Chapter 2
The Role of Instructional Activities for Collaboration in Simulation-Based Games

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Introduction

Success in life and work in today's knowledge society calls for novel approaches to support workplace learning. Technology, together with social networks, provides different levels of interactivity during the learning process, increasing the participation of learners and resulting in more active learning (Lytras et al., 2018). Autonomous and socially actionable competence and resources deriving from belongingness to a sociocultural community can also be seen as outcomes of learning processes (Kira et al., 2010). The use of technologies in the learning process not only supports students' and workers' learning processes but also the development of values, which are important for a sustainable society (Daniela et al., 2018). While technology-enhanced learning can be designed or reimagined and delivered based on principles, values and aspirations of sustainability, the promotion of sustainability in the community requires socially inclusive participation (see Hays & Reinders, 2020; Lytras et al., 2018, 16). Game-based learning (GBL) environments can be employed as pedagogical contexts for fostering sustainability.

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In recent years, GBL environments have been discussed extensively as pedagogically sound contexts for providing unique learning experiences in various school and work life contexts (e.g. Amory et al., 1999; Barab et al., 2005; Ravenscroft & Matheson, 2002; Prensky, 2003; Rieber & Noah, 2008; Kiili, 2005; Tynjälä et al., 2014). Against this background, we introduce GBL environments as fruitful settings for collaboration. However, despite this potential, there seems to be a lack of research-based knowledge concerning if, how and under which circumstances instructional activities are beneficial to collaboration in the context of simulation-based game environments. Therefore, in our empirical study, we set out to probe into how pre-game and during-game instructional activities contribute to collaboration in a simulation-based learning game.

Collaboration in GBL and Simulation-Based Games

GBL refers to a learning approach that involves a game environment with components of learning operations (e.g. practising, inspecting, communicating) to improve particular domain-related knowledge (e.g. English, business) and obtain expertise, where operations regularly deal with problem-solving and aim to enhance participants' experience of their achievement (Emerson et al., 2020). The literature on GBL has highlighted several positive educational outcomes of the application of educational games, such as providing the opportunity to offer learning experiences that are inspiring and effective (e.g. Yang, 2012) or practising skills and competences that are difficult to learn/understand (e.g. Ronimus et al., 2014; Koskimaa & Fenyvesi, 2015) and/or dangerous to do in real life (e.g. construction safety, Hämäläinen, 2008; aviation games, Proctor et al., 2007).

In accordance with these investigations, simulation-based games for educational purposes have demonstrated their potential for, for example, improving the participants' knowledge, skills and motivation regarding instruction (Papastergiou, 2009). In contrast, researchers have also raised a concern that in addition to individual learning, educational learning games could exploit the full potential of the social aspects of playing, as is often done in entertainment games (Hämäläinen, 2008). Next, we will discuss how games are beneficial for collaborative learning (see Lainema 2014; Lainema and Nurmi 2006; Lämsä et al., 2018; Oksanen et al., 2017).

Papastergiou (2009) postulated that educational game environments provide a fruitful context for collaborative learning and shared knowledge construction via social interaction, which is a pivotal attribute of online environments. Under the circumstances, the success of learning in GBL environments is dependent upon the quality and effectiveness of the interaction between participants. Thus, learning games involving multiple participants can serve as contexts for interactive and collaborative learning and provide social experiences that may promote high-level knowledge construction and learning (De Freitas & Oliver, 2006; Bluemink et al., 2010). Furthermore, novel technological advances enable the design of increasingly delicate and pedagogically accurate GBL environments (Rieber & Noah, 2008;

Lainema, 2004). In sum, GBL seems to offer vast opportunities to learn and to contribute to the process of knowledge construction (see also Daniela et al., 2018).

Related to this potential, studies have increasingly focused on developing a better understanding of the various collaboration processes that take place during simulation- and/or game-based environments. For example, according to Andrews et al. (2017), different interaction patterns can be identified in simulation-based games. Andrews-Todd and Forsyth (2020) explored different social and cognitive dimensions of collaboration in the context of simulation-based tasks. Furthermore, Hao et al. (2015) assessed collaborative problem-solving in simulation-based tasks, and Martínez-Cerdá et al. (2018) investigated the effects of games and other technologies on collaboration skills. Additionally, decision-making processes have been in the focus of GBL. For example, Linehan et al. (2009) found that the game environment offers possibilities to rehearse, enhance and assess participants' decision-making processes. Studies have also emphasised that simulation-based games can be utilised to develop the reflective and interpretative skills of learners (Harviainen et al., 2014) as well as competencies needed particularly in twenty-first-century digital work, such as the ability to use technology and to evaluate information, flexibility and self-direction. While all these approaches are vital for the development of high-level simulation-based games, less is known about instructional activities in these contexts. Therefore, we will next discuss the role of instructional activities in the context of simulation-based games.

Instructional Activities to Trigger Collaboration

The challenges of creating high-level collaboration include not only the design of high-level simulation-based games (Buchinger & da Silva, 2018; Andreoli et al., 2017) but also the instructor's ability to inspire and engage learners towards collaboration (Ingulfsen et al., 2018). Typically, instructional activities combine design and improvisation in that the curriculum frames the starting points for learning, the learning environment affords collaboration and the instructor's pre-design structures the learning process while leaving space for real-time flexibility (Hämäläinen & Vähäsantanen, 2011). Therefore, we need to understand if, how and under which circumstances the instructor's instructional activities are helpful for triggering and supporting students with the game content or problem-solving (Molin, 2017; Vangsnes & Økland, 2015). In relation to the temporal dimension, these instructional activities have been categorised into three main groups of pre-game, during-game and post-game phases of the learning process (Bado, 2019) (see Methods section Fig. 2.2).

There are divergent methods to execute pre-game, during-game and post-game instructional activities. The instructional activities before the actual game session may involve instructions and training (e.g. Kangas et al., 2017) and may primarily aim at preparing participants with the technology, content (Bado, 2019), game rules and the overall aim of the game. These instructional activities executed by instructors before actual gameplay may ensure that participants reach joint orientation for completing game-related tasks and objectives. Moreover, pre-game instruction may entail collaboration scripting (Hämäläinen, 2008; Van der Meij et al., 2020), handouts and readings (Zold, 2014; Bawa et al., 2018; Maguth et al., 2015), game manuals (Jong and Shang, 2015), instructional videos (Bado, 2019), lectures (Panoutsopoulos & Sampson, 2012; Poli et al., 2012; Liu, 2016) and a schedule for the learning event (Meluso et al., 2012). There is still uncertainty, however, how pre-game instructional activities contribute to collaboration amongst the participants.

During-game instructional activities can be applied in GBL environments and may entail providing technical support to the students (Vangsnes & Økland, 2015; Vasalou et al., 2017; Whalen et al., 2018), controlling the time and progress of the task (Tüzün et al., 2009) and managing the student teams' divisions of labour, such as in regard to who controls the keyboard and ensuring that team members are contributing equally to the mutual task (Bado, 2019). Haruehansawasin and Kiattikomol (2018) found that in successful GBL settings, the instructor's role as the facilitator of learning and the gameplaying process is to trigger the players' learning with the help of particular activities, such as offering timely assistance that originates from the students' needs, encouraging participants to contribute to discussions, offering instructional materials and giving instant feedback. Moreover, during-game instruction is implemented to help students experiencing difficulties with the game content or problem-solving (Liu et al., 2011; Hämäläinen & Oksanen, 2014). An additional aim of during-game instruction is to ensure an enjoyable and productive experience for the students during gameplay, and therefore these activities are frequently employed particularly in simulation-based games (Bado, 2019).

The post-game instructional activities usually involve debriefing after the game session to reinforce and build upon the knowledge acquired during gameplay (Lederman, 1992; Kangas et al., 2017). Debriefing can be executed as discussions amongst teams (Franciosi, 2017), as discussions between teacher and students (Jong & Shang, 2015), as homework in class with the instructor or as reflection texts written by the students after the gaming session.

While simulation-based games create fruitful contexts for collaborative learning, there seems to be a lack of research-based knowledge concerning how instructional activities are beneficial to collaboration in the context of simulation-based game environments. This study grounds the notion that a more in-depth examination of instructional activities is needed in order to better understand the relationships between the instructional activities (Bado, 2019) and the shared learning process in a multiplayer GBL environment. Therefore, we set out to probe into *how pre-game and during-game instructional activities contribute to collaboration in a simulation-based learning game*.

Methods

RealGame Simulation-Based Business Game Environment

RealGame is a dynamic, clock-driven simulation-based business game which represents the supply chain and the order-delivery processes of a manufacturing company (Lainema, 2003). Effectively, RealGame depicts an enterprise resource planning (ERP) system. The purpose of the game is to manage the simulated company and its supply chain in the game environment. Participants work in teams and purchase raw materials from the simulated raw material markets, manage their manufacturing and warehousing processes and deliver their products to simulated customer markets, meaning that teams compete for the same customer orders (see Romero et al., 2012). The aim is to streamline the company's operations and supply chain and to improve the company's performance in light of selected key performance indicators (KPIs).

In RealGame, the participants continuously make decisions on purchases, warehousing, production, deliveries and invoicing and can follow the operations and material flows of their (simulated) company in real time on their computer screens (see Fig. 2.1). This means that all operations taking place in the game are immediately visible to the participants. Events in the game proceed continuously, which demands that participants work in close collaboration and pay attention to several operational and strategic decision-making areas simultaneously. These decisions comprise, for example, which components to order, at what price and terms of delivery, which manufacturing lines to run and on how many shifts and which markets and customers to serve, amongst others. The performance of each company is assessed based on different KPIs, such as profitability, market share, production and raw material costs and inventory level.

Fig. 2.1 RealGame user interface

The transparency of operations and the cause-effects of decisions taken provide a dynamic view of how a business organisation functions. Consequently, RealGame provides an authentic learning experience illustrating the complexity of real-world business operations in a realistic manner (Lainema, 2004).

Instructional Activities in the Simulation-Based Game Session

A few days before the simulation game, session participants were divided into teams of two to three. The participants were experienced specialists and middle managers representing ten organisations from various industries ranging from steel, chemical and forest industries to education, media, wholesale and IT. The participants had diverse backgrounds and, thus, different types of knowledge.

One of the authors ran the simulation game and performed as a tutor the simulation game session. Before the actual game session, the tutor provided the teams with a game manual as a PDF file and a web link to a self-learning video by email. In the email, the participants also received information about their teammates as well as the timetable for the gaming session. The participants were encouraged to familiarise themselves with the instruction. However, as this was not controlled by the tutor, it was left to the participants' own initiative to prepare for the game.

Instructions before the game were delivered by email to the participants a week in advance. Links to Microsoft's *Teams* meeting software and the RealGame simulation game were emailed to the participants the day before. On the simulation day, the tutor first summoned all the participants in a joint *Teams* meeting to welcome everyone and to go through the timetable and practicalities regarding the gaming session. Specific organisational roles were not assigned to the participants. Instead of scripting the participant roles in the teams (Kobbe et al., 2007; Heinonen et al., 2020), the teams were allowed to spontaneously and autonomously organise their collaboration (Stahl, 2010).

During the game, the tutor provided two types of instruction. First, the tutor provided the teams with instruction through the game's own communication channel. The tutor sent pop-up instructions to the teams so that the instructions appeared as messages on the simulation users' game user interface. Second, halfway through the simulation session, the tutor summoned the teams to the joint *Teams* meeting to go through interim results and receive feedback on the teams' performance in the game. Additional pedagogical elements in the game included the tutor's written feedback via email after the game. Feedback after the game, however, remains outside scope of our treatment. Instead, we focus on examining the following pedagogical elements: instruction before the game, pop-up instruction during the game and the interim results session during the game (Fig. 2.2).

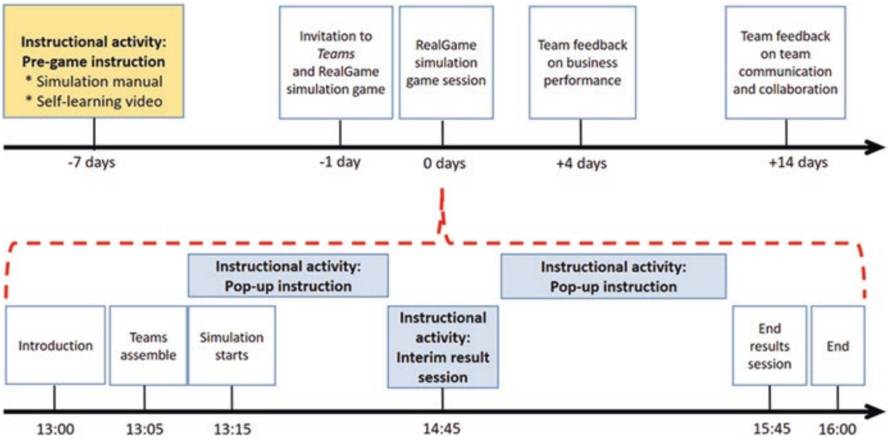

Fig. 2.2 Instructional activities in a RealGame session

Participants, Data Collection and Analysis

In this study, we focused on examining the role of instructional activities in regard to collaboration in the simulation-based game environment of RealGame. In our research setting, ten teams with two to three participants on each team took part in the simulation game in altogether three gaming sessions, with three to four teams in each session. All teams were geographically dispersed, meaning that the participants joined the game from their own locations with their PCs via Internet and communicated using Microsoft's *Teams* meeting software, enabling synchronous communication within the team.

Data collection was part of a larger research project targeting digital work, digital skills and wellbeing in digital work. Three of the authors were involved in designing the gaming event as well as collecting the data, which was organised and analysed by two of the authors.

During the simulation game, we collected screen capture data and audio materials from the teams, which allowed for tracing the role and influence of the pedagogical elements in regard to collaboration and teamwork. The data corpus comprised over 30 hours of recordings. The screen capture data were stored according to the university's data handling policies and could be accessed only by designated researchers. All participants were informed of the study and gave their written consent to participate in the study.

Data analysis was conducted by two of the authors. In particular, the analysis focused on examining the role and influence of the three selected pedagogical elements in the simulation game – instruction before the game, pop-up instruction during the game and the tutor's feedback in the interim session. While post-game activities, such as debriefing, have been found beneficial for learning (Lederman, 1992; Garris et al., 2002), they are omitted from our analysis as we concentrate on looking at those instructional activities that have importance for teamwork and collaboration. Our analysis thus focused on detailing how pre-game and during-game instructional activities were reflected in the teams' communication and collaboration while engaged in the simulation-based business game.

In the analysis, we employed a qualitative content analysis (Patton, 2015; Krippendorff, 2004) through three main phases of preparing, organising and reporting data (Elo & Kyngäs, 2008). Two researchers participated in this iterative analysis process by coding manually entire data set. First, in the preparation phase, all ten screen capture recordings were viewed several times by the researchers to obtain an understanding of the data as a whole. The unit of analysis for the current investigation was the entire dialogical episodes between participants in the multiplayer gaming situation. Based on the focus of this study, specific episodes were marked in the data to be examined in more detail. These episodes comprised the instances of teamwork at the beginning of the game, events after the pop-up instruction in the game and events after the tutor-led feedback session halfway through the game.

Next, in the organising phase, subsequent rounds of analysis were executed, and marked episodes were allocated into condensed units of meanings and compared with each other in light of their content and context. After various iterative rounds of scrutinising the screen capture data, we selected specific samples of the data for a more detailed analysis. Based on this progressive process, we aimed to understand these arrested samples from the view of the participants' collaborative simulation-based game session and in the context in which the dialogical episodes emerged. Afterwards, we juxtaposed interdependent aspects of various meanings and grouped similar meanings alongside each other. Finally, in the reporting phase, two main categories and nine subcategories were composed through careful discussions and close collaboration with two of the authors.

Researcher triangulation and data extracts demonstrating the results of the analyses were employed to support the trustworthiness of the analytical process. The analysis was conducted in the original language, Finnish, with a shift to English to produce the report. Illustrative data extracts were translated, and the translations were double-checked in collaboration of two researchers. Moreover, in order to protect participants' privacy, all participants' names were pseudonymised at this stage.

Findings

In this study, from the qualitative content analysis, two main categories emerged, as follows: (1) pre-game instructional activities that consist of five subcategories of *accelerating roles and responsibilities*, *building a common understanding*, *expediting the decision-making process*, *initiating meaningful communication* and *increasing knowledge sharing and co-creation* and (2) during-game instructional activities that consist of three subcategories of *directing the participants' attention to important aspects*, *advancing equal participation* and *fostering rich and dialogical communication* (see Table 2.1). These two main categories with their subcategories are

Table 2.1 Temporal and pedagogical dimensions of instructional activities for simulation-based game collaboration

Main categories Temporal dimension of instructional activity	Instructional activities	Subcategories Role of instructional activities in simulation-based game collaboration
1. Pre-game	Game manual Self-learning video	1.1 Accelerating adopting roles and responsibilities 1.2 Supporting building a common understanding 1.3 Expediting decision-making process 1.4 Initiating meaningful communication 1.5 Increasing knowledge sharing and co-creation
2. During-game	Pop-up instructions Interim results session	2.1 Directing the participants' attention to important aspects 2.2 Promoting team members' equal participation 2.3 Fostering and maintaining rich and dialogical communication 2.4 Supporting reflecting on team performance in comparison to other teams

described below together with extracts to further illustrate the qualitative data, hence illuminating the role of instructional activities for collaboration in a GBL setting.

Pre-game Instructional Activities

In general, our results indicate that implementing pre-game instructional activities, such as the game manual and the self-learning video, promoted the participants' teamwork and collaboration at the early phase of the simulation-based business game. First, the results show that these pre-game instructional activities triggered teamwork in relation to group dynamics and processes by *accelerating adopting roles and responsibilities* within teams. For example, participants who had gone through the instructional materials before the game session were more knowledgeable on the game content than the less-prepared team members. Hence, these participants were also keener to take an organiser or initiator role within their team. These roles were self-organised and emerged at a very early stage of the GBL process.

Second, it seemed that the pre-game instructional activities supported participants in *building a common understanding* with their team members. The following extract illustrates how one well-prepared participant actively checked her team members' prior knowledge by asking questions and guiding and sharing information with the others to ensure that they reached a consensus concerning the game content, rules and the overall aim. By advising others how to play the game, the participants aimed to confirm that they have shared goal orientation in order to work together and proceed in the game as a uniform group:

Tuulikki	Erm, there was that instructional video and a document, and I viewed them kinda, what was in them and (.) Did you have a chance to take a look at what kinda is the purpose (*of the game*)?
Iivari	For my part I can say (.) I'm a tourist here, sort of (.)
Tuulikki	Okay. If I shortly repeat and summarise so that we can proceed in the game (---) Yea, so I browsed through the instruction, so as a summary, this firm manufactures an end product called BioCounter. And to manufacture this end product we need one Processor and one Scanner (---) So that was kinda the basic idea of what we'll be trying to do there (*in the game*).
Iivari	Mmmhy.

Furthermore, our findings indicate that pre-game instructional activities *advanced* particular game actions, such as the *decision-making process*. Hence, in teams in which all participants had acquainted themselves with the pre-game instruction, the participants were able to promptly proceed to the task at hand by first discussing the specific decision-making areas in the game and, after that, sharing knowledge for the basis of making decisions. Activity roles and responsibilities were shared amongst the participants through open negotiation. The next data extract illustrates how equally prepared participants shared their newly acquired knowledge from the pre-game instruction and how they used this information as a basis for making assessments and decisions on next actions for the gameplay, such as raw material needs in their game-simulated company:

Petteri	In the hint (instruction) they said 6900 devices in a month (---)
Jouko	Yea so it was, it was yea.
Liisa	Yea, exactly!
Petteri	So if we produce on this volume, then we get the quantities per day, what we need in terms of raw material.
Liisa	Yea.
Jouko	Yea it seems to have been 230 BioCounters, ja 170 Scanners. (---). And it looks like BioCounter is the main product. (---)

The above data extract shows how the pre-game instruction accelerated the team's game actions and fostered a levelled decision-making process within the team. In addition, teams with equal pre-game preparation could build their *knowledge sharing and knowledge co-creation* on a firmer ground than teams with only one well-prepared participant.

Furthermore, teams with equal preparation were also quick to identify areas that needed clarification. In the previous extract, Jouko mistakenly referred to 'Scanner' as a finished product that could be sold to external customers ('And it looks like BioCounter is the **main product**'). However, as explained in the pre-game instruction, Scanner was a semifinished product that would be used in production on the BioCounter production line. The next extract illustrates a discussion taking place approximately 1.5 minutes after the interaction sequence in the previous extract:

Liisa	Sorry but now I have to clarify: do we sell both BioCounter and Scanner, or both or how did this go again?
Petteri	No, no there is one and only one product to be sold.
Jouko	Oh, I see, I see, so that's how it was.

Liisa is confused by the comment made by Jouko in the previous extract ('And it looks like BioCounter is the **main product**') as she, too, has read the pre-game instruction where it is stated that the game company has only one end product. Therefore, Liisa seeks clarification on the issue by asking if there are two end products. Petteri assertively responds to Liisa's question, correcting the false claim made by Jouko (No, no there is **one and only one** product to be sold out). Jouko accepts Petteri's viewpoint and more or less admits his mistake.

Thus, equal preparation for the game by studying the pre-game instruction *initiated meaningful team communication* and provided the participants with a solid shared basis to collectively debate and contemplate the available information. Having a comparable level of prior knowledge of the game also provided the participants better opportunities for identifying misinterpretations and for correcting them in order to reach common understanding within their team.

Alternatively, teams with inadequate pre-game preparation suffered from the inability to grasp the essential elements in the game. This hampered the participants' possibilities to identify relevant aspects in the game and diffused their attention. As a consequence, the participants would be absorbed in discussions about the basics of the game, which, in turn, would restrain the team's decision-making. When the whole team was involved in discussing the same issue, decision-making was slow, and other equally important areas would be left out of scope.

At the same time, insufficiently prepared participants were at risk of being dropped out of the discussions and the joint decision-making processes as the better-prepared participants were considered more trustworthy. For example, when the team leader noticed that one participant did not have prior knowledge concerning the game content, she focused her discourse only towards the third team member, who expressed her knowledge and ideas. It seems that trust was established between team members who were able to communicate about the task on a similar level.

During-Game Instructional Activities

Pop-Up Instruction

Instruction through the game's own communication channel entailed pop-up instruction that appeared on the game user interface. The purpose of this instruction was to provide expedient and timely information about the game's functionalities and to focus the teams' attention on relevant decision-making areas in the game.

The next data extract illustrates how pop-up instruction is reflected in team communication and collaboration:

Jouko Here's a message 'Result of your company can be found under the clock (*on the computer screen*). All teams seem to have negative result, as the market is not yet properly awake' (--)
Liisa Yea here is the income statement.
Jouko I wonder if there was a kinda hidden message in that suggesting that if the market is not yet awake, so =
Petteri =should we manufacture goods to stock=
Jouko =to stock, so could we dare erm to run the machinery (*on the production line*) at a bit brisker pace (.)
Petteri [yea]
Liisa [do] it all right, and now an offer with lower price got sent, and more of these could be made.

The above extract illustrates how during-game instruction in the form of pop-up notifications helped in directing the participants' attention to the aspects of the game that were relevant in each phase of the game. As the game events were continuously unfolding on the participants' computer screens, there was little time to get familiar with all the features of the game during gaming. Instead, decisions needed to be made promptly and frequently. The pop-up instruction pointed out important areas to consider and fostered rich and dialogical team communication during which conclusions could be drawn and action plans developed.

The next extract illustrates how pop-up instruction helped a less meticulously prepared participant to assume a constructive and active role in the team:

Anni It says here now: 'Scanner production is first run in three shifts, the end product only in the morning shift'.
Mika We get Scanners (.) we have too many in stock (1)
Kalle [So we must stop them yea]
Anni [So we must stop the night shift] (.) Let's do it, shall we now send this order is everything ok with it.

As shown in the above data extract, the pop-up instruction paved the way for Anni to have the attention of her teammates. By reading the instruction in the pop-up window, Anni could initiate a discussion on a current issue regarding the management of the game company's supply chain. Anni's initiative immediately ignited a discussion, during which a problem was identified by Mika ('We get Scanners (.) we have too many in stock'), and relevant solutions were immediately suggested by Kalle and Anni. Concluding the discussion, Anni announced the decision ('Let's do it') and proceeded to deal with the next tasks in the game.

Pop-up instruction thus provided opportunities for the less-prepared participants to also focus the teams' attention to timely issues and to initiate knowledge-building activities as well as to assume a central role in drawing conclusions and taking part in decision-making sequences.

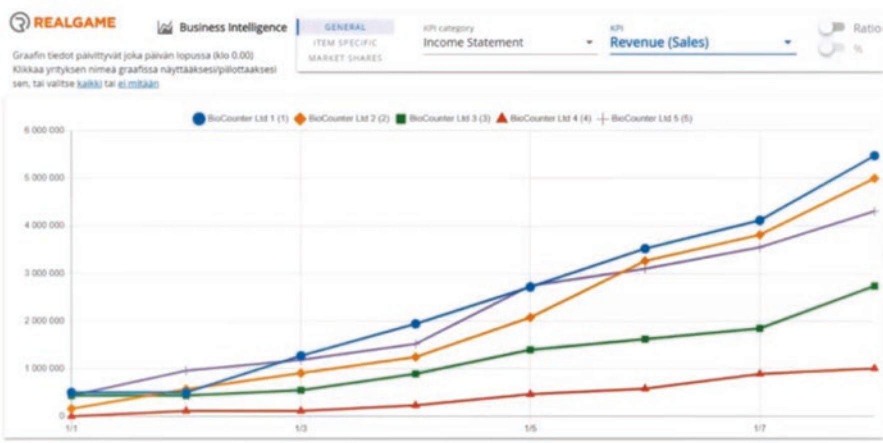

Fig. 2.3 Screenshot from interim results session. KPI: result (profit)

Feedback in the Interim Results Session

The interim results session was held by the tutor in the general *Teams* room and lasted about 15 minutes. The KPIs of all game companies reflecting the efficiency and fluency of managing the supply chain were displayed by sharing the tutor's screen with all participants in a graphical form, allowing comparison between the game companies (see Fig. 2.3). The KPIs were selected from the income statement (e.g. revenue/sales, gross margin, cash) and from the material process (e.g. inventory, delivery accuracy, manufacturing costs, waste). While going through the KPIs, the tutor pointed out differences in the game companies' performance and explained the factors affecting each KPI as well as potential reasons for good/poor performance.

After the interim results session, all teams returned to their designated *Teams* spaces and continued their team collaboration in the simulation-based game. The next data extract illustrates how participants utilised the content of the feedback session to analyse their team performance and to discuss potential areas for development:

Juha	Observations did you go through our KPI slash operations (gives a laugh)
Kaisa	Well not actually, I also only just returned online so that (.)
Juha	Okay (.) It seems though that they are going in the right direction, our KPI, almost [everywhere] that delivery accuracy must be grasped (gives a laugh) in kinda control.
Kaisa	[Yea, yea] Yea but I was wondering a bit about where it (.) and of course these (.) production costs.
Juha	Yea that is another one, yea (1) There is also a lot of waste.
Kaisa	I've kinda not noticed that deliveries would've been (delayed), but maybe there has been something (.) Delays on the way.
Juha	Yea yea, there's been something.

As shown in the data extracts, the feedback received in the interim results session could be used by the teams to discuss game strategy and to adjust their actions in various decision-making areas. The interim results session provided the teams with opportunities to *reflect on their performance in comparison to other teams* and to identify areas of good performance as well as areas for improvement. At the same time, the feedback helped to build connections between events by explicating the causal relationships between different areas in the game company, such as sales and results, and the feedback allowed for learning the generic business dynamics present in real-life commercial organisations. This way, the during-game instruction in the form of interim feedback fostered the teams' learning and knowledge building by showing how different functions and areas of a company affect each other.

In addition, the feedback during the interim results session triggered the identification of causalities between actions taken in the game and the outcomes in light of the KPI analysis:

Laura	(---) Yea we've actually been forced to buy them Processors with such a high price (.)
Iisa	Yea them we should actually not buy at all anymore.
Laura	[No no]
Iisa	[No] (2) And then also our average price in them is quite high (gives a laugh)
Laura	(.) Yea, it is.
Iisa	Now that we went through that (interim feedback session) one can read this (the game) again a bit better.
Laura	Yea (2) But waste we do not have. (---)

The above extract illustrates how participants were able to employ the instruction and feedback provided in the interim results session to analyse the performance of their simulation company and the consequences of their team's previous actions in the game. Also, participants made conclusions based on the information shown in the interim results and their own prior actions in the game. Clearly, during-game instruction in the form of interim results was beneficial for mutual reflection on cause-effect dynamics regarding the teams' actions and helped the participants to plan for future decision-making in the game.

Furthermore, the feedback helped to highlight the fact that since all areas in the game company are connected, the contribution of each participant in the team is much needed and valuable.

Concluding Discussion

Our study contributes to a discussion about how pre-game and during-game instructional activities fostered the collaboration in teams engaged in a simulation-based business game. The most interesting finding was that the instructor's instructional activities in different phases of the simulation-based game played a significant role in how the participants positioned themselves regarding the mutual learning task and how they took responsibility and assumed accountability for collaboration and guided their teammates' activities. Moreover, pre-game instructional activities advanced particular game actions, such as the decision-making process, team communication and the organisation and management of activities.

The findings of our study corroborate that, at best, GBL environments create opportunities to enhance active self-directed learning and encourage complex collaborative problem-solving in authentic settings (Lainema, 2009; Harviainen et al., 2014). The instructor's role in GBL is associated with planning and organising learning circumstances in which collaborative and inspiring teamwork may arise. Thus, the instructor's role is facilitative and accommodating, supporting and assisting the learners' collaborative learning process and encouraging their contribution to collaboration (Haruehansawasin & Kiattikomol, 2018; Bado, 2019). In our case, pre-game instructional activities were implemented to prepare the students for the use of technology (Vasalou et al., 2017; Whalen et al., 2018) and to enable pre-game orientation (Tüzün et al., 2009). Knowledge of the game environment, the game dynamics and decision-making in the game allow for a speedy start to the game. Furthermore, investing in studying the pre-game instruction may increase the participants' commitment to the game as well as strengthen the participants' impetus to invest in the gaming activities.

Instructional activities during the simulation-based game, in turn, aimed at helping the participants with the game content and problem-solving (Molin, 2017; Vangsnes & Økland, 2015; Liu et al., 2011; Hämäläinen & Oksanen, 2014). In addition, instruction during the game aimed at fostering collaboration and communication within teams and focusing the participants' attention towards timely and relevant aspects of the game. Our findings are in line with previous studies in that instructional activities especially during the learning event support the participants' own initiatives (see also Lytras et al., 2018). Our study also revealed an additional important aspect regarding instructional activities, namely, that with the help of instruction, the participants were able to proceed from making simple decisions (e.g. making raw material orders) to tactical decisions (e.g. ordering raw materials with optimal price/delivery time ratio) and further to strategic decision-making and planning, such as focusing on specific market areas or customers. In other words, the instruction guided the participants to first make a decision and, after that, to understand the outcome of their decision and, finally, to grasp the complex dynamics and causal relations affecting decisions. Thus, at best, instructional activities help the participants to develop from a novice to a competent decision-maker able to analyse the consequences of their actions.

Consequently, our empirical results illustrate that the participants' collaboration is related to the quality and timing of the pedagogical activities as well as to how the instructional activities are implemented and to what kind of feedback the instructor provides to the participants in guiding their journey from novice to expert (see also Fuller & Unwin, 2003). Levelling the amount, degree and type of instruction in GBL environments requires careful consideration and balancing between instruction and the learners' intrinsic learning activities. Therefore, more research on the pedagogic aspects regarding GBL is needed in order to better understand how instruction can be designed and timed to best support collaboration in simulation-based game environments.

The challenges of earlier workplace learning research call for a better understanding of the forms of collaboration in game-based environments. Namely, the criticality of collaboration is emphasised in contemporary work life, where digital teamwork and dispersed teams have become commonplace (Ferrari, 2012), and the latest views of learning also stress the social and collaborative aspects in facilitating workplace learning (see Tynjälä et al., 2014). GBL environments, such as RealGame, can provide a levelled and accessible platform for collaboration amongst participants in different phases of work life. Thus, GBL has the potential of illustrating the concept of sustainable learning and education as a possibility to create and proliferate sustainable approaches to workplace learning (Lytras et al., 2018; Daniela et al., 2018; Hays & Reinders, 2020). As has been shown, having a sense of belonging and receiving continuous positive feedback from the instructor can, at best, slow down or even halt the process of social exclusion (Määttä, 2014). Enthusiasm, interest, motivation, autonomy and a sense of belonging support and predict good learning outcomes throughout life (see Eccles & Roeser 2011). Thus, future studies need to investigate how collaboration experiences in game-based settings can contribute to public health and work-life balance. Furthermore, we need a better understanding regarding if and under which circumstances GBL can offer long-term adaptive and proactive possibilities for workplaces to create sustainable work in which existing personal resources are benefited from, developed further through learning or translated into novel resources (Kira et al., 2010).

The intention behind sustainable learning and education is to instil in people the skills and dispositions to thrive in complicated, challenging and ever-changing circumstances and contribute to making the world a better place in which to live (Hays & Reinders, 2020). These elements of sustainable learning are also important in technology-enhanced learning, such as games, when aiming at inclusive and equitable quality education that promotes lifelong learning opportunities in all age groups. Sustainability is also a fundamental element in workplace learning and applicable in the context of GBL. Initiating meaningful communication, increasing knowledge sharing and co-creation, promoting team members' equal participation and fostering and maintaining rich and dialogical communication are valuable competencies in work life and therefore important elements for creating a sustainable work culture and skills that can be honed with the assistance of real-time instruction and feedback in GBL.

At its best, simulation-based games can help to achieve the goals of sustainable workplace learning – the more fully we accept and appreciate our co-workers, organisations and societies as important, interdependent and deserving of a viable future, and the more we engage with them towards positive ends, the more universally accepted the importance of sustainability will be, and the more likely we are to attain it (Hays & Reinders, 2020). Future studies should focus on developing a better understanding on experiences of belonging, ability, autonomy, meaning, responsibility, identity and commitment in the context of simulation-based games as these can reasonably be viewed as central motivators of human activity (see Eccles & Roeser 2011). Crafting sustainable work is particularly relevant in post-industrial work and workplaces, and we need novel research-based ways to facilitate sustainable and technology-enhanced learning and to promote the development of personal resources leading to sustainable work ability (see Kira et al., 2010). The methods that support learning, collaboration and interaction in GBL may be used to obtain these objectives.

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