

Framing self-organized online team collaboration in a higher education course on Informatics and Society

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Abstract— This Full Paper in the Innovative Practice track describes a new approach towards online agile teamwork in a higher education context. The presented learning format is based on the agile epic bedtime story game and the concept of self-organized learning. It focuses on time-constrained teamwork, with the aim to achieve a shared result from the work of several loosely connected teams through iterative learning and feedback loops within and across teams. We previously successfully applied and evaluated this team collaboration format in onsite learning. In this online adaptation, the efficiency of this approach is complemented with team-building exercises, to somewhat compensate for the lack of social interaction that is inherent to online communication. This approach combines the idea of agile gamification in education with previous concepts of self-organized learning (S-O-L) and the container-differences-exchange (CDE) model to organize self-organization. The infrastructure prerequisites for this format are moderate: a tool for video conferencing, a digital whiteboard and a digital collaborative writing tool. The online learning format was implemented and evaluated in an undergraduate University course on Informatics and Society in autumn 2020 with 36 participating students. We conducted a summative qualitative content analysis of student reports to examine the effect this format has both on the learning experience as well as the social interaction between participants. Self-organized teamwork appeared viable for learning: Students rated the question how well it enabled them to learn the content of the course with a median of 8 on a scale from 1 (worst) to 10 (best) and a standard deviation of 1.5. Students considered iterative work in the same team productive, while communication across teams was perceived challenging. Teams established continuity in their communication, also between sessions, through freely available communication tools. The single most important factor to help social interaction mentioned by students was the use of breakout rooms.

Keywords—Self-Organized Learning, Gamification, Online Learning, CDE Model

I. INTRODUCTION

The sudden shift in university education from onsite to online learning in 2020 imposed new challenges to teachers and students alike. While we prepared an undergraduate course on computer science and society at the University of Vienna, Austria, we were seeking ways to mitigate the lack of personal interaction in an online format. Our goal was to best enable the online learning experience of students as well as to create a virtual space for interpersonal interactions. Social

interactions in universities have starkly suffered with campus life being supplanted by online learning.

The learning approach we chose makes a basic assumption: that learning can be greatly improved when people get in a playful mood, e.g. by framing the course to a playing field where teams produce something in a game-like setting. In this approach, learning is enabled by giving teams a clear learning goal and providing an adequate frame and support for self-organized team collaboration.

Agile methods have become increasingly prevalent in software development over the past decades and have spread to many other business domains, as diverse as the cosmetics and automotive industries [1]. The agile manifesto [2] which captures the main principles these methods follow, postulates (among other points) that self-organized team work, face-to-face communication and the flexibility to respond to changes are key success factors in solving complex tasks. To convey agile methods and agile principles and to foster the learning of self-organized teams, a variety of gamification approaches have emerged in the agile community.

Building on the positive experience on the gamification epic bedtime stories approach in previous semesters [3] we adapted this format to online learning. The original Epic Bedtime Stories approach is tailored for practical experience in and to improve scaled agile teamwork. Several teams create a document together in a time constrained setting. Their challenge is not only to create a chapter per team, but each team also has to meet the predefined acceptance criteria within a timeframe of typically 2 to 4 hours (Fig. 1).

In this gamification approach, one of the lecturers takes the role of the so-called creator. This person explains the objective and acceptance criteria of the document to the teams and gives regular feedback on how well this objective is met after each iteration of the document creation process.

Applying this agile approach to an educational context provides an interactive format to convey the content of the course. Additionally, it also creates a learning opportunity for students to experience time-bound teamwork and to reflect on what makes collaboration effective in reaching goals.

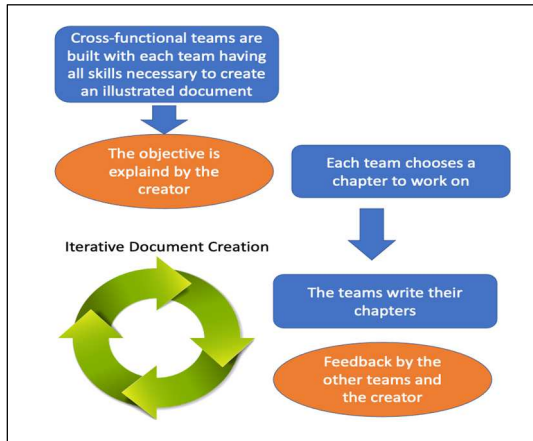


Fig. 1: Epic Bedtime Story Process

This process also mirrors the communication complexity of (small) organizations in so far as the teams have to collaborate to ensure that their combined chapters compose a consistent overall document.

To adequately frame the self-organized learning in this course we found inspiration in the container-differences-exchange (CDE) model [4] that the first author had previously used for team coaching and trainings in business contexts. This model features the concept of a container for self-organization, which is composed of organizational and technical constraints aiming to set an adequate frame for self-organized collaboration: A frame should not be too wide, to avoid communication becoming chaotic, and not too narrow to avoid dampening the creative potential of the participants. To meet that end, the frame needs to be continuously adjusted by mindfully observing the verbal and non-verbal signals coming from the learning group.

At the end of the course, we asked the students to fill out a questionnaire to learn more about our main research question (RQ1): *How can a university course be arranged to support self-organized online learning (SOOL)?* 36 out of the 38 students who signed up for the course replied. Their answers were the basis for the summative qualitative content analysis presented in this paper.

Next, we examine related approaches of applying agile methodologies and compare current online team collaboration strategies in University contexts. In Section 3, we outline our educational approach including the concept of the agile epic bedtime story process adapted to online higher education. Subsequently, we present the findings of our qualitative content analysis on students' learning experience. Finally, we discuss students' feedback in the context of the CDE model and propose suggestions for enabling learning through online team collaboration in University courses.

II. RELATED WORK

Collaboration is pivotal in industry and academic work environments. Several studies highlight that an agile learning environment can effectively support students' learning in collaboration and self-organization [5] [6]. Online

collaborative learning is challenging due to communication barriers, differing skills or expectations, or trust among team members [7] [8]. Due to the COVID-19 pandemic, didactical approaches need to be adapted or introduced to foster collaborative learning among engineering students in distance learning [9] [10] [11] [12]. Effective online education may help in building relationships and to engage students. It is based on timely personal interaction, clear communication and organization, appropriate technology, flexibility and high expectations [13]. An agile approach towards online collaborative learning can support task management and group dynamics [8]. In agile learning environments, teams work iteratively, receive incremental feedback, and discuss steps to be taken [6]. A preparation phase may support initial team structuring [14].

Gamification can already be considered an established approach in business. As far back as 1984, research on applying gameplay at work was conducted, pursuing the question "why do people put up to ten times as much energy and effort into their avocations as in their vocations?" [15]. It was hypothesized that the answer, among others, can be found in clearly defined goals, more frequent feedback and the feeling of participants that they have a higher degree of choice in games, particularly when it comes to the choice of the methods they use. All of these principles are incorporated in agile games such as Lego4Scrum [16] or Epic Bedtime Stories.

A neuropsychological perspective posits that when playing, our brains establish a particularly high number of new synaptic connections that can help unfold new potentials [17]. When we analyze communication as interaction of individuals, we can view them as "Games people play" [18]. From an organizational perspective, then, communication patterns in organizations can be seen as game rules [19]. A further step postulates that the roots and essence of organizations lie in building and strengthening social formations through games and rituals [20]. This knowledge has been extensively applied in business by using gamification approaches in team building and even organizational development. It has also been pointed out how social learning processes on team and organizational level can be fostered through gamification [21].

Gamification as means for education has increasingly become a focus of scientific research over the past decade. The number of articles published between 2010 and 2014 has risen from 10 to 50 [22]. A study of 754 gamification cases found that in business contexts, gamification is used for a variety of purposes, first of all Human Resource Management (HRM), closely followed by training: "HRM (148/754, 19.7%) had a relatively large proportion among the categories, followed by training (143/754, 19.0%), social issue (133/754, 17.7%), education (127/754, 16.9%), commercialization (108/754, 14.3%), and lifestyle (95/754, 12.6%)." [23].

A systematic mapping study of gamification in education showed that "the use of educational games as learning tools is a promising approach due to the games' abilities to teach and the fact that they reinforce not only knowledge but also important skills such as problem-solving, collaboration, and

communication.” [24]. However, self-organized learning through gamification, does not appear as a category in this study, unlike in the business domain.

A well examined example that transfers gamification for the purpose of education into an online setting is the Crystal Island Learning Environment [25]. This game features a 3D virtual environment in which students can collaborate to solve tasks. This required substantial investment in creating the computer game itself as well as the computational models simulating the reaction to the students’ actions. Empirical analysis evaluating the effectiveness of this approach found that it “did exhibit learning gains, but that those gains were less than those produced by traditional instructional approaches. However, the motivational benefits of narrative-centered learning, particularly with regard to self-efficacy, presence, interest, and perception of control, were substantial” [26].

At the core of agile learning is the principle that self-organizing teams are best suited to accomplish complex tasks. Agile coaching and teaching can be seen as ways of strengthening the ability of a team to continuously learn and improve in a self-organized way [27]. The idea of self-organized learning (S-O-L) is even older than agile methods [28]. There has also been research on suitable environments for self-organized learning. From a person-based psychological perspective, it has been argued that “the S-O-L practice depends on the ability of the learner to self-monitor and control the learning process.” [27]. It further stated that “shared meaning is negotiated conversationally from social networks. Such social networks can be understood as conversational learning environments that construct their own viability and validity, resulting in a capacity for creative and flexible thinking” [27]. The role of the teacher is considered to be a learning coach who uses appropriate conversational tools and reflective techniques to facilitate the student’s learning. His/her task is to build an appropriate environment that enables meaningful conversation, e.g. through conversational templates.

The CDE model is “a qualitative conceptual model of a set of meta-variables that represent a wide variety of constraints that influence the speed, direction, and outcomes of self-organizing processes in human systems” [4]. This model distinguishes between:

1. The container in which communication happens
2. The differences in communication (e.g. from iteration to iteration) from which the teams can learn
3. The exchange of teams with the outside

The CDE model draws from systemic and complexity theories including the systems theory by Niklas Luhman [29]. In this view, social systems are complex adaptive systems that display self-organization if they have no central command and control structure. The container in the CDE models is meant to adequately constrain the freedom of self-organization. “We often complain about constraint. Yet, high levels of agreement and certainty within a system result from constraints that reduce the system’s degrees of freedom [30].” It “makes the emergent patterns manifest, so that everyone involved in the project is able to see and name them [30].” To make

differences in communication patterns manifest in order to learn from them is an approach also used in systemic coaching [31].

III. DIDACTICAL CONCEPT AND EDUCATIONAL APPROACH

The approach introduced in this course combines these three ideas: It intends to provide (1) an adequate frame for self-organized online learning (SOOL), with (2) the gamification approach Epic Bedtime Story providing an iterative series of collaboration and conversational templates for reflection and (3) the CDE model as framework how to organize self-organization.

Adapting the Epic Bedtime Stories approach to a University setting, we developed the following procedure: The first three-hour unit is dedicated to getting the participants to know each other better through various exercises and to then form teams. In one of these exercises, students rate themselves on the essential four skills needed for this venture. This allows them to form teams with a balanced set of diverse skills. This is followed by a series of random breakout sessions where students can introduce themselves to one another in small groups of 4-5 people. Based on that, students build teams themselves, simply by putting their names into one out of six team buckets on a digital whiteboard.

As part of the first session, the students also receive short input on the subject matter. Each team then selects a chapter and is tasked to prepare an initial draft of this chapter for the next session. This kind of self-organized team building is (among others) used by agile methods such as Large Scale Scrum [32] and has been prevalent in agile business contexts for several years.

In the second session of 3 hours, the teams then write the booklet together. This is done iteratively: after half an hour work, the teams show their results and receive feedback by other students and the lecturers, which they can incorporate in the next iteration.

In this case, the students’ objective was to write a “Survival Guide to Online Education” comprising of the following chapters:

1. Establishing friendships
2. Team collaboration at university courses
3. Keeping oneself well-informed through online media
4. Keeping oneself well-informed on happenings at University
5. How to fail every single exam in spite of putting in a lot of effort
6. Self-defense against cyber mobbing aka defense against the dark arts
7. Joker: topic to be chosen freely by the team

Following the idea of self-organization, our main role was not as knowledge experts but as facilitators to create an environment for the teams to playfully learn. To establish the different levels of interventions we had at hand, we used the CDE model to understand and enable self-organization.

The container in our course was for one set by the technical constraints of online collaboration. Our goal here was to harness the available tools as much as possible, e.g. by encouraging students to keep video turned on throughout the session and to provide additional tools such as digital whiteboards with carefully customer-tailored templates. The container in the CDE model is also formed by the spoken or otherwise conveyed organizational rules. In the context of this course, a grade-point system and other ground rules served as additional organizational boundaries.

We sought to make clear communication rules by asking students at the beginning of the course, to participate at any time, to speak up when anything was unclear or when something didn't make sense. The intent was to set an example for an open atmosphere where any constructive participation was embraced. Furthermore, we provided questions for the team retrospectives. These questions were based on the practices in agile coaching [33] and systemic coaching [31].

Facilitating self-organizing also requires providing various forms of exchange for the teams. In our case exchange was built into the game: firstly, at the iterative reviews where other teams and we as teachers gave feedback which could be incorporated immediately in the following iteration. Secondly, through so-called guilds, where the settings changed: instead of the cross-functional teams, where they worked in continuity in and between the modules, course participants found themselves in a new social composition: among other experts with a similar focus e.g., graphics or writing.

This approach creates learning opportunities for students on three levels:

- On the content of the booklet created: Getting feedback from the other teams and the lectors and having the chance to incorporate this feedback several times, the students can improve their understanding of the subject matter step by step.
- On teamwork: how to produce valuable results in teams under time constraints and to experience the increase in communication complexity when several teams need to coordinate. These are situations they will likely encounter in their future work life as software engineers.
- To learn how to best adapt their university education to online settings.

To further enhance these learning opportunities, the teams briefly reflect on their experiences after each iteration, called retrospective, following the Scrum approach [34].

The final product students created together comprises 30 A5 pages available here: <https://rb.gy/6xnuhf>.

IV. METHOD

To evaluate the students' experience in self-organized learning, we asked them questions about their online agile team collaboration. In particular:

RQ1: How can a university course be arranged to support self-organized online learning (SOOL)?

To gain insights on students' perception of key context factors supporting SOOL, we differentiate further:

RQ1.1: What are the relevant factors in the frame of the course to enable SOOL?

RQ1.2: What infrastructure is necessary for successful SOOL?

After two online collaboration sessions, students were invited to give individual feedback on their perceptions of the time-constrained online teamwork answering seven guiding questions, two of which were scaled:

1. On a scale from 1 (worst) to 10 (best), how well did the way we worked together in these two sessions enable you to learn about the content of the course? (Given the available time and the fact that online communication was mandatory)
2. On a scale from 1 (worst) to 10 (best), how well did the way we worked together in these two sessions enable you to better get to know your fellow students? (Given the available time and the fact that online communication was mandatory)
3. What helped in getting to know fellow students?
4. What hindered getting to know one another?
5. What in the way we worked together in these two sessions could have improved your learning experience?
6. What infrastructure enhancements (tools, ...) could have improved your learning experience?
7. In this second session today: how, in your own words, did communication unfold in your team and across teams? (Describe in two paragraphs)

We analyzed student reports in a summative qualitative content analysis [35]. The sampling unit of our analysis was the course on "Computer Science and Society" in the winter term of 2020. Our recording unit is 36 reports (n=36) of 38 course participants in total. Our coding unit was a unit of thought, usually a written paragraph. Reports were anonymized for evaluation.

We created categories inductively from students' written accounts. Our categories were thematic, referring to specific arguments or topics, and analytical, in that codes were further clustered based on reciprocities. We constructed a code book in the form of a hierarchical category system: code/subcode.

First, we defined the structure of the code book, with each entry having the form: "code", "code count", "report references", "anchor example", "tags and question of interest". We coded three reports as reference cases together, adapted the code book structure and subdivided the coding of the rest of the reports among the authors. Reports were then coded by the authors separately. In several iterations, code definitions were discussed and adapted, if required. Finally, we clustered groups of related codes together. In total, we coded 91 codes, of which 29 had more than one occurrence in student reports, with 127 subcodes. Sixty-two codes had no subcodes and were only coded once. We excluded these from the results. Findings were sent to an external auditor for evaluation.

V. RESULTS

The results of the two scaled questions in the questionnaire (Q1, Q2) are depicted in Fig. 2. Student answers can be found on scales between 1 ("worst") and 10 ("best") respectively.

The median of the replies for both questions is 8, with the standard deviation of Q2 with 2.5 being higher than the one of Q1 which was 1.5. Whether this learning approach facilitated students learning was rated on or above the mark of 7 by 75% of the participants. Opinions were more widespread regarding the question how well this format enabled students to get to know one another. Here, agreement of 75% of the participants was only reached with mark 5 and above.

The correlation coefficient between the two datasets, the answers of Q1 and Q2, shows a weak positive correlation of 0.15 (Fig. 2).

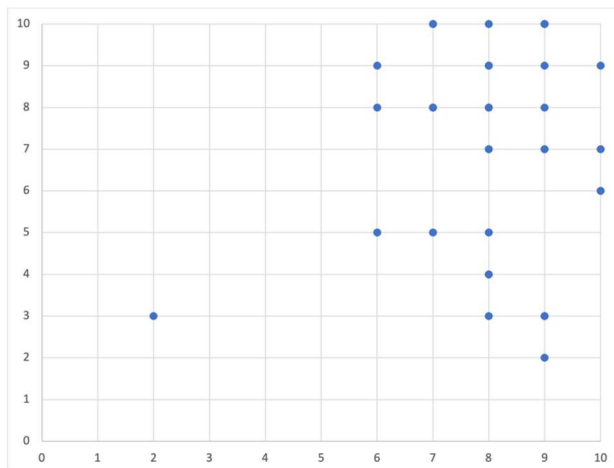


Fig 2. Results of scaled questions. The x-axis shows the answers to Q1, the y-axis shows the answers to Q2 for each student

Table 1 enlists all codes with at least two occurrences alongside anchor examples. The most prevalent codes were “Breakout rooms good to get to know people” and “Communication within the team worked very well” which were coded in 21 of 36 (58%) participant reports.

TABLE I. CODES, OCCURRENCES AND ANCHOR EXAMPLES

Code	#	Anchor Examples
Breakout rooms good to get to know people	21	It was helpful to join in a random room in BreakOutRooms. In a small group, it was easier to overcome awkwardness and uncertainty
Communication within the team worked very well	21	We discussed all of the mistakes and inconsistency with assigned task and tried to improve our paper.
Keeping contact	16	For the small group assignment with the use of discord we arranged a meeting once in every week, which allowed us to keep track of where we stand in our assignment process. In those sessions, although not drastically, we get to know each other better.
Assignment clearer	13	I think the Survival Guide assignment could have had some clearer instructions, because my team used Overleaf/Latex for our guide, so when we had to paste our guide into the shared Google document it was quite difficult. If had we known about that we would have used something else instead of Overleaf.

Communication across teams worked less well than within team	12	Communication worked well in my own group, but less so with the other groups.
Tools sufficient	11	In my opinion, we had everything to become a successful collaboration. Our group used two apps for interaction with each other, Whatsup to appoint date and time when we make cooperate call, and Discord where we shared all our ideas and shared information. Also, we used a Google Documents file where everyone pasted their parts of a text and could make changes in it.
Full participation with video and audio	10	Not everyone in the Breakout-Rooms had their microphone turned on (or their microphone didn't work) which made the communication not as smooth as it could have been.
More time in breakout rooms	9	The communication between the guild members was also very good. We all switched to the guilds that we were interested and having a common subject of interest made the communication easy. The difficulty was having a very restrictive time limit which may affect the end result, thus the outlook of the whole guide.
Blind dates helped to get an idea who the other students were	8	The “Blind-Dates” we had before getting together in groups helped to get an idea of who the other students are.
Discord was helpful	8	My team and I used Discord for communication for our team project and for communication during the lecture (For example on deciding who should present the guide that we've created).
Not meeting in person; online not as personal as face-to-face	8	Communicating face to face, of course. In my opinion, you can only really get to know each other when you meet offline.
Guilds helpful	7	In the session with people from the other groups, the discussion was surprisingly very sophisticated at the time, but then again, the discussion was between people who had proficiency in the same skill. It was engaging, and everyone was able to point some problems out in the document, and everyone was very open.
Working in small teams	7	For me personally working in teams was a completely new experience in this semester and it helped pretty much to get to know each other, to learn how to work together and organize ourselves to achieve a common goal.
Communication across teams worked well	3	Everyone was respectful while communicating and there was no “destructive behavior”
Lack of participation by fellow team members	3	A lot of people claimed to not have a functioning microphone (over a prolonged period of time), which was - at best - a dubious excuse for not wanting to talk to other people. Others did not even bother to come online and attend our group discussions during the beforehand agreed upon time.

Team members who chose whom they knew (sympathetic)	3	To be honest with you, which is also the point of this review, I did not make sure that I get into a team where everyone has a competence that is great for the team, but instead looked to team up with people, which I do previously found sympathetic.
Alternative to allow for less chaotic collaborative work on overall document	2	When working together on the prototype of the guide, you could have found an alternative where everything takes place in a more orderly manner and not everyone changes something at the same time.
BBB for connecting with each other	2	We used BigBlueButton, a presentation platform, which enabled us to connect and work together, and with the help of Clipboard, we could build our team and met other students.
Contents for informatics and society were not in focus, rather communication and team building	2	The focus of the course part was very much on (online) communication / team building / jointly managing a project. That was good in itself, I just found that this is a relatively selective excerpt from "Current topics from the field of computer science and society". It might have made communication a little easier if, for example, we had discussed various topics from computer science and society at the first appointment in the break-out rooms instead of our abilities, because then everyone could talk about something instead of everyone about themselves (that may be easier for some).
Framing Constructive Communication	2	I am happy that this module outlined the importance of constructive communication – a trait which is easier described than demonstrated.
More time	2	It would have been better if we had maybe one more meeting for the project.
Not used to guilds	2	Between the teams, primarily in the guilds, chaos took over a little more at the beginning due to the larger number of participants and also because of the poor knowledge of the members.
Online discussion	2	In a way, the online meetings are both a blessing and a curse. On the one hand, they give you a feeling of anonymity and thus lower the threshold to say something, especially at the beginning. On the other hand, they also make the flow of conversation more difficult: bad connections prevent you from saying or understanding something, it quickly happens that everyone says something at the same time and then everyone pauses.
The way we worked improved my social skills	2	The way we worked together in these two sessions and between them helped me to overcome fear to speak in public, so I improved my social skills.
Tried best to overcome shortcomings inherent to online setting	2	However, the main thing that interfered with us in getting to know each other was the cause that we had online sessions. But generally, we got tried to do our best to overcome these difficulties.
A more organized Moodle page	2	One thing that comes to mind would probably be a more organized Moodle page. Although, this could just be me, since I dislike Moodle in general.

A tool for shared notes in breakout rooms	2	Some kind of tool for shared notes in the break-out rooms would still have been good, although there were "shared notes" in the rooms, but they were gone after the break-out session was over.
Active communication from both sides	2	Active communication from both sides is really the only thing that helps here.
An envoy to other guilds, when working in guilds	2	Maybe you could have made a few improvements to the task in the guilds, for example an "ambassador" to other guilds.

VI. DISCUSSION

A. Discussion of results

Quantitative findings show that students believed that this kind of self-organized teamwork was helpful in learning relevant content: 75% of students rated the support of content learning (Q1) on a scale from 0 (worst) to 10 (best) as 7 or higher. The median rating was 8 (with a standard deviation of 1.5). A few students shared that their social skills were advanced (2 mentions), particularly related to communication and teamwork (2 mentions), rather than broader societal topics related to Informatics.

RQ1: How can a university course be arranged to support self-organized online learning (SOOL)?

RQ1.1: What are the relevant factors in the frame of the course to enable SOOL?

Students pointed out quite clearly what helped or hindered their social interaction. The two most mentioned codes were the possibility to use "Breakout rooms" (21 mentions) and "Communication within the team worked very well" (both mentioned by 58% of the participants - 21 report mentions each). Since team communication during the course sessions was mainly possible in these breakout rooms, where they collaborated and self-organized without the presence of a lector, it can be concluded that breakout sessions were of very high relevance for SOOL in this setting. As one student stated regarding the breakout rooms: "How well this succeeds then eludes the course instructors and becomes the responsibility of the students themselves. It therefore depends on each individual how much you get involved in the given conversations and subsequently reveal yourself." This indicates that students did indeed feel "in charge of his/her own personal system of meanings" as intended by S-O-L [24], as well as in its online application SOOL.

Collaborating online, establishing and maintaining social contact appears more difficult: Course sessions end abruptly, and there are no informal meetings outside of the course structure. Many students (16 mentions) were concerned on how to maintain contact with their colleagues. Some observed that their familiar patterns of social interaction, such as establishing deeper personal contact between lectures, did not work in an online setting. One participant wrote: "It would have been nice if there was an easy way to get in touch with the people you met, after the duration of the course / breakout room, possibly through Moodle because often times different people attend different courses and once it is over you lose contact with them."

Different communication settings, within teams and across teams, drew rather differentiated responses. While participants generally agreed on being able to learn course contents through SOOL, 75% of the participants marked whether they could get in touch with fellow students easily on a scale from 0 (worst) to 10 (best) with 5 and above. The rating median was 8 (with a standard deviation of 2,5). From the qualitative content analysis, we can infer the following reasons for such variation: Students mentioned that they either would have liked to have more time in general (2 mentions) or more time in breakout rooms (9 mentions). Many students reported on the gained value in collaboration by turning on the microphone and the camera when working together (12 mentions). Students found it difficult when team members were not reachable during work sessions (3 mentions). Several students highlighted difficulties in collaborating online as opposed to meeting face-to-face (8 mentions). One student particularly reflects on the benefits and drawbacks of online conversation in a group (2 mentions): *"In a way, the online meetings are both a blessing and a curse. On the one hand, they give you a feeling of anonymity and thus lower the threshold to say something, especially at the beginning. On the other hand, they also make the conversation more difficult: bad connections prevent you from saying or understanding something, it quickly happens that everyone says something at the same time and then everyone pauses."*

Recurring work within the same team was considered as productive (7 mentions concerning work in small teams) and held with respectful communication by most of the students (21 mentions). One student stated with regard to teamwork: *"We gathered ideas together and always quickly came to an agreement"*. The more complex communication between teams on the other hand was often perceived as challenging (12 mentions). A student shared, for example: *"Communication worked well in my own group, but only moderately with the other groups. I find this format very difficult as it is often. There are 'leadership' problems. In each new group, a new interpersonal hierarchy always had to be found. But I found it very exciting here how quickly you have adapted yourself again and again. Once there was a 'leader' and another time everyone acted equally."* Students stated that they were not used to working in guilds (2 mentions). Yet, others pointed out benefits of meeting in guilds (7 mentions): *"In the session with people from the other groups, the discussion was surprisingly very sophisticated at the time, but then again, the discussion was between people who had proficiency in the same skill. It was engaging, and everyone was able to point some problems out in the document, and everyone was very open."* Other students shared that communication across teams worked well (3 mentions): *"At first, communication between the teams was faltering, but it has improved after groups were formed again according to specialty and each draft was checked again for errors."*

The warm-up phase to collaborative writing was considered worthwhile to get to know other students participating in the course (8 mentions). One participant shared a personal advantage of the online format: *"It was*

helpful to join in a random room in BreakOutRooms. In a small group, it was easier to overcome awkwardness and uncertainty." As the skills-self-attribution exercise was rarely mentioned, we assume students used it primarily as a communication anchor to get in contact with each other before forming teams on their own. Few students shared in their reports that they chose team members that they perceived as sympathetic (3 mentions).

RQ1.2: What infrastructure is necessary for successful SOOL?

Many students rated the infrastructure in place (Moodle as a knowledge base, Zoom for interactive sessions, a digital whiteboard for team building and GoogleDocs for collaborative writing) as a sufficient selection (11 mentions). The qualitative content analysis shows how some teams managed to mitigate hurdles in maintaining a continuous communication with rituals using freely available standard communication tools: *"For the small group assignment with the use of discord we arranged a meeting once in every week, which allowed us to keep track of where we stand in our assignment process. In those sessions, although not drastically, we get to know each other better."* Discord was frequently noted as a helpful tool to arrange meetings both during and outside the course (8 mentions). The emerging overall communication structure bears a resemblance to what has been called a dual-operating system in organizations [36]: a concept which describes a second informal communication structure beside the official communication channels. The online communication on Discord established by students on their own could be seen as such a second operating system that runs in parallel to the official Zoom calls.

B. Limitations

The findings outlined here apply to a specific context: undergraduate students of Computer Science. Therefore, we can assume that participants are familiar and comfortable with using information and communication technology for collaboration. The learning format has not yet been evaluated in other course contexts.

Researcher bias was identified by both authors. They have facilitated the epic bedtime story format several times previously in on-site higher education courses before implementing the format online. The first author also uses this approach in corporate business contexts. The results of the content analysis were sent to an expert auditor with experience in higher education course design in Computer Science who did not participate in the epic bedtime story setting nor in writing the paper. Suggestions regarding the integration of references to the paper, transparent description of the course setting and the presentation of results were considered.

The main goal of the entire course with the embedded epic bedtime story format is to support a reflective attitude of Computer Science students. How well the learning format enabled students to learn was evaluated from their own point of view as no tests were conducted in this course. Individual student reflections and teamwork products can thus not be

easily compared to more traditional learning formats with standardized tests.

Some student responses were translated by the authors.

VII. CONCLUSION

The questionnaire results and the students' strong participation throughout the course clearly indicate that they found this format helpful to learn course contents, and more so to get to know one another. Their differentiated answers to the questionnaire indicate that they also improved their online communication skills and their competencies in using online tools. SOOL appears to be a particularly supportive addition to the didactical toolbox during a pandemic, where online work is sometimes a must and social interaction often suffers. Compared with gamification learning approaches featuring sophisticated virtual reality environments like the crystal island experiment [26], the infrastructure prerequisites for an Epic Bedtime Story based course are far more affordable. What both approaches might have in common (and further research could follow-up on this hypotheses) that it creates a high level of involvement and motivation for students to achieve results on their own as teams. Benefits such as "self-efficacy, presence, interest, and perception of control" [28] are key goals in S-O-L. Therefore, we conclude that this approach is a promising and low-cost way to transfer the concepts of S-O-L to online learning.

Key factors to create a successful SOOL course include (1) an adequate communication design: the selection of a suitable gamification approach, and (2) an adequate balance of different communication settings: continuous work as teams in breakout sessions, where the teams can iteratively evolve their results, mixed with communication between teams. This communication design provides a *container* for self-organization to unfold, furthermore the chance for *exchange* as described in the CDE model. Regular reflections with some guidance from the lecturers can help the teams to identify relevant *differences* in their communication and to learn from them. For appropriate framing of such a course, it is further highly valuable to clearly state purpose and structural prerequisites (13 mentions "assignments clearer" 2 mentions in "alternative tool for less chaotic working together"). In an online context with shifting communication settings, this needs more careful preparation than when working in traditional online formats or in an onsite context.

From a perspective of S-O-L, communication settings should be "conversational learning environments that construct their own viability and validity, resulting in a capacity for creative and flexible thinking" [30]. Our qualitative content analysis shows that such conversational learning environments can successfully be constructed with the help of video conferencing tools and breakout sessions with small groups of seven people or less. As students pointed out, it is important that all participants have their video and microphone turned on and their attention is focused on the work within the group.

Social dynamics similar to those in onsite learning contexts could be observed (and maybe were accelerated by the online format), such as some students gaining the benefits

of a group session without contributing much and the irritation of others because of that.

It is helpful to encourage contact of the teams in between the lectures and propose means of doing so. How to maintain team contact was a topic raised by several students in their answers to the questionnaire.

Further application and evaluation of SOOL in other learning contexts can bring further insight. Particularly the question, whether the content of the course can be conveyed better through this learning format could not be answered through this research.

This effort seems worthwhile, as one student wrote: "*I have never expected that a lecture could be done in this manner. Despite the reality of a pandemic, we could interact with each other during the lecture.*"

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