Communications of the Association for Information Systems

Volume 53 Paper 16

10-20-2023

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Recommended Citation
Järveläinen, J. (2023). Relativity of Mindfulness: Team Collaboration in Digital and Physical Educational Escape Rooms. Communications of the Association for Information Systems, 53, 397-422.
https://doi.org/10.17705/1CAIS.05316

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Cover Page Footnote

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Communications of the Association for Information Systems

Education Article DOI: 10.17705/1CAIS.05316 ISSN: 1529-3181

Relativity of Mindfulness: Team Collaboration in Digital and Physical Educational Escape Rooms

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Abstract:

This study focuses on collaboration among team members in educational escape rooms in higher education. The objective of this study was to understand how collective mindfulness and less mindful behavior unfold in physical and digital game-based learning. The video data were collected from three different courses comprising 107 students on 28 teams, totaling more than 16 hours of material. The qualitative analysis revealed both collectively mindful and less mindful behaviors in team interactions. This paper contributes to collective mindfulness literature in understanding team collaboration by observing that mindfulness may be relative depending on the observation perspective. It also presents factors that affect member equality in both digital and physical escape rooms. Lastly, a nuanced description of how team collaboration occurred in a short-term problem-solving situation is developed.

Keywords: Educational Escape Room, Collective Mindfulness, Game-Based Learning, Relativity of Mindfulness.

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1 Introduction

We are currently in the midst of a crossroads in higher education; faculty and students are ruminating about the future of digital technologies in education (Clary et al., 2022; Guppy et al., 2022). This change in the teaching environment and expectations poses many challenges for teachers. They deliberate for instance on how to ensure student learning (Przybilla et al., 2021), how to keep them motivated (Toney et al., 2021), and how familiar teaching methods, such as group assignments (Raman et al., 2021), can be adapted into this new environment.

One approach to increasing student motivation, improving perceived learning, and creating enjoyment has been the use of gamification and game-based learning (Subhash & Cudney, 2018). Gamification can also encourage collaboration and create positive emotions within the team (Morschheuser et al., 2017). Educational escape rooms (EERs) can be used with gamified group assignments (Järveläinen & Paavilainen - Mäntymäki, 2019), in which a team collaborates to complete tasks requiring course-related knowledge to "escape" the room. EERs foster active learning, collaboration, and communication within the team (Tercanli et al., 2021; Veldkamp et al., 2020). However, we do not know how student teams actually collaborate in games or what kind of impact remote learning environments make on student collaborations compared with physical learning environments. Studying differences in team collaborations between digital and physical game environments could provide interesting insights. Most of the gamification literature is focused on the individual perspective (Koivisto & Hamari, 2019), although games support often naturally emerging collaboration (Morschheuser et al., 2017), and thus allow studying collaboration closer. Not only is sharing knowledge and communicating together on complex topics necessary but also instructive (Brady & Andersen, 2019). Thus, studying interactions between team members could aid in assignment design to encourage collaboration between students, especially in games.

Prior research has argued that collaborating groups can form collective intelligence or mindfulness when they solve complex problems (Badham & King, 2021). Collective mindfulness "is as much about the quality of attention as it is about the conservation of attention. It is as much about what people do with what they notice as it is about the activity of noticing itself" (Weick et al., 1999, p. 37). Badham and King (2021) consider it group intelligence, which is formed through social interactions. Collective mindfulness has been connected to organizational learning (Levinthal & Rerup, 2006; Rerup & Levinthal, 2014), and team performance (Curtis et al., 2017), as it "highlights the nature and value of thought and action" (Badham & King, 2021, p. 16), which is desirable in learning. Thus, collective mindfulness is a suitable lens to understand interactions within teams, for example in gamified environments.

Levinthal and Rerup (2006) argue that collective mindfulness cannot be maintained for long, as attention is rare and fleeting. Yet, surprisingly, most of the collective mindfulness studies in information systems have a long-term perspective (Aanestad & Jensen, 2016; Carlo et al., 2012; Valorinta, 2009) although a few exceptions exist (Bartelt & Dennis, 2022; Curtis et al., 2017) focusing on text-based decision-making. However, collaboration in EERs is quite different from text-based decision-making, since collaborators can at least hear each other, see shared material and discuss it verbally. Therefore, studying team collaboration in short-term problem-solving situations might clarify the problem-solving process and our understanding of how collective mindfulness unfolds. The research question of this paper is:

How does collectively mindful and less mindful behavior unfold in physical and digital game-based learning?

This paper examines how game players collaborate on teams in EERs. Considering that EERs usually have a strict time limit for solving problems, puzzles, and riddles, as well as knowledge about the subject matter, which team members may share in their collective mind (Vergne et al., 2019), an interesting context is created in which to observe collaborative behavior. Two master's level courses used physical EERs as a group exam to evaluate students' learning. Students enjoyed the physical game for several consecutive years, but after the university campus lockdown due to COVID-19, a digital version of the game was designed, and another digital EER was introduced for an unrelated course. The exam sessions were video-recorded both before and during COVID-19 lockdown, which allowed for the examination of team behavior both in physical and digital EERs. Team behavior was investigated using collective mindfulness theory as a lens and vocabulary to understand the interaction between players. The teams had to pass the exam reliably and demonstrate their learning during a given time frame, which required heightened situational awareness. During the analysis, it became clear that the teams' problem-solving processes included both collectively mindful and less mindful behavior, as reported in prior research

(Carlo et al., 2012; Levinthal & Rerup, 2006). Although mindfulness usually is connected to better performance and less mindful behavior to worse performance, prior literature has demonstrated that both are required because the heightened attention from mindfulness is a scarce resource (Levinthal & Rerup, 2006; Salovaara et al., 2019).

As for the rest of this paper, the study's theoretical background—including prior literature on collective mindfulness and less mindful behavior—is examined. Then the study's methodological choices are explained, including data collection in the study's context, namely EERs. After this, the empirical results from the comparison study are discussed, then the study's theoretical and practical contributions are explained.

2 Collective Mindfulness

Langer and Moldoveanu (2000, pp. 1–2) examined the concept of mindfulness, describing it as the "process of drawing novel distinctions" that may lead to "1) a greater sensitivity to one's environment, 2) more openness to new information, 3) the creation of new categories for structuring perception, and 4) enhanced awareness of multiple perspectives in problem solving." Later, this definition was adapted to the organizational or group level from its psychological, individual origins. Group-level mindfulness often is termed collective mindfulness and has been studied extensively in information systems and other disciplines (Dernbecher & Beck, 2017). Aanestad and Jensen (2016, p. 16) define collective mindfulness as "the capability of remaining 'aware of something that may be important...'" (Merriam Webster's definition of "mindful") in an open and undefined situation, where the organizational setting deems that this awareness goes beyond the individual to encompass the collective setting." This study focuses on the collective mindfulness perspective, and unless otherwise indicated, the term mindfulness refers to collective mindfulness in this paper.

Mindfulness has been connected closely to high-reliability organizations (Sutcliffe et al., 2016), but also to building projects (Carlo et al., 2012) and digital high-reliability organizations (e.g., computer security companies (Salovaara et al., 2019) and military organizations (Spagnoletti & Salvi, 2020)). However, mindfulness also can be found in other environments (e.g., discussions during a board meeting (Cooren, 2004) and in knowledge-intensive small and medium size enterprises (SMEs) (Becke, 2013)). Many collective mindfulness studies have focused on the organizational level, but some also have examined smaller groups (Dernbecher & Beck, 2017) (e.g., the U.S. Navy SEALs (Fraher et al., 2017), software development teams (Mcavoy & Butler, 2009), and student teams (Bartelt & Dennis, 2022; Curtis et al., 2017)).

The definitions of collective mindfulness describe the five practices leading to mindfulness on the collective level: preoccupation with failure; reluctance to simplify interpretations; sensitivity to operations; commitment to resilience; and deference to expertise (Salovaara et al., 2019; Vogus & Sutcliffe, 2012; Weick et al., 1999). *Preoccupation with failure* means that the organization focuses on avoiding possible failures, views near-failures as indicators of system health, tries to analyze failures to find root causes, and encourages employees to report even small errors (Weick et al., 1999). Considering that many studies of collective mindfulness have been executed in safety-oriented, high-reliability organizations, preoccupation with failure can be viewed as being "aware of something that may be important" (e.g., noticing a tool lying on an aircraft carrier deck that might cause serious damage to planes and/or injury to pilots (Landau & Chisholm, 1995)). The second practice is *reluctance to simplify interpretations*, which refers to when an organization detects and examines anomalies instead of ignoring them as single incidents and finding possible problems that might lead to large errors (Carlo et al., 2012). Aanestad and Jensen (2016) further describe it as trying to make sense and structure the situation to understand it better before making any decisions. *Sensitivity to operations*, the third practice, represents effortful situational awareness that the organization sustains, often collectively because the operational environment is too complex for a single person to control (Weick et al., 1999). For example, in the movie Apollo 13, the mission control center acted as a team by creating awareness of the situation when flight director Gene Krantz (played by Ed Harris) asks each flight controller monitoring a specific part of the spacecraft and pilots whether they are ready for the launch. The fourth practice, *commitment to resilience*, could be summarized as "locating pathways to recovery" (Weick & Sutcliffe, 2006, p. 516), but it also refers to knowledge, routines, and other advanced preparations for possible problems, as well as to the ability to improvise in unexpected situations with ad-hoc teams (Weick et al., 1999). For example, Salovaara et al. (2019) observed that an anti-malware software company formed an ad hoc problem-solving team to tackle unexpected security threats. The final practice, *deference to expertise*, means that

decision-making is delegated to people with expertise instead of relying on hierarchical decision-makers (Fraher et al., 2017). An illustration of this practice might be relying on each expert's skills to make relevant decisions in a hospital operating room when something unexpected happens (Sutcliffe, 2011).

Intuitively, mindful behavior seems to be a more desirable state than less mindful behavior, but conflicting results have emerged. Prior literature has focused often on the instrumental value of collective mindfulness, namely organizations acting mindfully to perform better (Badham & King, 2021). Levinthal and Rerup (2006) argued that sustaining mindfulness paradoxically would lead to the routinization of mindfulness, although individuals and organizations cannot remain mindful constantly. Therefore, organizational units formulate standard operating procedures, routines, and practices to keep employees mindful of specific matters (Levinthal & Rerup, 2006). They argued that well-rehearsed routines are the necessary fuel for the ability to react in unexpected situations in a mindful way (e.g., by combining modified or adjusted routines). Considering that attention is a rare state and easily misplaced, routines as a less-mindful behavior are required to sustain mindfulness ability when most needed (Levinthal & Rerup, 2006; Vu et al., 2018).

Since mindfulness cannot be sustained for long (Levinthal & Rerup, 2006), it is surprising that many of the empirical studies have focused on long-term projects or processes. Carlo et al. (2012) studied a building project in 1997-2002 focusing on important events and "how CATIA [a 3-D design software] became a part of their lived experience of the project" (p. 1087). Aanestad and Jensen (2016) investigated the post-implementation information system adaptation process in a Norwegian hospital for two years. Valorinta (2009) studied the supply-chain operations process and observed different kinds of projects in two organizations for several hundred hours. Fraher et al. (2017) studied US Navy SEALs, especially their training with publicly available marketing and recruitment videos which contained video snippets from Navy SEALs' famous Hell Week where the candidates are pushed to their mental limits and expected to fail and learn from it. In each of these examples, it is unlikely that mindfulness has been preserved throughout the whole studied period.

Therefore, instead of adopting the long-term perspective, we are focusing on critically observing the unfolding of collective mindfulness practices in short time periods, where mindfulness can be sustained and have clear instrumental value (cf. Badham & King, 2021). There are a few studies focusing on the short-term perspective, namely short group decision-making chat sessions (Bartelt & Dennis, 2022; Curtis et al., 2017). These studies have, however, used a quantitative approach, which does not allow for understanding the collective mindfulness practices and their unfolding, which has been studied qualitatively in longer studies (e.g. Aanestad & Jensen, 2016; Carlo et al., 2012; Salovaara et al., 2019). A study focusing on short-term situations will allow for a more nuanced investigation of collective mindfulness practices than the long-term processes, where mindfulness can be observed on a more abstract level.

As neither groups nor individuals cannot be constantly mindful, they have to be sometimes less mindful or even mindless to be able to achieve mindfulness when needed (Levinthal & Rerup, 2006). Langer and Piper (1987, p. 280) defined mindlessness as "marked by a rigid use of information during which the individual is not aware of its potentially novel aspects." So then, what is collective mindlessness or a mindless organization? Weick et al. (1999, p. 39) define collective mindlessness as "when fewer cognitive processes are activated less often […], characterized by reliance on past categories, acting on 'automatic pilot,' and fixation on a single perspective without awareness that things could be otherwise." Braun and Martz (2007) connected groupthink and the bandwagon effect to mindlessness within organizations. Fiol and O'Connor (2003) described the bandwagon effect which occurs when an organization follows others in their activities rather than examining whether the technology, idea, product, or other factors actually are suitable for them. For example, following others by applying agile methods without considering their suitability for organizations (Mcavoy & Butler, 2009) is an example of a less mindful bandwagon effect. Janis (1991, p. 237) defined groupthink as the "mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members' strivings for unanimity override their motivation to realistically appraise alternative courses of action." Both bandwagon effect and groupthink contrast with the collective mindfulness practice of reluctance to simplify interpretations, in which different opinions and alternative interpretations are welcomed.

Prior literature on collective mindlessness is scattered, and empirical studies are scant. In addition to Carlo et al.'s (2012) study, Salovaara et al. (2019) studied the mindless algorithmic processing of security threats in F-Secure, a company that provides, for example, anti-malware software for devices. They found that the frame problem, in which algorithms "cannot think 'outside-the-box' or beyond the rules"

(Salovaara et al., 2019), leads to mindless algorithmic processing of emerging threats and requires varied human processes to achieve mindful detection of these threats. However, Spagnoletti and Salvi (2020) argued that algorithmic processes help humans visualize and detect threats; therefore, humans can induce mindfulness from a mindless digital platform. Teo et al. (2011) listed several examples of mindless behavior leading to IT failures (e.g., failed enterprise resource planning implementation leading to the bankruptcy of FoxMeyer, or when Toys R Us failed to be sensitive to operations and could not fulfill all online shopping orders for Christmas). This study uses the term 'less mindful' instead of the more provocative mindlessness concept, and unless otherwise indicated, the term less mindful refers to collectively less mindful behavior in this paper.

3 Methodology

I used qualitative case methodology to understand how collective mindful and less mindful behavior occur in both physical and digital game-based learning. In a Finnish university, either me or my students video-recorded student teams in EER assignments in several courses in both a physical and a digital format. This provided an opportunity to observe how teams interact and how collective mindful and less mindful behavior manifest in the interactions. The videos comprise rich and dynamic audiovisual data–including gestures, tone of voice, and facial expressions–and are suitable for analysis from multiple perspectives and aspects (van Osch & Mendelson, 2011). Video recordings allow for analysis of interactions between organizational members, such as students, as well as for studying process sequences (LeBaron et al., 2018), and it is easy to rewind particularly interesting parts of videos facilitating interpretation (VanKooten, 2019).

3.1 Context and Data Collection

Usually, game-based learning is defined as the integration of games into teaching and learning (Hamari & Nousiainen, 2015), although other examples exist (Osatuyi et al., 2018). Motivation, player engagement, adaptivity, and graceful failure are some reasons for using games in education (Plass et al., 2015). EERs are a recent addition to game-based learning research and can improve student motivation and engagement (e.g., in team building and to enhance problem-solving skills (Tercanli et al., 2021)). EERs have been used in several higher education disciplines (e.g., game architecture (Warmelink et al., 2017), pharmacology (Eukel et al., 2017), and business policy and strategy (Duggins, 2019)). Escape games often are used with teams, which collaboratively solve physical or digital puzzles within a certain time frame (Nicholson, 2018). The physical escape game can be in a box, room(s), or even in a building or throughout a campus (Tercanli et al., 2021). Collaboration is required to solve such puzzles, and discussions are required because the riddles and puzzles usually are challenging (Kim et al., 2009). Difficult tasks facilitate learning (Hamari et al., 2016), but task difficulty should not be too high, or else clues and hints should be provided so that students do not get discouraged and quit before the game is finished (Plass et al., 2015).

Collaboration within games and collective gamification have not been studied substantially (Koivisto & Hamari, 2019). Several studies have observed that games' social aspects are important and that people enjoy playing games collaboratively (e.g., Morschheuser et al., 2017; Teng & Chen, 2014). However, few studies have examined how collaboration happens or manifests itself within gaming contexts. For instance, there are some studies on EERs that touch upon student collaboration or social interactions (Makri et al., 2021; Tercanli et al., 2021), but the majority of them still focus on presenting how collaboration is enabled in EERs (e.g., Hanus et al., 2019; Peleg et al., 2019) or how students or instructors have perceived the collaboration (e.g., Gordon et al., 2019; Saltz & Heckman, 2020; Williams, 2018), instead of studying the collaboration in detail. Therefore, it is suggested that collective mindfulness could be harnessed to examine team interaction. To the best of our knowledge, collective mindfulness has not been studied in gamification before.

I designed the first EER (that I personally ever made) for a research methods course in 2018. The physical EERs were operated in three- to five-person teams in a meeting room on the university campus. I advised students to select a suitable time slot for already-established student teams, which had worked together the whole semester and knew how to communicate efficiently. The students were sent a background story one hour before the actual game began so they would have time to familiarize themselves. The story was that one person from the team had the opportunity to write a master's thesis for a company and would need to pitch the research proposal to the company board in one hour on the topic "How to avoid service interruptions in a system migration situation." However, the notes for the

proposal were missing and the team member was handcuffed to a chair, so the team should release the fellow member before the pitch starts. It is not possible to lock any students in a room on campus, like in a real escape room, so the sense of excitement was created with handcuffs, and a student volunteer was always chosen to be handcuffed, with all students reminded that they can leave the room anytime they wanted if necessary. The physical EER included four tasks: 1) select three suitable theories from 12 alternatives; 2) select a suitable methodology for the research topic; 3) select three suitable data collection methods with appropriate data samples for each method; and, 4) select appropriate data sources (e.g., documents, interviewees). The first three tasks generated a code number for a lock to reveal the next task, and the last task gave the team members a riddle (in this case, an anagram of mixed letters) for a place where the handcuff key was located. I functioned as the game master by explaining the game details and giving the team hints during the game, as well as observing their knowledge of the research method topics. The background story and correct answers were modified each semester, but the idea remained the same for all. The game was used both in Finnish-speaking and English-speaking international research methods courses. Figure 1 provides the set-up in a physical EER (left-hand side) with the clock, task agenda on the board, a suitcase containing one task, and urgency-creating handcuffs.

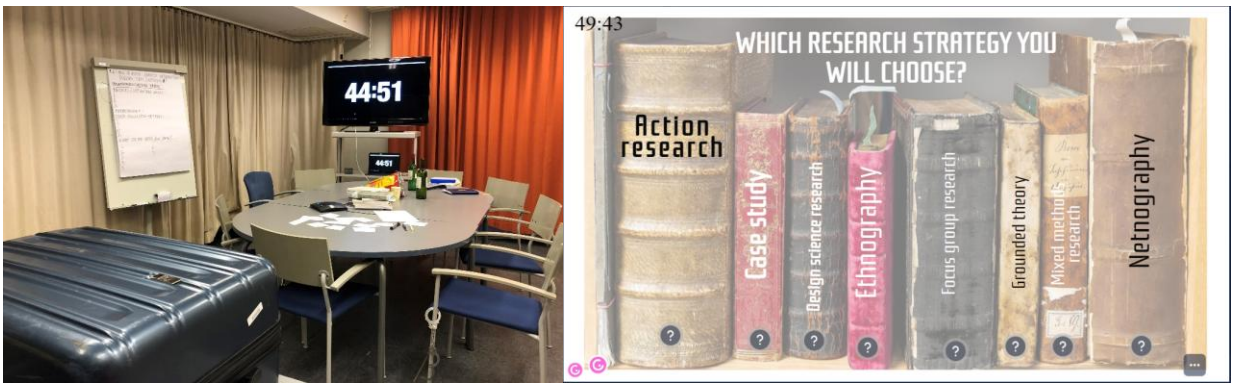

Figure 1. Physical EER and Digital EER for the Research Methods Course (images by the author).

In early spring 2020, COVID-19 required adapting the well-liked physical EER of the research methods course into a digital version. The presentation software Genially had introduced gamification presentations, including escape room presentations, and was used. On the right-hand side of Figure 1, a screenshot of the first task in the digital EER is provided, mimicking the methodology books on the physical EER's table. Each book represents a research strategy choice, and each question mark provides more information and a hidden code word for the particular methodology or method. During April 2020, the digital game was piloted with colleagues and based on these experiences, previously established student teams were strongly encouraged although this recommendation was not always followed. The storyline was renewed to make the game more engaging because the thrill of handcuffing one team member was not possible online. Instead of pitching a master's thesis, the team had to solve a robbery of research results from a university. Although the digital EER employed the same types of tasks, the sequence of the tasks was mixed: 1) select a suitable methodology to solve the robbery; 2) select three suitable data collection methods to solve the robbery with appropriate data samples for each method; 3) select three suitable data sources (e.g., interviewees, data to observe) to find the thief; and, 4) select three suitable theories that could explain the thief's behavior. The storyline was sent to students an hour before the game and I acted as the game master while observing learning and giving technical and (if asked) content hints.

Both EERs used in the research methods courses were used as an exam to gauge what students learned during the course, but the exam was just 10% of the course grade, with the final essay and other assignments comprising 90%. The students were given the instruction that the quickest team to escape with reasonable explanations or logic behind their selections would win, and would be awarded the highest marks. Thus, the teams competed against each other, which ensured that students did not reveal exam details to others. Two teams did not pass the exam in time, while the best teams escaped in approximately 25 minutes.

Considering that the digital escape room worked quite well, I also designed a digital EER for a Management of Information Security course, comprising 60 students in four- to five-person teams familiar with each other from previous course assignments. They were placed in simultaneous and separate Zoom

breakout rooms; thus, I could not attend all the sessions. Therefore, the game had to be designed to be sufficiently intuitive for students to pass the game exam without a constant teacher presence. The game also included four tasks to test students' knowledge, applying learned content in the course related to, for example, business continuity and reasons behind non-compliance. One task required the teams to write a word based on hints, and three other tasks had several multiple-choice questions, testing the application of knowledge in a quiz-like setup. After each task was completed, the students received two letters, and in the end, they would combine the letters into a final word. I gave the class instructions on how to find the game and proceed, then the student teams were distributed into breakout rooms on Zoom, in which one student shared the screen for the others and, if every team member agreed, video-recorded the game session and team discussions to complete the tasks. After the team completed the tasks, the team members submitted the final solution for the game to a learning management system, which awarded students fixed points regardless of their time. Voluntary student teams recorded the sessions, and the videos were submitted to a shared folder for analytical purposes.

The three set-ups—the research methods course's physical EER, digital EER, and security course digital EER—are quite different, for example in content, but also different in the degree of teacher involvement and design. However, the interesting case here is the collaborations between students, which were video- and audio-recorded, a similarity in all three set-ups and the object of study. The context, analysis, and results have been described in rich detail to give the reader the opportunity to "audit" the research process (cf. Lincoln & Guba, 1985). Furthermore, I have observed these collaborations for a long time, in several different courses, which also can be viewed as source triangulation. The data set is large, but only relevant elements of collective mindfulness have been presented here in rich detail.

To sum up, the videos were gathered from three different courses from spring 2018 until spring 2021, three with physical EERs and four with digital EERs. Altogether, 107 students participated in the analyzed sessions on 28 teams. In Table 1 below, the data used for the study are summarized. All video recordings were voluntary and consent for video recording for research purposes was obtained from each member. One student team did not agree to recording and two student teams did not record the session by themselves in the Information Security course. More videos were available from these courses, but because a saturation point was reached in the analysis eight videos were not analyzed and were excluded from the data set.

Table 1. Data Used in the Study

Course	Course format	Participants	Amount of data
Research Methods, fall 2018	Physical EER with teacher	8, 4 per team	2 videos (65 min 58 s)
Research Methods, fall 2019	Physical EER with teacher	20, 3–4 per team	6 videos (252 min 20 s)
Research Methods, spring 2019	Physical EER with teacher	7, 3–4 per team	2 videos (85 min 38 s)
Research Methods, spring 2020	Digital EER with teacher	10, 3–4 per team	3 videos (138 min 30 s)
Research Methods, fall 2020	Digital EER with teacher	17, 4–5 per team	4 videos (153 min 14 s)
Management of Information Security, fall 2020	Digital EER without teacher	35, 4–5 per team	8 videos (177 min 25 s)
Research Methods, spring 2021	Digital EER with teacher	10, 3–4 per team	3 videos (114 min 17 s)
All material combined		107 students	16h 27 min 32 sec

3.2 Data Analysis

The data analysis began by inductively coding the team activities and behavior in the EERs following open coding (as in grounded theory) of video data (VanKooten, 2019). I first watched some of the videos without taking notes, and some patterns emerged, so I began narrating teams' interactions and activities briefly while also paying attention to team members' roles, sometimes transcribing interesting statements or gestures with time stamps. Thus, the unit of analysis was the activities of team members, including verbal interactions, which were relevant to team performance in the game. Some typical activities during the first phase were silent reading, pointing, or writing on paper. Interactions between team members, for example, touched upon excluding some alternatives, suggestions, discussions, task verifications, etc.

After some physical EER videos had been coded, I found that the activities in digital EERs differed, at least partly, so these videos were coded. Similar activity patterns emerged in the digital setups, and similarities and differences between the digital and physical EERs were observed. Some activity patterns, on an operational level, were related to the task at hand, while others were on a more tactical level, related to the game as a whole. Some of the activities did not seem to benefit the team, so the codes were re-examined. I had previously noticed collective mindfulness as an interesting theory, which allowed me to connect the activities with mindfulness practices. At this point, Carlo et al. (2012) served as an inspiration for emerging mindful and less mindful poles of the practices because only a few articles reported detailed analyses of the practices. For example, verification of a task objective was categorized as "awareness to risk taking," or a suggestion to crack a lock (opportunistic behavior) was categorized as "commitment to resilience". This required also a re-analysis of the data, and after transcribing relevant parts of six representative teams' puzzle-solving processes, I was able to further clarify the coding with NVivo (see the coding table in Appendix A).

Then I turned my gaze toward the differences between physical and digital EERs, adding them to the analytical document, which ultimately was 45 pages long. To clarify the differences, I eventually transferred the codes and examples in which the code was presented (course, team, and task) to a mind map, creating separate mind maps for physical and digital EER analyses. The original analytical document was examined carefully to ensure that all possible codes were presented on the mind map. After reorganizing the codes and clustering each code into categories, the mindfulness practices were introduced to the mind maps, and categories were linked to respective practices. The sequential analysis clarified the end result presented in the following section because I perceived the differences and similarities between set-ups more clearly. This observation facilitated the interpretation of data and connected observations to mindfulness practices.

4 Empirical Results

The students coming to the research methods course EERs received in their background story a couple of ground rules. One of the most important rules was: "The winner is the team who does the operationalization tasks and finds the [handcuff] key with the hints fastest and with the best reasonable explanations." The puzzles had to be solved sequentially, in a certain order, to advance to the next puzzle, so there was not much room for simultaneous puzzle solving (Tercanli et al., 2021), although in the physical EERs some students could find locks while others still solved puzzles. The teacher explained the structure of the game to the students and in the physical setup the structure was also presented on a flip board (visible constantly), and in the digital version, the structure and team progress was shown before every new puzzle. The teacher also explained to students before starting the game, how much time they could use for each task and if they had to reserve more time for a certain puzzle.

The security course EERs also had a 45-minute time limit, but they were designed to be simpler multiple-choice question-based and student teams were usually able to do them in 17 to 26 minutes. The teacher explained the game idea in a lecture and then student teams were able to do the game independently in breakout rooms. The teacher visited the breakout rooms one at a time to see progress and facilitate sessions.

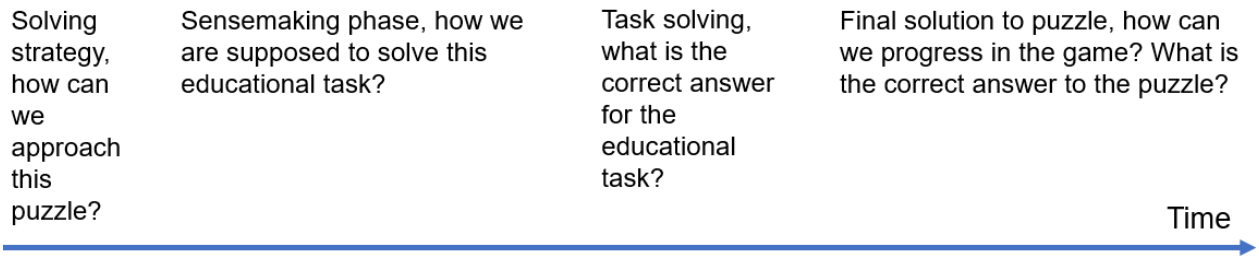

Figure 2. Puzzle-Solving Phases in EERs

Regardless of the set-up, the solving strategy of a puzzle had some similar phases between the teams (see Figure 2), but how much discussion and time each phase took differed. Each puzzle contained an educational task and a game-like element, such as finding a code for a lock. Usually, the team first verified the objective of the current puzzle, then they started to solve the educational task and then the puzzle by opening a lock with the discovered code (physical version) or testing a solution with a code (digital

version). This sometimes succeeded but sometimes did not, and then the team had to return to the solving phase. In the research methods course EERs, solving the puzzle often included discussions on solving strategy, silent reading and pondering, and team members suggesting solutions and justifying them, which follows the management of the attention process suggested by Bartelt and Dennis (2022). Discussions on a solving strategy involved, for example, deciding to use an exclusion strategy, discussing in which order or from which perspective the task is to be approached, summarizing the situation, or reflecting on reasons for failure. The security course EERs had similar phases, but the pace was quicker, and solving strategy discussions were shorter since students had already played some digital multiple-choice games.

4.1 Conflict Between Performance Time and Demonstrating Learning

The exams had two different goals: performance time in the exam and demonstrating learning by giving reasonable explanations for every choice. The teams did not worry much about time or balancing between the two goals, especially in the long, more complex research methods course EERs. The time aspect was mentioned in the EER background stories and the clock was very visible in the physical room on a large screen or constantly observable in the upper left-hand side corner of the digital game. Before the exam started, the teacher also explained the structure and emphasized approximately how many minutes they would have for each task or if some tasks took a long time. Only a few teams asked questions before the exam, such as about how fast other teams have been or how many teams have passed the exam in time.

However, some teams were very concerned about the grading of the exam. For instance, Jesse[1] and the team (digital RM20, team 2) asked several questions before the exam. When the teacher concluded that time is of the essence, but reasonable explanations are required to pass the exam, they continued questioning: “But it is better to do the explanations in an efficient way? Will you [teacher] say when explanations are enough?” The team had prepared well for the exam. After receiving the background story, they discussed possible methodologies and suitable data collection methods. They wanted to know and prepare for every possible detail to achieve the best results; something that very few other teams did.

The first task focused on selecting a suitable research strategy to solve the given “crime”. The screen showed a virtual bookcase with old books representing different methodologies (see Figure 1). When the task and the countdown clock appeared on the screen, Jesse and the team started systematically inspecting the bookcase from the left (from the Action research book) explaining why it would not be suitable (*Justifying suggestions*). The next book was “Case study”. Jesse said, “We discussed that it’s probably one of the best options because […]” (*Encouraging discussion, Justifying suggestions, Preparedness*). The team still explained thoroughly why they would not select any of the remaining alternatives despite their preparedness, questions about efficiency before the exam, and selecting a very suitable alternative. Only after this systematic exclusion did they proceed to the puzzle-solving phase.

This team used the same game tactics throughout the exam (*Acting as in previous tasks*). Only after finishing the second task did Carey remind the team about time (*Minding the exam status*), which others recognized. The systematic exclusion (*Game tactics*) continued: team members challenged each other if not satisfied with the explanations of others:

> *Kris then suggests the fifth option, since there is a question and a 'rambling' answer (Justifying suggestions), but after a short silence (Silent reading and pondering), Carey challenges that idea "But it also could be a structured interview."* (Challenging others)

The team spent a long time on the third task and had only seven minutes remaining for the last task. Carey reminded them of time on several instances (*Minding the exam status*), and Kris tried to hurry, but Jesse still wanted to read every piece of information (*Game tactics*). After they tested one wrong code, Kris *noticed a new clue*, and they concluded that they would have to choose an option “having a smaller number than seven” (*Game tactics*). Yet, Jesse wanted to see the last two options, numbers 11 and 12, Carey said "I’m getting nervous" and showed the options Jesse asked for. Carey was not convinced about them (*Discussing, sensemaking together*), and Kris reminded them that they had to pick some options from the beginning of the list (*Game tactics, Instructing others*). Finally, the team was not able to settle for any option, so they opportunistically tried all of them (*Improvising*).

[1] Names have been anonymized and made gender neutral.

This narrative illustrates the fluctuations in the team's mindfulness between the performance time and demonstrating their learning. Focusing on both goals simultaneously was difficult. According to Weick et al. (1999, p. 37), mindfulness is defined as the "capability to induce rich awareness of discriminatory detail and a capacity for action." In this context, if the team focused (action) on logical explanations (detail), they would not be able to concentrate as much on performance time (another detail). Levinthal and Rerup (2006, p. 506) argue that "the depth and breadth of what they are mindful is likely to vary," and since attention is limited, it has to be used thriftily. Despite knowing the correct answers to the first two tasks due to pre-exam discussions, the team continued to systematically exclude the remaining alternatives, valuing demonstrating their learning over the time it would take. Even when the time was running out in the last task, they wanted to review all available information and explain their reasoning. They relied on their established routines, such as excluding alternatives or justifying arguments, which they had previously used to solve problems in other contexts. Combining these established routines and each team member's knowledge in novel ways enabled teams to solve mindfully and innovatively new problems.

But when that tactic did fail, they tried to beat the clock by testing all the possibilities without explanations. From the perspective of performance time, testing all the possibilities opportunistically was very mindful behavior, but less mindful from the demonstration of learning perspective. As we can see from the narrative, the timekeeping in these EERs fell often on only one team member, in this case, Carey. Although she contributed to the reasonable explanations too, as the chosen "team leader" who controlled the screen, maybe she felt obliged to keep the time. The same specialization of a team leader as a timekeeper was observed in other teams, at least when the time was running up. Choosing the team leader was in every EER team a very democratic process, seldom anyone volunteered to be a team "leader", but other team members had to convince one to become one. The handcuffed team leader (in physical EER) could not move but could participate in puzzle solving, and maybe they saw keeping time as a possibility to contribute to team performance when others were finding the lock.

In the security course EER, the teams were usually able to complete the game quite quickly and therefore the performance time was not a concern or conflicting goal to most teams. In one team though, Sam, the team leader, clicked on the next slide because he apparently finished reading the instructions, although a team member had just asked him to wait until the others finished reading the text. Sam also quickly chose options on multiple-choice questions without pausing to think about whether everyone agreed, or providing any kind of justification for the choice. One team member asked how many times they could try to answer the question correctly and Sam assumed that they had an indefinite number of tries in the game so he probably did not perceive any risks in trying several times. Another team member tried to engage everyone in a discussion, but Sam was just clicking on options whenever he heard any suggestions later mentioning that he was very concerned about the time limit.

The conflict between performance time and giving reasonable explanations was observed in both environments, there was no difference between physical and digital EER teams. Most teams started to mind the exam status only when the time was running out but some teams were more concerned about the time throughout the game. For instance, some asked "Do we get sanctions if we choose some wrong option?" (physical RM20, team 1), and some asked for more time when they discovered an inconsistency between the game and background story (digital RM19, team 3) or they struggled with maximizing the digital game window for 30 seconds, etc. (digital RM19, team 1).

4.2 Conflict Between Team Performance and Individuality

Teams had different approaches to puzzle-solving, some discussed very actively, but some were more reflective. The reflectivity manifested mainly as silent reading and pondering, and it was particularly observed in the digital EERs. In the following narrative, three other team members remained mostly silent when the team leader Evan and Kai discussed the solution (digital RM20, team 4):

> *On the page, there are 7 pictures of different kinds of data, such as interview transcripts, comma-separated values of a survey, observation codes, log files, and the question "So what kind of data would you get with semi-structured interviews?" The team was silent (Silent reading and pondering), and then Evan pointed at the survey and log file pictures and said "At least not this one or that one" (Game tactics). Evan then asked whether the others saw the mouse moving and Kai confirmed seeing it (Discussion of solving strategy, Game tactics). Others were still trying to silently ponder, but Evan speculated "Isn't this one narrative?" (Encouraging discussion), and others agreed. Kai suggested the picture on the bottom left side and asked for others' opinions (Encouraging discussion) and continued to justify her argument (Discussing, sensemaking*

> *together). Others agreed (Reaching consensus) and Evan said, "Yes, let's choose that one" and clicked it. It was correct.*

Although illustrating the temporal aspect in a written format is difficult here, compared to the other teams, the pace of puzzle solving was slower in this team. The team was not discussing constantly, but they were silent often. In other puzzles, other members were participating more, but the pace was slow in those too:

> *Evan summarized the situation "So now we have two wrong answers, focus groups and narratives are not ok" (Discussion of solving strategy). Kai asked "Could it be either one of those observations?" and Frankie wondered, what was the difference between them (Encouraging discussion). Jamie contemplated "So would he then observe those guys, the participants, I don't know" (Discussing, sensemaking together). Evan continued, "Have they [those guys mentioned before] behaved in such a way when they have gotten some [research] results?" (Encouraging discussion). Jamie agreed, and Evan asked "Could it be that one?" (mouse hovered over the observation sample) (Encouraging discussion) and Kai urged her to try this alternative. Evan clicked and when it was correct, said "Nice". Others also celebrated very modestly. [After the puzzle had been solved,] Frankie said "The other observation [participant] would probably have meant that he should have been participating in the situation." (Reflecting reasons for failure/success) Kai had been pondering the same and Evan agreed with this.*

The team did not spend too much time discussing and finally they were among the fastest teams measured in performance time. The chosen team leader, Evan, and Kai were the main discussants in this EER session and sometimes Evan tried several times to get answers from team members who spent a long time mainly silently reading and pondering. All team members had their cameras on, they had been cooperating for a long time, and everybody contributed sufficiently, so any kind of free-riding due to ignorance on course topics was not observed.

But is silent pondering collectively mindful? Since the team was very quick, silent pondering might be mindful from the performance time perspective, but not perhaps from the demonstrating learning aspect. Bartelt and Dennis (2022) argue that if the information is not shared between team members, it cannot be considered in decision-making. We can see from the last example that after the team had solved a puzzle, Frankie, only then, expressed their understanding of one alternative and others had been thinking the same. Would it not help the team more to discuss the ideas aloud to demonstrate their learning? Silent pondering is very mindful individually – a person is sensitive to the new task and tries to understand the ambiguous clues (Curtis et al., 2017; cf, Langer & Moldoveanu, 2000). However, the other team members are not aware of what kind of distinctions an individual member is drawing unless they express it somehow.

The physical EER teams also read and pondered silently, but it was not so easy to stay silent as in digital EER. There certainly was more pressure to contribute to the team's performance. For example, in one team (physical RM19, team 1), Jordan and Morgan were discussing actively, but Alex still contributed by pointing to papers, moving pieces of paper to the excluded pile, and humming in agreement. In later tasks, Alex eventually started to vocalize and share knowledge, which was even better than the others. In this EER session, Alex's expertise might have been valuable already in the first task (although we can only speculate that Alex would have been able to help). Alex's knowledge did not benefit the team before they began to communicate; therefore, on a collective level, keeping knowledge to oneself is less mindful.

Since everyone's contribution was expected in the physical EER, the teams were relatively equal, despite that one member was handcuffed into a chair. Each member could become the most trusted expert, somebody who gained authority with their knowledge. The leader often invited others to contribute after the task information had been read silently. For instance, the leader might ask politely, "What would you choose? I don't want to exclude anything" (physical RM19, Team 5, Task 3) or "Any ideas?" (digital RM20, Team 2, Task 1). Those team leaders, nominally higher in the hierarchy, invited the others to offer suggestions, balancing the hierarchy. The team listened to well-explained arguments, so the decision-making was delegated to the experts.

The team leader in the digital EERs controlled the screen and game, but anyone who had insights to offer could suggest them for the problem at hand. Some team members were ignored if they did not seem to know the content knowledge or provide good justifications, or the other team members did not understand the suggestions.

In fact, individualistic behavior by team leaders was observed in digital EERs. Some participants controlled the screen when the game started, making their own decisions without listening to the others. For instance, one controller, Rory (RM20, team 1), at first did not understand what to do in one task, so they less mindfully hovered the mouse all over the screen although the others tried to explain to them what Rory should do. Then Rory had an idea about the situation: Rory surmised that the documents (as a data source) must contain the stolen research results. Others did not agree with this interpretation, but as the game was progressing well they saw no reason to challenge the idea. When it was time to select which documents they would use as data sources, Rory started to explain the selections based on their idea and did not listen to the other's suggestions. Unfortunately, Rory's idea took the team to a wrong decision and they had to discuss further to find the correct solution. This is an example of the entrenchment problem (i.e., becoming fixated on certain solutions to a certain problem and having difficulties adapting to a new task or being unable to generate new ideas (Dane, 2010; Salovaara et al., 2019)).

Individualistic behavior also was observed in the security course digital EER: One team spent more than five minutes with the first task in which they had to write a specific word as the task solution and this delay caused anxiousness. The team comprised four members, with three talkative members, provided multiple suggestions, which were tried one after another. A quieter team member, Kim, also tried to suggest a (correct) solution, but the member controlling the game did not hear his solution or even asked Kim to repeat the suggestion. Kim suggested a few other alternatives than the first (correct) one afterward and was listened to. After a long period of frustration, they finally summoned the teacher who gave one more hint after which the correct solution emerged. The others noticed that Kim had mentioned this one already, but because the controlling person did not hear it in the first place and Kim did not repeat his suggestion, they lost several minutes. The controlling person apologized for not listening to everyone and Kim was listened to more carefully later.

Individualistic behavior was less mindful from the demonstrating learning perspective and sometimes even from the performance time perspective. The team leader tried to make hierarchical decisions instead of trusting the team as a collective where team members could have different specializations and decision-making is left to the most experienced ("deference to expertise" (Weick et al., 1999)). The team leader tried to solve the puzzle single-handedly, not listening to other's suggestions. If the exam had been individual, this kind of behavior would have been very mindful, but since the team was supposed to cooperate and demonstrate their learning together, individualistic behavior was less mindful. EER is not a nuclear plant or command center for a spacecraft, where one person cannot be aware of every crucial detail, but is still a complex situation with two different goals and therefore discussion and sensemaking together, using everyone's expertise, should facilitate problem-solving.

This team was the fastest on their course despite the individualistic behavior, which took the team to a sideline. The team later managed to solve the puzzles quickly and demonstrate their learning together. Individualistic behavior harmed the team's performance from the time perspective in this puzzle, but there were other situations where the team leader controlling the screen was able to benefit the team with individualistic behavior (for instance making a decision to click something when others are still discussing).

4.3 The Process of Unfolding Collective Mindfulness in EER

A nuanced image of how collective mindfulness practices actually unfold in a short-term puzzle-solving exercise emerged when the different activities were arranged in sequence and linked to mindfulness practices used in this study (see Figure 3). The problem-solving process was similar in all settings but as mentioned earlier the time spent for different phases (in black in Figure 3) varied depending on set-ups, teams, and puzzles.

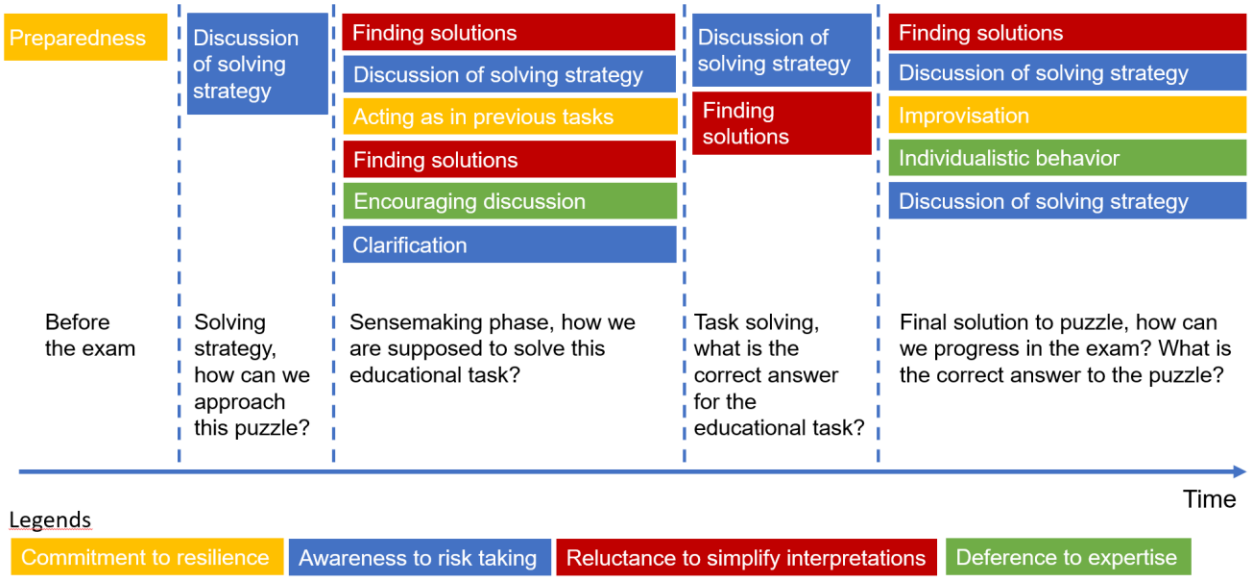

Figure 3. Puzzle-Solving Activities in EERs in Sequence, through Collective Mindfulness Practices (presented in different colors).

In addition to individual studying, some teams had *prepared* for the exams together and met before the exam to discuss their understanding or initial ideas based on the background story, which had been sent one hour before the exam session started. This kind of preparation showed the teams' "commitment to resilience". The next phase focused on a discussion of *solving strategy*, the teams wanted to ensure that every member knew the objective and how the puzzle would be solved and was aware of the risks.

The third phase, *sensemaking*, contains several activities, each mainly contributing to the educational task the team had to solve. After everyone had silently read the relevant materials, they tried to discuss the material and game tactics. Sometimes they asked some questions from the teacher and often began to solve the puzzle in the same manner as previous tasks. Members' expertise was needed and discussion was encouraged, different solutions were presented and justified, and clarifications were made. Although the activities are presented in the figure as clear blocks (sequential order from top down), the reality was more complex and the activities were sometimes in a different order or the team iterated many rounds of different activity combinations. All the different mindfulness practices were present in this phase.

The next phase was *task solving*. After some idea of how the educational task could be solved emerged, the teams often summarized the situation and continued to find the solution for all the separate parts. They justified suggestions, noticed new clues, read and thought aloud, and challenged or even ignored each other. In this phase, the "awareness to risk taking" and "reluctance to simplify interpretations" practices were most prominent.

In the last phase, *the final solution to the puzzle* was sought. When the team was happy with the solution and reached a consensus, then they tested the solution, and if it was not correct they reflected on the reasons for failure and returned to previous phases. At this final solution phase, they usually also checked the clock or their progress and if the time was running out, tried improvising. Most of the individualistic behavior by team leaders happened in this phase, they tried to progress in the game by clicking some solutions without discussion with their team. Thus, this final solution to the puzzle phase also had all the mindfulness practices present.

5 Discussion

5.1 Relativity of Mindfulness

A central finding in this study was that mindfulness seems to be relative to a goal and if there are conflicting goals, mindfulness fluctuates between these goals. The EER exams have two goals: 1) the students must demonstrate their knowledge, and 2) they must finish the exam in a limited time to pass. Occasionally, these goals seemed conflicting: Some students were so mindful of the time that they forgot

to discuss the reasons behind their selections, while others were so eager to demonstrate their learning that they had to be reminded that time was running out.

When the teams were focused on demonstrating their learning (see Table 2), they tried to find solutions to puzzles, which can be considered as part of the ”reluctance to simplify interpretations” practice in collective mindfulness. Team members for example together discussed, justified their suggestions, challenged each other when necessary, and finally reached a consensus and thus were mindfully explaining the reasoning behind their choices. Since team members had different kinds of expertise (“deference to expertise” practice), they tried to encourage discussion about some specific solution, by asking questions about other’s opinions or directly for support for their own suggestions.

The teams had to be wary of the time and sensitive to operations, but many opportunities for small failures within the tasks also were possible, which could lead to failing the whole exam. In this study, the short-term perspective of EERs complicated the separation of activities into “preoccupation with failure” and “sensitivity to operations” practices. Therefore, the teams had to have an “awareness to risk taking,” which combines the collective mindfulness practices of “preoccupation with failure” and “sensitivity to operations.” We define “awareness to risk taking” as heightened situational attention to risk taking and analyzing failures, but also near-misses, to create an overall picture of the situation. So, when they were demonstrating their learning, they had ”awareness to risk taking”, when they gave some clarifying content-related instructions to others, and discussed the puzzle-solving strategy by summarizing the situation and reflecting on reasons for failure or success.

Table 2. Activities or Interactions Facilitating the Team in Demonstrating Learning

Collective mindfulness practice	Category	Code
Awareness to risk taking	Clarification	Instructing others
	Discussion of solving strategy	Reflecting on reasons for failure/ success
		Summarizing the situation
Deference to expertise	Encouraging discussion	
Reluctance to simplify interpretations	Finding solutions	Challenging others
		Discussing/sensemaking together
		Justifying suggestions
		Noticing new clues
		Reaching consensus
		Reading and thinking aloud

When the teams focused on their performance time, they did other kinds of activities (see Table 3). They had a different kind of ”awareness to risk taking”: they minded the exam status (time or progress in the exam), verified the objective of or tested a solution to a particular puzzle either together or from the teacher. They interacted with the teacher, asked clarifying questions about technical matters, or even asked for more time opportunistically. They also clarified to each other their behavior if an individual team member did something unexpected or pointed out solution alternatives on paper or on screen. Some discussions on game tactics were related to time-saving, for instance when the team decided to gather excluded puzzle pieces on one pile and possible alternatives to another so that they could focus on a smaller set of alternatives.

Some activities showed that the teams were committed to resilience. For instance, when teams improvised by opportunistically trying all possible numbers from the last slot of a number lock, when the first four numbers were solved already, or clicked through all possible alternatives on the screen when no reasonable solution had been found. These activities were not demonstrating their learning, but perhaps their innovativeness. Also, some teams adopted a routine and tried to act as in previous tasks throughout the whole game, for instance trying to find numbers in every puzzle for a code lock, although no numbers were given.

However, some activities had a dual role and could be mindful both from the performance time and the demonstrating learning perspective. For instance, coming prepared to the exam and vocalizing it during the exam demonstrates the team members’ learning, but on the other hand, it could shorten the performance time, since the team would not have to spend time to reach a consensus during the exam. Also, some discussions of game tactics, such as suggesting that the team systematically discusses all alternatives to exclude less relevant ones, is aimed to demonstrate learning. And, sometimes, mainly in a digital EER, the team leader behaved very individualistically and wanted to demonstrate their own learning instead of relying on the team. However, some individualistic behavior also saved time for the team, for

example when team members were discussing extensively some solution and the team leader clicked before there was full consensus on a correct alternative making the decision based on their own expertise.

Table 3. Activities or Interactions Facilitating the Team in Performance Time (orange) or Both Goals (yellow).

Collective mindfulness practice	Category	Code
Awareness to risk taking	Clarification	Explaining behavior
		Pointing
	Discussion of solving strategy	Game tactics
		Minding the exam status
		Verification of objective
		Testing solution
	Interaction with teacher	Asking teacher
		Asking for more time
Commitment to resilience	Preparedness	
	Improvisation	
	Acting as in previous tasks	
Deference to expertise	Individualistic behavior	

Thus, while the teams were performing their activities, their attention fluctuated between the conflicting goals, performance time, and demonstrating their learning. It cannot be concluded that ”awareness to risk taking” practice leads to better performance in either of the goals, but some activities were more mindful from the performance time perspective and other activities were more mindful from the demonstrating learning perspective, and some could be mindful for both goals. All the observed activities were required to pass the exam with two goals, but the teams seemed to be more mindful about demonstrating their learning and were less mindful or “forgot” about the time in their interactions until the time started to run out. When teams had only a few minutes or seconds left, some teams became overly concerned about the time and were less mindful or “forgot” about demonstrating their learning and started to improvise, mathematically deduce, or use other means to pass the exam in time without vocalizing their learning aloud. As Levinthal and Rerup (2006) argue, in order to be mindful at times, it is necessary to be less mindful and rely on routines such as timekeeping.

Similar fluctuation was observed in team performance versus individual behavior. Our main focus is on the team level and we could observe that most activities were very mindful collectively and they benefited the team’s performance. However, teams are a mixture of individuals, who more or less advance the team’s efforts for various reasons (see Table 4). Some might be better prepared for the exam than others, uninformed team members may lead the team in the wrong direction and knowledgeable participants could facilitate the puzzle-solving. In some digital EER teams, individualistic behavior aimed to demonstrate a team leader’s knowledge, but more often, this activity was not communicated properly to the team, ending in confusion and going in the wrong direction, which then took more time to remedy. Silent reading and pondering are very mindful from an individual perspective and all teams did this usually at the beginning of each puzzle. One focuses on the problem at hand while trying to categorize new information (Langer & Moldoveanu, 2000). However, in problem-solving, silence is not viewed as a collectively mindful strategy with negotiation (Weick et al., 1999) and information sharing (Carlo et al., 2012) required for mindfulness. The team collectively is trying to solve a problem—not as individuals, but as a team. A team member’s tacit knowledge should be socialized in this shared EER experience, externalized or made explicit, thereby allowing for combining this knowledge with other team members’ knowledge (Nonaka et al., 2000). This allows for collective team action, as well as the creation of team culture and routines (Erden et al., 2008), which are needed in EERs. Sometimes, the team members ignored each other’s suggestions or arguments although they might have had good ideas even if those members were at the time very focused on discussing their own ideas that later proved wrong.

Table 4. Activities and Interactions Benefiting Individuals Rather than Teams

Collective mindfulness practice	Category	Code
Commitment to resilience	Preparedness	
Deference to expertise	Individualistic behavior	
Reluctance to simplify interpretations	Finding solutions	Silent reading and pondering
	Ignoring others	

Thus, mindfulness could be considered relative to a particular goal. In this study, the relativity of mindfulness was observed on two different dimensions. First, teams were mindful either in demonstrating their learning or in their performance time in a single point of time and respectively less mindful about

performance time or demonstrating learning. Second, some activities were collectively mindful and aimed to benefit the team performance (both temporally and content-wise), but some activities were not benefiting the team performance directly and therefore might be considered less mindful. On the other hand, these activities might then be considered mindful on an individual level.

5.2 Differences between Physical and Digital EER Set-ups

More similarities than differences were found between the physical and digital set-ups in collective mindfulness activities. The relativity of mindfulness was observed in both physical and digital EERs. In all set-ups, teams immersed themselves in the game and occasionally forgot the time constraints. Immersion in games is typical, although it does not necessarily improve perceived learning (Hamari et al., 2016), at least in single player games. However, in EERs, a team discusses and justifies suggestions, which might exert a different effect on perceived learning. Some observed differences in physical and digital setups are mentioned in Table 5.

Table 5. Differences Between Physical and Digital EERs.

	Physical EER	**Digital EER**
Visibility of people affects equal participation	Rich media (facial expressions, and bodily cues) allows even silent members to participate. Free-riding is not so easy, which facilitates collectively mindful puzzle solving.	A silent team member can be ignored or they can free-ride more easily, and then not all collective knowledge is used for puzzle solving.
Control vs. equality	Chosen leader was handcuffed to a chair and thus not as mobile as other members. Team members were more equal and everyone could claim a leadership position.	Person controlling the mouse has a clear leadership position. Allows more individualistic behavior, which can be seen as less mindful ”deference to expertise”.
Visibility of materials affects equality	Not all team members were able to see all the materials simultaneously and equally. Awareness of the exam status then was different for some participants, which was less mindful collectively.	Everyone saw materials almost simultaneously, leveling the field and allowing discussion. Awareness of the exam status thus was similar for each participant, which facilitated mindful puzzle solving.
Clicking through vs. verification with the teacher	Instead of trying to open the lock with the discovered code, the teams asked for verification from the teacher. The team was highly attentive to ”awareness to risk taking” practice.	”Awareness to risk taking” sometimes vanished, since there were no severe consequences from clicking wrong alternative.

Collectively, mindful puzzle-solving with engagement by all team members was easier in the physical setup. Seeing all participants, their facial expressions and bodily cues, instead of hearing only their voices and tone was one significant difference between physical and digital EERs. Only a few digital EER teams used cameras, but even when the camera was used, equal participation was clearer in physical EERs than in digital ones. In a physical setting, everyone was able to participate by pointing to solutions, finding locks, etc. However, it seemed that in many digital teams the team leader had to continuously encourage discussion or some team members were not as active as others. We do not know whether the reason behind less active participation in digital environments was related to Zoom fatigue (Toney et al., 2021), lack of content knowledge, or something else. Przybilla et al. (2021) reported a lower degree of interaction and reduced creativity while observing collaborative virtual teams during COVID-19 distance learning, even with video. It was common in both settings that the verbal activity of participants varied between the tasks, but the silent members in digital settings were not contributing to the team effort in any way. In a short 45 to 50 minute EER every member’s knowledge would facilitate puzzle-solving, as Levinthal and Rerup (2006, p. 506) point out “To prevent cognitive overload, the complex, unfolding tasks are often shared by several individuals or groups.” The problems in technology-mediated collaboration and decision-making have been observed also by Curtis et al. (2017) and Bartelt and Dennis (2022).

Another difference between the physical and digital set-ups was that in digital EERs, the materials were more equally visible to everyone than in the physical set-up, which enabled mindful puzzle-solving. Some physical EER puzzles had three to five team members around one paper, which does not allow equal visibility of the material to each. Especially the handcuffed or remotely participating persons who could not see all the materials, they were easily ignored if they remained silent. The visibility of the materials affects

the “awareness to risk taking” practice because, without all information, it is difficult to know what the current situation is or to contribute to it (cf. Carlo et al., 2012; Curtis et al., 2017). An equal field and equal opportunities for each team member permit equal game experience empowering all players (cf. Plass et al., 2015). However, occasionally technical set-ups resulted in different latency for each participant in the digital set-ups creating unequal access, but after the latency had been noticed by the team leader it was usually accommodated.

The third clear difference was that digital EER allowed the team leader’s individualistic behavior, and when that happened, puzzle-solving was less mindful collectively. The team leader shared only the screen and controlled the game since the technology used did not allow for multiple controllers. EERs require collaboration, which, in these digital designs, gives more control to one person, thereby allowing for individualistic behavior. Individualistic behavior was not common but happened in some teams. In contrast, the physical EER was more similar to a multiplayer game since the voluntary team leader was an honorary title at best. In the physical EER, every player was able to equally participate and a knowledgeable person might become the *de facto* team leader to whom everyone listened. Some team members in physical EERs also behaved individualistically, but, for instance, searching for a lock when others discuss solutions was aimed at team benefit. Thus, the equality of participants enabled the ”deference to expertise” practice to occur in the physical set-up. Mindful organizing does not require a hierarchy, but real experts or the entire collective can make decisions (Weick et al., 1999).

The equality of participants is the key to mindful puzzle-solving in the EERs. When all participants see each other and the materials and are able to participate alike with no person controlling the game more than anyone else, the puzzle-solving and decision-making become very democratic. The team can rely on each other’s expertise and all members are aware of what kind of risks they are taking since their situational awareness is as high as their ability to act. In fact, the definition of collective mindfulness “is as much about the quality of attention as it is about the conservation of attention. It is as much about what people do with what they notice as it is about the activity of noticing itself” (Weick et al., 1999, p. 37). Therefore, an ideal EER might combine physical presence with digital elements, perhaps with augmented or virtual reality.

Teacher presence affected some team behavior. Physical EER teams seemed to have more ”awareness to risk taking” when a teacher was present since almost all puzzle solutions were tested with the teacher before the team tried opening the lock. Locks were hidden in a large room, although in plain sight, and it is possible that the team found it easier to ask the teacher sitting close by for validation than it was to find the lock and try to open it. However, in digital EERs the “locks” were clicks on the screen and failing to click the wrong alternative did not result in significant failure in the puzzle. This kind of testing correct solutions by clicking was especially noticeable in the security course EER, where the teacher was not monitoring the team, but this occurred also in the digital research methods course EER while the teacher was watching and demonstrating learning was mandated. Small failures in a task easily become non-events (Carlo et al. 2012; Weick et al. 1999). Further, the design and especially teacher presence in different set-ups also affected team behavior. Digitizing, making a digital copy of a physical EER, is difficult, but requires a slightly different design to capture the game’s essential elements such as an engaging storyline, competitive elements, and a sense of urgency (Tercanli et al., 2021; Veldkamp et al., 2020).

To sum up, the digitalization of EERs on the one hand leveled the playing field when all material was equally visible to everyone, but on the other hand created possibilities for unequal participation by allowing the individualistic behavior of team leaders and freeriding of other participants. These differences can affect the collective mindfulness of the teams. However, only some digital teams took advantage of these possibilities, many teams aimed for equality in every stage of the exam and behaved as the physical EER teams. Therefore, collective mindfulness was possible in both digital and physical setups.

6 Contributions of the Study

6.1 Theoretical Contributions

This study’s objective was to understand how collective mindful and less mindful behavior unfold in physical and digital game-based learning. Team behavior and collaboration from videos of both physical and digital EERs were analyzed. The data comprised more than 16 hours of recordings of 28 teams comprising 107 students. Three theoretical contributions and practical contributions are presented.

The first contribution is to collective mindfulness literature by demonstrating the relativity of mindfulness: collective mindfulness must be determined in relation to the activity's aim. The same activity or behavior can be collectively mindful from one perspective and less collectively mindful from another (e.g. if conflicting goals are present). Conflicting goals are common in games, particularly in escape room games, in which time pressure can force eager participants to find workarounds to avoid using content knowledge. In our study, some students wanted to demonstrate their knowledge more than escape the room quickly; therefore, thorough explanations and justifications were mindful from the demonstrating learning perspective, but not from the time perspective. As Carlo et al. (2012) explained, collective mindfulness (and mindlessness) is a process, but our study extends this with relativity: Depending on the perspective, interpretations of behavior may differ, as presented in Tables 2, 3, and 4, but as Levinthal and Rerup (2006) noted, achieving mindfulness also requires less mindful activities because a continuous state of alertness is virtually impossible to reach.

Second, the paper shows how collaboration within teams is different in digital and physical escape room games and what kind of impact the digital environment has on collective mindfulness. Teams can be collectively mindful in both digital and physical EERs, but some team members were less actively participating in the discussion in the digital set-ups (cf. Przybilla et al., 2021) when participants in a physical EER were equally active. Further, this kind of design based on online presentation software does enable individualistic behavior by the team leader and, therefore, a multiplayer EER would make the game more equal. Thus, the equality of participation seems to affect collective mindfulness, since the less active members might have more useful expertise for problem solving.

Finally, the paper portrays a detailed, sequential description of how collective mindfulness unfolds in a collaborative short-term problem-solving situation. To the best of my knowledge, this is the first attempt to present how collective mindfulness practices actually are unfolding in a temporally short problem-solving situation with this level of detail. Curtis et al. (2017) and Bartelt and Dennis (2022) have studied short-term problem-solving with different technological tools, and their analysis focused on decision-making and managing attention that they studied quantitatively with experiments. The qualitative video analysis applied in this study allowed focus on all activities that emerged during the EER sessions. According to prior research, mindfulness is fostered in "reluctance to simplify interpretations", "commitment to resilience", "deference to expertise", "preoccupation with failure", and "sensitivity to the operations" (the last two are combined into "awareness to risk taking" in this study) of interrelated practices (Sutcliffe, 2011; Weick et al. 1999). This interrelation was clarified in this study by creating a detailed description of activities in different phases of problem-solving. As the information systems research community continues to be interested in mindfulness (e.g. Bartelt & Dennis, 2022; Guan & Hsu, 2022), this kind of nuanced representation may facilitate the operationalization of collective mindfulness.

6.2 Practical Contributions

The study also has practical contributions. First, this study demonstrates to instructors that game-based learning, gamification, and educational escape rooms can be valuable parts of teaching and even lead to collectively mindful learning on specific topics. The time pressure in EERs encourages team members to focus and discuss (i.e., collaborate). It cultivates the joy of improvising and collaborative learning, neither of which are typical in assessment situations. Thus, collaborative learning in a gamified group exam may extend the learning process to the exam session, unlike with individual exams in which a student writes all the gathered knowledge to exam questions and later receives perhaps only a grade without any comments. Therefore, designing collaborative games with limited time would be recommended. Even quizzes such as Kahoot, without the escape room setting, discussed among a team may elicit this effect. There seem to be limits to team sizes, as three- and four-person teams are suitable, but teams comprising five or more enable free-riding (Järveläinen & Paavilainen - Mäntymäki, 2019). This study also points out that instructors may need to use or design such digital games where all participants are equal. For example, students might be encouraged to prepare as a team to take the exam, possibly leading to dividing up study areas, with team members assigned to groups, then collaborative learning might become more central.

Further, digital EERs should entail some sanctions for wrong answers to keep the teams more sensitive to failures and to discussing their choices thoroughly before mindlessly clicking buttons. This also would present knowledge better, perhaps making the EER more escape-room-like instead of quiz-like, although the enjoyment aspect might be decreased. Furthermore, video-recording EERs is a good way to evaluate knowledge because some participants may not be noticed during the hectic process. Finally, designing a

digital EER in which all players may control the game simultaneously might level the playing field even further.

6.3 Limitations and Further Research

The study was conducted in one country, with both Finnish and international teams, but one teacher designed all the games. This may affect the results in terms of teacher interference in physical EERs. EERs are also just one example of games; therefore, these results may not be applicable in other game contexts as Tsang and Williams (2012) argue. However, they suggest that empirical statements can be generalizable to theory, a practice employed here.

Although some participants were very eager to attend EERs because they were keen escape-room gamers this eagerness did not seem to affect their performance, except for one team. On this team, one member noticed capital letters as soon as the page loaded and before the others could find any capital letters he already had the “Heureka” spelled out. This also could be viewed as individual mindfulness. Further research might examine the interplay between individual and collective mindfulness in a gamification environment as Fraher et al. (2017) did within the U.S. Navy SEALs.

Another future avenue might be to study how collective mindfulness and less mindful behaviors actually affected game performance. This analysis was not included in this paper, but the videos allow for analyzing this as well. Although noted earlier that sharing information and communicating together were essential, initial results seem to indicate that communication was limited, as some successful teams were rather silent and communicated only minimally.

Acknowledgments

I’d like to thank the anonymous reviewers, associate editor, and encouragement of Editor-in-chief, Professor Fred Niederman. Further, PhD Markus P. Zimmer’s comments helped me to finalize the manuscript.

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Appendix A: Coding Table with Exemplary Observations or Quotes

Theme	Category	Code	Example observation or quote
Awareness to risk taking	Clarification	Explaining behavior	First person summarizes "Let's try what we get from here, there could be some word here." Second person wonders "Really?" and the first person starts to list the underlined letters "S-O", at this point the second person notices the underlined letters. (RM2019, g5, t4)
		Instructing others	Somebody asks what grounded theory is, and another one explains it (RM2018_Fall, g2, t2).
		Pointing	Someone points at the survey sample and log file and says "At least not this one or that one." (RM2020_Fall, g4, t3)
	Discussion of solving strategy	Game tactics	"Let's make piles for those theories that are surely not suitable" (RM2019_Fall, g3, t1). "Don't click yet; let's think first" (RM2020_Fall, g3, t2).
		Minding the exam status	Minding the time (RM2020_Spring, g2, t3).
		Reflecting reasons for failure / success	After making choices about data sources, one team member notices that some letters have been underlined. The team gathers the underlined letters, and they noticed that the letters do not make any sense, so they return to select new data sources (RM2019_Fall, g1, t4).
		Summarizing the situation	A quiet member asks, "Have we selected the correct methods already?" Another says that two have been selected, but what might be the third one? (RM2019, g1, t3).
		Testing solution	Checking the first three theories with the teacher, who confirms that one is correct. Afterward, suggesting two replacement theories, which are incorrect again. "That was a knockout" (RM2019_Fall, g2, t1).
		Verification of objective	"Do we get minus points if we guess wrong?" (RM2020_Fall, g1, t2).
	Interaction with teacher	Asking teacher	Someone asks, whether she can try an option and teacher confirms. (RM2020_Spring, g2, t3)
		Asking for more time	"The texts come with a little delay [due to Wi-Fi speed differences]; could the clicking person wait for a while" (RM2020_Fall, g2, t4)?
Commitment to resilience	Preparedness		Someone has studied for the exam and has notes (RM20202_Spring, g1, t2). Someone has pen and paper while others do not (RM2020_Fall, g3, t1).
	Improvisation		Logical reasoning of calculations (numbers must add up to double-digit numbers, which limits possibilities) (RM2018_Fall, g1, t3).
	Acting as in previous tasks		The team is looking for numbers until they notice that the paper does not contain any. A silent member notices the underlined words (RM2019_Fall, g2, t4).
Deference to expertise	Encouraging discussion		"What would you choose?" someone asks because she does not want to exclude any alternative (RM2019_Fall, g5, t3).
	Individualistic behavior		Making combinations between listed methods and listed data samples to a paper by himself: "We just have to do something" (RM2019_Fall, g2, t3)
Reluctance to simplify interpretations	Finding solutions	Challenging others	A knowledgeable person challenges a justified solution by a less-knowledgeable person without justification and is listened to (RM2018_Fall, g1, t3).
		Discussing, sensemaking together	Asking for clarification from others: "What are the design requirements" (RM2019_Fall, g1, t4)?
		Justifying suggestions	The background story is read repeatedly because it mentions "surveillance cameras seemed perfectly all right"; selecting camera videos as a data source is not logical (RM2020_Fall, g3, t3).
		Noticing new	Someone noticed that a suitcase is unexpectedly in a

		clues	normal meeting room (RM2019_Fall, g1, t2).
		Reaching consensus	Someone makes a suggestion without justification, then another one makes a counter-suggestion with justification, so the counter-suggestion is selected by consensus (RM2020_Fall, g4, t3).
		Reading and thinking aloud	After silent reading, the team leader starts to read aloud (RM2019_Fall, g5, t2).
		Silent reading and pondering	Someone asks about the markings at the bottom of the paper (placeholders for calculations). Silent pondering after finding a few solutions. The teacher hints about the second column, then they figure out that they must combine numbers from the columns and calculate the code (RM2019_Fall, g3, t3).
	Groupthink		Someone explains why action research might be the one, and other team members utter agreeing sounds without any discussion (RM2022_Fall, g1, t1)
	Ignoring others		Clicking through alternatives, when someone says, “No, no, no” and tries to stop her from making a mistake (RM2020_Spring, g3, t3).

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