer simulation game they need to share relevant information and to interact appropriately with their team members (Caputo et al., 2019; Lipponen, 2002; Qian & Clark 2016; Wuertz et al., 2018). Hence, communication in virtual teams benefits especially from prompt, open and continuous information sharing targeting at a shared understanding that lays a foundation for optimal allocation of joint efforts (Oksanen et al., 2017). An important prerequisite for this is an environment that allows for synchronous collaboration.

Another important finding is that the most crucial aspects for fostering *collaboration* in virtual teams were linked to team members' shared contribution to mutual objectives in the simulation game, expressed as an unambiguous commitment to a common goal, joint team efforts and matching one's own contribution with that of the others. An additional fostering aspect was the positive and supportive atmosphere in the team. These findings further support the idea of educational simulation games fostering a specific focus on learning, employing a goal-directed learning scenario (Daniela, 2021). Moreover, Littleton and Häkkinen (1999) summarised that collaboration is about creating shared meaning with those around us, driven by a commitment to a common goal. To sum up, learning may occur through social activities when working together towards shared objective(s) surrounded by positive and encouraging team atmosphere. This may be supported by offering educational scenarios, such as involving contributions from all team members, so that individuals in different roles can contribute to the collaborative effort. In this context, the implementation of a collaboration script - a series of instructional guidelines intending to enhance collaboration within student teams - would be advantageous (Heinonen et al., 2020).

Our results show that virtual teamwork benefited from a balanced role and task distribution among team members, and hence *organising* virtual teamwork was frequently mentioned in the students' reflections as an aspect fostering collaboration. In relation to game pathway, good organisation of the staffing and handovers both within and between shifts were identified as important aspects when allocating joint efforts to manage a real-world-like supply chain process. In contrast, the current investigation found that HE students experienced organising constraints, such as deficient handovers and weak task planning that hampered the achievement of mutual tasks in the virtual teams. This is in line with prior research indicating that virtual teams may suffer from less planned

or smooth coordination (Mathieu et al., 2020). The organisation of virtual collaboration before simulation-based learning activities demands special efforts. To create more equal and favourable conditions for all students' teams, teachers can provide them with pre-game instructional support and encourage teams to prepare well in advance (Syynimaa et al., 2021). Furthermore, understanding the critical importance of organising for thriving teamwork and how it can be facilitated in teams pertain to invaluable work life competencies, because much of the knowledge work in today's organisations takes place in virtual contexts.

As a consequence of the technology-enhanced nature of CSCL settings, shared activities involve students to employ digital tools in a meaningful way to ensure joint understanding, and this way to ensure that their collaboration is sustainable. (Hernández-Sellés et al., 2019; Çakır et al., 2009). Interestingly, our data revealed that having participated in online learning for over a year due to the global COVID-19 pandemic, the students were accustomed to using various online learning and communication tools and platforms, evidenced as the skilful use and combination of technologies. In the technology-filled context of the study this was an important aspect that fostered smooth teamwork. In a similar vein, technology-enhanced communication in the learning environment was, by many students, perceived as straightforward and efficient. However, some students felt that face-to-face communication would have been helpful. Our findings are in line with previous research that has suggested that having multiple different technologies embedded in the CSCL environment allows for the students to create the combinations that best suit their needs (Lainema et al., 2021). Another benefit of integrating technology tools to the learning environment, identified by Martens et al. (2007) is that learning how to use digital tools takes place at the same time as learning the skills needed in teamwork.

This study contributes to research on CSCL and GBL by providing unique descriptions of students' experiences of aspects that have an impact on their teamwork in a virtual learning context. As digital learning solutions and virtual learning have become increasingly popular in HE, an improved understanding of students' perceptions and views is needed. With this new knowledge it is possible to enhance the use of GBL firstly, to promote effective learning of the substance matter, and secondly, to provide opportunities to learn and rehearse elementary skills that are required in today's work life.

The findings of this study also emphasise the importance of the teacher's instructional activities both before and during class. Having identified the aspects that affect teamwork in virtual teams, teachers can find ways to provide the required instruction and adaptive assistance for teams that experience challenges in their teamwork. Furthermore, this emerging information can potentially help both simulation game designers and HE teachers to develop innovative learning environments that optimally support higher education students in their collaborative learning experiences to develop appropriate 21st century skills. Although this study focuses primarily on university students' experiences of collaboration in multi-site teams, the results may be relevant when combining a simulation-based learning procedure with an individual reflection task. Our results show that students benefit from critical reflection on their experiences, especially when they are encouraged to identify the factors that promote and hinder virtual collaboration. The university students in this study produce rich and detailed descriptions of how they confront and actively seek solutions to various collaborative situations in multi-sited virtual teams. On the other hand, students become more aware of their own abilities and weaknesses. This is line with previous

research, and it is well documented that reflection enhance students learning (Chan & Lee, 2021) by deepening learning through making sense of the learning experiences (Boud et al., 2013).

Considering the findings of this study, it is essential to acknowledge the limitations inherent in a case study approach. The data is derived solely from one specific course with a specific GBL environment, impacting the generalisability of the results. Consequently, we cannot assert that these findings apply universally to collaboration in all types of digital learning environments. Furthermore, the GBL environment in question was based on synchronous teamwork, and the results are, therefore, specific to the types of collaborative learning environments that are based on synchronous presence and activity. However, we emphasise the significance of the learning environment's authenticity and the learning task as crucial contributors to the trustworthiness of the results and assert that these aspects increase the likelihood of the applicability of our results to many of the current-day digital environments.

Another constraint of the study lies in restricting the data analysis to four specific fostering and hampering aspects of the virtual collaboration, preventing a comprehensive description of all aspects embedded in the data. Nevertheless, the study offers the advantage of presenting a thorough analysis of the selected aspects and illustrating their realisation in digital team-based collaboration.

Furthermore, our study paves the way for future research. Our data suggests that offering the digital teams' practices, guidelines and tools for managing collaboration and communication tools may lead to engaging teamwork and heightened awareness of aspects related to fruitful collaboration. This area is deserving of further investigation. Additionally, exploring the role of organising practices and their applicability in digital teamwork represents another intriguing avenue for future research, especially considering their heightened relevance due to the increased prevalence of remote work.

Recent developments in work life, and particularly the global COVID-19 pandemic have highlighted the criticality of skills needed in virtual teamwork. In addition to technological skills the key competencies include collaboration, communication, and organising. Furthermore, students must learn to identify and solve challenges that are characteristic to teamwork in virtual environments. GBL environments have proven to be promising learning contexts for rehearsing and learning these elementary skills. Results of the present study display aspects that have an impact on teamwork in a simulation-based learning environment and emphasise the importance of providing students an opportunity to exercise these skills in authentic, safe, and inspiring settings.

HE is under pressure to provide meaningful and current education that advances the development of skills and competencies needed in 21st century society (Van Laar et al., 2017). In addition, HE is urged to develop education that is more flexible and accessible to learners who balance between work and studies (Seaman et al., 2018), who experience challenges with accessibility (Fichten et al., 2009) and who originate from less developed regions (Gonzalez et al., 2020). Canals et al. (2018) further emphasise the need for innovative pedagogical practices and modes of delivery with a broader impact. GBL environments offer a potential educational platform that can help to address these needs.

References

Abdigapbarova, U., & Zhiyenbayeva, N. (2023). Organization of student-centered learning within the professional training of a future teacher in a digital environment. *Education and Information Technologies, 28*(1), 647-661. https://doi.org/10.1007/s10639-022-11159-5

Abt, C. C. (1970). *Serious games*. New York: Viking Press.

Alaswad, Z., & Nadolny, L. (2015). Designing for game-based learning: The effective integration of technology to support learning. *Journal of Educational Technology Systems, 43*(4), 389-402. https://doi.org/10.1177/0047239515588

Becker, K. (2021). What's the difference between gamification, serious games, educational games, and game-based learning. *Academia Letters, 209*(2) 1-4. https://doi.org/10.20935/AL209

Bell, B. S., Kanar, A. M., & Kozlowski, S. W. (2008). Current issues and future directions in simulation-based training in North America. *The International Journal of Human Resource Management, 19*(8), 1416-1434. https://doi.org/10.1080/09585190802200173

Bodnar, C. A., & Clark, R. M. (2017). Can game-based learning enhance engineering communication skills? *IEEE transactions on professional communication, 60*(1), 24-41. https://doi.org/10.1109/TPC.2016.2632838

Boud, D., Keogh, R., & Walker, D. (2013). Promoting reflection in learning a model. In D. Boud, R. Keogh, & D. Walker (Eds.), *Reflection: Turning experience into learning* (pp. 18–40). Routledge Falmer.

Busetto, L., Wick, W., & Gumbinger, C. (2020). How to use and assess qualitative research methods. *Neurological Research and practice*, 2(14) 1-10. https://doi.org/10.1186/s42466-020-00059-z

Çakır, M.P., Zemel, A., & Stahl, G. (2009). The joint organization of interaction within a multimodal CSCL medium. *International Journal of Computer-Supported Collaborative Learning*, 4, 115-149. https://doi.org/10.1007/s11412-009-9061-0

Canals, L., Burkle, M., & Nørgård, R. T. (2018). Universities of the future: Several perspectives on the future of higher education. *International Journal of Educational Technology in Higher Education, 15*(46). Retrieved from https://educationaltechnologyjournal.springeropen.com/universitiesofthefuture

Caputo, A., Marzi, G., Maley, J. and Silic, M. (2019). Ten years of conflict management research 2007-2017: An update on themes, concepts and relationships. *International Journal of Conflict Management, 30*(1), 87–110. https://doi.org/10.1108/IJCMA-06-2018-0078

Ceschi, A., Dorofeeva, K., & Sartori, R. (2014). Studying teamwork and team climate by using a business simulation: how communication and innovation can improve group learning and decision-making performance. *European Journal of Training and Development, 38*(3) 211-230. https://doi.org/10.1108/ejtd-01-2013-0004

Chan, C. K., & Lee, K. K. (2021). Reflection literacy: A multilevel perspective on the challenges of using reflections in higher education through a comprehensive literature review. *Educational Research Review, 32,* 100376. https://doi:10.1016/j.edurev.2020.100376

Chang, C. Y., Kao, C. H., Hwang, G. J., & Lin, F. H. (2020). From experiencing to critical thinking: A contextual game-based learning approach to improving nursing students' performance in electrocardiogram training. *Educational Technology Research and Development, 68*(3), 1225-1245. https://doi.org/10.1007/s11423-019-09723-x

Chang, C. Y., Chung, M. H., & Yang, J. C. (2022). Facilitating nursing students' skill training in distance education via online game-based learning with the watch-summarize-question approach during the COVID-19 pandemic: A quasi-experimental study. *Nurse Education Today, 109*, 105256. https://doi.org/10.1016/j.nedt.2021.105256

Chung, K. S. K., & Paredes, W. C. (2015). Towards a social networks model for online learning & performance. *Journal of Educational Technology & Society*, *18*(3), 240-253. http://www.jstor.org/stable/jeductechsoci.18.3.240

Dahalan, F., Alias, N., & Shaharom, M. S. N. (2023). Gamification and game based learning for vocational education and training: A systematic literature review. *Education and Information Technologies*, *29*(2), 1279-1317. https://doi.org/10.1007/s10639-022-11548-w

Daniela, L. (2021). Hopes for Game-Based Learning. In L. Daniela (Ed.), *Smart Pedagogy of Game-based Learning*. (pp. 5–10). Springer Cham. https://doi.org/10.1007/978-3-030-76986-4

Davids, A. I. R., Van den Bossche, P., Gijbels, D. & Fandos Garrido, M. (2017). The impact of individual, educational, and workplace factors on the transfer of school-based learning into the workplace. *Vocations and Learning, 10*, 275–306. https://doi.org/10.1007/s12186-016-9168-1

De Freitas, S., & Oliver, M. (2006). How can exploratory learning with games and simulations within the curriculum be most effectively evaluated? *Computers & Education, 46*(3), 249-264. https://doi.org/10.1016/j.compedu.2005.11.007

De Wit, H., & Altbach, P. G. (2023). International higher education for the future: Major crises and post-pandemic challenges. *Change: The Magazine of Higher Learning, 55*(1), 17-23. https://doi.org/10.1080/00091383.2023.2151799

Dillenbourg, P., Järvelä, S., & Fischer, F. (2009). The evolution of research on computer-supported collaborative learning. In N. Balacheff, S. Ludvigsen, T. de Jong, A. Lazonder, & S. Barnes (Eds.), *Technology-enhanced learning: Principles and products* (pp. 3–19). Springer. https://doi.org/10.1007/978-1-4020-9827-7_1

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing, 62*(1), 107-115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Erhel, S., & Jamet, E. (2013). Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness. *Computers & Education, 67*, 156-167. https://doi.org/10.1016/j.compedu.2013.02.019

Fichten, C. S., Ferraro, V., Asuncion, J. V., Chwojka, C., Barile, M., Nguyen, M. N., Klomp, R. & Wolforth, J. (2009). Disabilities and e-learning problems and solutions: An exploratory study. *Journal of Educational Technology &* Society, 12(4), 241-256. http://www.jstor.org/stable/jeductechsoci.12.4.241

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation and Gaming, 33*(4) 441-467. https://doi.org/10.1177/1046878102238607

Gee, J. P. (2005). Learning by design: Good video games as learning machines. *E-learning and Digital Media*, *2*(1), 5-16. https://doi.org/10.2304/elea.2005.2.1.5

Gonzalez, T., De La Rubia, M. A., Hincz, K. P., Comas-Lopez, M., Subirats, L., Fort, S., & Sacha, G. M. (2020). Influence of COVID-19 confinement on students' performance in higher education. *PLoS One, 15*(10). https://doi.org/10.1371/journal.pone.0239490

Gonzalez-Perez, M. A., Velez-Calle, A., Cathro, V, Dan V. Caprar, D. & Taras, V. (2014). Virtual teams and international business teaching and learning: The case of the Global Enterprise Experience (GEE). *Journal of Teaching in International Business, 25*(3), 200–213. https://doi.org/10.1080/08975930.2014.925738

Graneheim U.H. & Lundman B. (2004) Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 24*(2), 105–112. https://doi.org/10.1016/j.nedt.2003.10.001

Gretter, S., & Yadav, A. (2016). Computational thinking and media & information literacy: An integrated approach to teaching twenty-first century skills. *TechTrends, 60,* 510-516. https://doi.org/10.1007/s11528-016-0098-4

Gurbuz, S. C., & Celik, M. (2022). Serious games in future skills development: A systematic review of the design approaches. *Computer Applications in Engineering Education, 30*(5), 1591-1612. https://doi.org/10.1002/cae.22557

Hao, J., Liu, L., von Davier, A., & Kyllonen, P. (2015). Assessing collaborative problem solving with simulation based tasks. In Lindwall, O., Häkkinen, P., Koschman, T. Tchounikine, P. Ludvigsen, S. (Eds.) *Exploring the Material Conditions of Learning: The Computer Supported Collaborative Learning* (CSCL) Conference 2015, Volume 2. Gothenburg, Sweden: The International Society of the Learning Sciences. https://repository.isls.org//handle/1/462

Harviainen, J. T., Lainema, T., & Saarinen, E. (2014). Player-reported impediments to game-based learning. *Transactions of the Digital Games Research Association*, *1*(2). https://doi.org/10.26503/todigra.v1i2.14

Heinonen, K., De Grez, N., Hämäläinen, R., De Wever, B., & van der Meijs, S. (2020). Scripting as a pedagogical method to guide collaborative writing: university students' reflections. *Research and Practice in Technology Enhanced Learning*, *15*(1), 1-20. https://doi.org/10.1186/s41039-020-00131-x

Hernández-Sellés, N., Muñoz-Carril, P. C., & González-Sanmamed, M. (2019). Computer-supported collaborative learning: An analysis of the relationship between interaction, emotional support and online collaborative tools. *Computers & Education, 138,* 1-12. https://doi.org/10.1016/j.compedu.2019.04.012

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*(9), 1277-1288. https://doi.org/10.1177/1049732305276687

Jeong, H., & Hmelo-Silver, C. E. (2012). Technology supports in CSCL. In J. van Aalst, K. Thompson, M. J. Jacobson, & P. Reinmann (Eds.), The future of learning: *Proceedings of the 10th International Conference of the Learning Sciences* (ICLS 2012) Volume 1, Full papers (pp. 339–346). Sydney, Australia: Society of the Learning Sciences. https://repository.isls.org//handle/1/2224

Jääskä, E., & Aaltonen, K. (2022). Teachers' experiences of using game-based learning methods in project management higher education. *Project Leadership and Society, 3,* 100041. https://doi.org/10.1016/j.plas.2022.100041

Karagiannis, S., & Magkos, E. (2021). Engaging students in basic cybersecurity concepts using digital game-based learning: Computer games as virtual learning environments. In Tsihrintzis, G., Virvou, M. (Eds.) *Advances in Core Computer Science-Based Technologies, Learning and Analytics in Intelligent Systems*, vol 14. (pp. 55-81). Springer, Cham. https://doi.org/10.1007/978-3-030-41196-1_4

Kilcullen, M., Feitosa, J., & Salas, E. (2022). Insights from the virtual team science: Rapid deployment during

COVID-19. *Human Factors, 64*(8), 1429-1440. https://doi.org/10.1177/00187208219916

Klostermann, M., Ontrup, G., Thomaschewski, L., & Kluge, A. (2021). Something old or something new? An empirical study on the instant adjustment to virtual teamwork during COVID-19. *Zeitschrift Für Arbeits-Und Organisationspsychologie A&O., 65*(4), 215-230. https://doi.org/10.1026/0932-4089/a000368

Knight, J. (2023). Using game-based learning to improve learning outcomes in K-12 mathematics education. In L., Nicola-Gavrilă (Eds.), *Digital Future in Education: Paradoxes, Hopes and Realities* (pp. 79-101). RITHA Publishing House. https://doi.org/10.57017/SERITHA.2023.DFE.ch5

Krath, J., Schürmann, L., & Von Korflesch, H. F. (2021). Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Computers in Human Behavior, 125*, 106963. https://doi.org/10.1016/j.chb.2021.106963

Krippendorff, K. (2018). *Content analysis: An introduction to its methodology* (4th ed). Sage publications.

Kucher, T. (2021). Principles and Best Practices of Designing Digital Game-Based Learning Environments. *International Journal of Technology in Education and Science, 5*(2), 213-223. https://doi.org/10.46328/ijtes.190

Kyngäs, H. (2020). Inductive content analysis. In Kyngäs, H., Mikkonen, K., Kääriäinen, M. (Eds.) *The Application of Content Analysis in Nursing Science Research* (pp. 13-21). Springer, Cham. https://doi.org/10.1007/978-3-030-30199-6_2

Lainema, T. (2003). *Enhancing organizational business process perception: Experiences from constructing and applying a dynamic business simulation gam*e. Turku School of Economics and Business Administration.

Lainema, T., & Nurmi, S. (2006). Applying an authentic, dynamic learning environment in real world business. *Computers & Education, 47*(1), 94-115. https://doi.org/10.1016/j.compedu.2004.10.002

Lainema, K., Syynimaa, K., Lainema, T., & Hämäläinen, R. (2021). Organizing for collaboration in simulation-based environments: An affordance perspective. *Journal of Research on Technology in Education, 55*(2), 307-323. https://doi.org/10.1080/15391523.2021.1962451

Leonardi, P. M. (2013). When does technology use enable network change in organizations? A comparative study of feature use and shared affordances. *MIS quarterly*, 749-775. https://doi.org/10.25300/MISQ/2013/37.3.04

Linehan, C., Lawson, S., Doughty, M., & Kirman, B. (2009). Developing a serious game to evaluate and train group decision making skills. In *Proceedings of the 13th international MindTrek conference: Everyday Life in the Ubiquitous Era* (pp. 106-113). https://doi.org/10.1145/1621841.1621861

Littleton, K., & Häkkinen, P. (1999). Learning together: Understanding the processes of computer-based collaborative learning. In P. Dillenbourg (Eds.) *Collaborative learning: Cognitive and computational approaches*. (pp. 20 -30). Amsterdam: Pergamon/Elsevier Science.

Lengyel, P. S. (2020). Can the game-based learning come? Virtual classroom in higher education of 21st century. *International Journal of Emerging Technologies in Learning, 15*(2). https://doi.org/10.3991/ijet.v15i02.11521

Lipponen, L. (2002). Exploring foundations for computer-supported collaborative learning, Computer support for collaborative learning: Foundations for a CSCL community. In *Proceedings of the international conference on computer supported collaborative learning (CSCL 2002) Boulder, CO, USA* (pp. 72-81).

Martens, R., Bastiaens, T., & Kirschner, P. A. (2007). New learning design in distance education: The impact on

student perception and motivation. *Distance Education, 28*(1), 81-93. https://doi.org/10.1080/01587910701305327

Martínez-Cerdá, J. F., Torrent-Sellens, J., & González-González, I. (2018). Promoting collaborative skills in online university: Comparing effects of games, mixed reality, social media, and other tools for ICT-supported pedagogical practices. *Behaviour & Information Technology, 37*(10-11), 1055-1071. https://doi.org/10.1080/0144929X.2018.1476919

Mathieu, J. E., Luciano, M. M., D'Innocenzo, L., Klock, E. A., & LePine, J. A. (2020). The development and construct validity of a team processes survey measure. *Organizational Research Methods, 23*(3), 399-431. https://doi.org/10.1177/1094428119840801

Moretti, F., van Vliet, L., Bensing, J., Deledda, G., Mazzi, M., Rimondini, M., Zimmermann, C., & Fletcher, I. (2011). A standardized approach to qualitative content analysis of focus group discussions from different countries. *Patient Education and Counseling, 82*(3), 420-428. https://doi.org/10.1016/j.pec.2011.01.005

Oksanen, K., Lainema, T., & Hämäläinen, R. (2017). Learning from social collaboration: A paradigm shift in evaluating game-based learning. In Handbook of research on serious games for educational applications (pp. 41-65). IGI Global. https://doi.org/10.4018/978-1-5225-0513-6.ch003

Oyelere, S. S., Bouali, N., Kaliisa, R., Obaido, G., Yunusa, A. A., & Jimoh, E. R. (2020). Exploring the trends of educational virtual reality games: a systematic review of empirical studies. *Smart Learning Environments, 7*, 1-22. https://doi.org/10.1186/s40561-020-00142-7

Palmunen, L. M., Lainema, T., & Pelto, E. (2021). Towards a manager's mental model: Conceptual change through business simulation. *The International Journal of Management Education, 19*(2), 100460.

Papastergiou, M. (2009). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers & Education, 52*(1), 1-12. https://doi.org/10.1016/j.compedu.2008.06.004

Patton, M. Q. (2001). *Qualitative evaluation and research methods* (2nd ed.). Thousand Oaks, CA: SAGE.

Peterson, M. (2023). Digital simulation games in CALL: A research review. *Computer Assisted Language Learning*, *36*(5-6), 943-967. https://doi.org/10.1080/09588221.2021.1954954

Pivec, P., & Pivec, M. (2011). Digital games: Changing education, one raid at a time. *International Journal of Game-Based Learning (IJGBL), 1*(1), 1-18. http://dx.doi.org/10.4018/ijgbl.2011010101

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist, 50*(4), 258-283. https://doi.org/10.1080/00461520.2015.1122533

Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment, 1*(1), 21-21. https://doi.org/10.1145/950566.950596

Priyaadharshini, M., Dakshina, R., & Sandhya, S. (2020). Learning analytics: game-based learning for programming course in higher education. *Procedia Computer Science, 172,* 468-472. https://doi.org/10.1016/j.procs.2020.05.143

Qian, M., & Clark, K. R. (2016). Game-based Learning and 21st century skills: A review of recent research. *Computers in Human Behavior, 63,* 50–58. https://doi.org/10.1016/j.chb.2016.05.023

Rieber, L. P. (2005). Multimedia learning in games, simulations, and microworlds. In R. Mayer (Eds.), *The Cambridge handbook of multimedia learning,* 549-567. New York: Cambridge University Press. https://psycnet.apa.org/doi/10.1017/CBO9780511816819.034

Riemer, M. J. (2007). Communication skills for the 21st century engineer. *Global Journal of Engineering. Education, 11*(1), 89-100. https://www.researchgate.net/publication/299507876

Romero, M., Usart, M., Ott, M., Earp, J., de Freitas, S., & Arnab, S. (2012). Learning through playing for or against each other? Promoting collaborative learning in digital game-based learning. In *Proceedings of the European Conference on Information Systems*. https://aisel.aisnet.org/ecis2012/93

Ronimus, M., Kujala, J., Tolvanen, A., & Lyytinen, H. (2014). Children's engagement during digital game-based learning of reading: The effects of time, rewards, and challenge. *Computers & Education, 71*, 237-246. https://doi.org/10.1016/j.compedu.2013.10.008

Salmon, G. (2019). May the fourth be with you: Creating education 4.0. *Journal of Learning for Development, 6*(2), 95-115. https://doi.org/10.56059/jl4d.v6i2.352

Schartel Dunn, S., Dawson, M. & Block, B. (2020). Teaching teamwork in the business school. *Journal of Education for Business, 96*(6), 381–386. https://doi.org/10.1080/08832323.2020.1840322

Seaman, J. E., Allen, I. E., & Seaman, J. (2018). *Grade Increase: Tracking Distance Education in the United States*. Babson Survey Research Group. https://files.eric.ed.gov/fulltext/ED580852.pdf

Seethamraju, R. (2011). Enhancing student learning of enterprise integration and business process orientation through an ERP business simulation game. *Journal of Information Systems Education, 22*(1), 19. https://jise.org/Volume22/n1/JISEv22n1p19.pdf

Spöttl, G., & Windelband, L. (2021). The 4th industrial revolution–its impact on vocational skills. *Journal of Education and Work, 34*(1), 29-52. https://doi.org/10.1080/13639080.2020.1858230

Syynimaa, K., Lainema, K., Hämäläinen, R., Lainema, T., & Lämsä, T. (2021). The Role of Instructional Activities for Collaboration in Simulation-Based Games. In Daniela, L. (Eds) *Smart Pedagogy of Game-based Learning* (pp. 21-40). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-76986-4_14

Thornhill-Miller, B., Camarda, A., Mercier, M., Burkhardt, J.-M., Morisseau, T., Bourgeois-Bougrine, S., Vinchon, F., El Hayek, S., Augereau-Landais, M., Mourey, F., Feybesse, C., Sundquist, D., & Lubart, T. (2023). Creativity, critical thinking, communication, and collaboration: Assessment, certification, and promotion of 21st century skills for the future of work and education. *Journal of Intelligence, 11*(3), 54. https://doi.org/10.3390/jintelligence11030054

Udeozor, C., Toyoda, R., Russo Abegão, F., & Glassey, J. (2023). Digital games in engineering education: systematic review and future trends. *European Journal of Engineering Education, 48*(2), 321-339. https://doi.org/10.1080/03043797.2022.2093168

Van Laar, E., Van Deursen, A. J., Van Dijk, J. A., & De Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior, 72*, 577-588. https://doi.org/10.1016/j.chb.2017.03.010

Vlachopoulos, D., & Makri, A. (2017). The effect of games and simulations on higher education: a systematic literature review. *International Journal of Educational Technology in Higher Education, 14*(1), 1-33. https://doi.org/10.1186/s41239-017-0062-1

White, M. D., & Marsh, E. E. (2006). Content analysis: A flexible methodology. *Library trends, 55*(1), 22-45. https://doi.org/10.1353/lib.2006.0053

Wuertz, J., Alharthi, S. A., Hamilton, W. A., Bateman, S., Gutwin, C., Tang, A., Toups Dugas, P.O., & Hammer,

J. (2018). A design framework for awareness cues in distributed multiplayer games. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (pp. 1-14). https://doi.org/10.1145/3173574.3173817

Yang, Y. T. C. (2012). Building virtual cities, inspiring intelligent citizens: Digital games for developing students' problem solving and learning motivation. *Computers & Education, 59*(2), 365-377. https://doi.org/10.1016/j.compedu.2012.01.012

Yang, K. H., & Lu, B. C. (2021). Towards the successful game-based learning: Detection and feedback to misconceptions is the key. *Computers & Education, 160*(3). https://doi.org/10.1016/j.compedu.2020.104033

Author Information

Kirsi Syynimaa

https://orcid.org/0000-0001-9365-0894

University of Jyväskylä, Department of Education

P.O. Box 35, FI-40014 University of Jyväskylä

Finland

Contact e-mail: *kirsi.syynimaa@jyu.fi*

Kirsi Lainema

https://orcid.org/0000-0003-3621-8696

University of Turku, Turku School of Economics

P.O. Box 20014 University of Turku

Finland

Timo Lainema

https://orcid.org/0000-0002-8987-3400

Magisys Ltd

Vilkastuksenkatu 10, FI-20320 Turku

Finland