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Breaking the Ice? How to Foster the Sense of Community in MOOCs

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***Abstract*—Massive Open Online Courses (MOOCs) are usually attended by several thousand learners who barely get to know each other during the course period. Being unaware of fellow learners often results in a low sense of community. In addition, many MOOC learners are afraid of using the course forum, which often is the only participation opportunity in social course activities apart from forming smaller learning groups. Thus, learners can easily be frustrated with the course content when feeling alone. To improve social presence and the sense of community, course instructors can use ice-breaking games. First, this paper evaluates which kind of ice-breaking games can be used in MOOCs. Afterward, we present the results from a first experiment where we use self-reflection sociograms as an ice-breaking activity. Most learners perceived the implemented "Self-Reflection Questionnaires" (SRQ) ice-breaker as a positive course feature (68.35%). SRQs increased the sense of community, and learners were satisfied (91.06%) with their perceived community sense level. The SRQs were also helpful for the teaching teams. Our results indicate that further investigation of SRQs is beneficial to explore the provided value for course instructors and their influence on individual MOOC learners and community-building.**

***Index Terms*—MOOC, community, ice-breaker game, social presence, warm-up activity, self-reflection, sociogram**

I. Introduction

Massive Open Online Courses (MOOCs) are usually attended by several thousand learners. A major advantage of MOOCs over other e-learning formats is that the interaction with the teaching team and between learners is highly encouraged in a course forum. In contrast, other e-learning formats often lack a dedicated place to interact with the community [2].

Most MOOCs are conducted over fixed course periods, which leads to another advantage: all learners are working on the same learning materials at a similar time. The interaction and simultaneous work foster the learners' feeling that they are dealing with the learning materials together as a learning group. As fellow learners are working on the same learning materials and tasks, everyone can ask for help, discuss problems and promptly receive feedback from others while being in a learning session. However, to benefit from these advantages, learners must be aware of the presence of other learners and actively participate in these opportunities. The awareness of other learners is described by the concepts of *social presence* and the *sense of community*. Social presence represents "the degree to which a person is perceived as 'real' in mediated communication" [3]. The sense of community "is a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together" [5]. Thus, both concepts are relevant for MOOCs to connect the thousands of 'real' learners and allow them to form one or multiple learning groups.

But how to foster social presence and a sense of community in a MOOC? Making general enrollment numbers visible does not achieve this goal but quite the contrary: many initially enrolled learners don't show up in the course; average show rates in MOOCs range between 20% and 45% [4], active contribution and course completion rates are even lower [6]. Learners that actively participate in the course don't read or see much from most of their fellow learners during the course period. The most common place to meet other course participants is the course forum. Usually, however, only up to 15% [6] of learners actively participate in forum discussions, and many of them are advanced in the course topic [6]. Thus, they sometimes make beginners feel uncomfortable and reduce emotional safety with their forum posts, e.g., by discussing topics beyond the course scope, using harsh language, or repeatedly correcting others. Therefore, the feeling of isolation and being left alone with individual learning difficulties can even grow for many learners.

To prevent these feelings and facilitate a stronger sense of community, we experimented with ice-breaking games. We aim to provide a social activity that allows learners to feel the presence of others without being afraid of evoking any negative feelings. This paper presents our first experiences with self-reflection sociograms as an ice-breaking activity.

II. Experiment

A. Why Breaking the Ice

The goal of ice-breaker games or warm-up activities is stated to *create better communication*, *provide an opportunity to interact with fellow learners*, *create trust*, or *reduce anxiety* [9]. A *positive atmosphere* should be fostered, where all learners can *share their individual experience* [8]. The activities should be simple and not too time-consuming.

Previous work on warm-up activities in MOOCs mainly focuses on building sub-groups and applying ice-breaking

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there instead of addressing the whole learner base of the course (e.g., [1]). In terms of ice-breaking for the entire learner group, social activities have primarily been directed to the course forum, such as using get-to-know-you posts [7]. These can range from a simple round of personal introductions to answering specific questions related to course content or include an ice-breaking exercise like posting an image in response to an exercise [8]. However, our goal is to create an ice-breaking activity that avoids redirection to the course forum to make it as accessible as possible, so we require a different solution.

B. Preceding Considerations

Many analog ice-breaking games work well in the digital world. However, only a few of them can handle an unlimited number of participants, which is required for MOOCs. Since MOOCs are learning activities, ice-breakers should be entertaining but should not exclusively aim at physical activation or entertainment. To address all learners, we best consider those activities that aim to create an overall picture instead of fostering an individual exchange. Ice-breaking sociograms, which highlight commonalities of heterogeneous learning groups, have been particularly striking for us. A sociogram can be related, e.g., to prior experience, expectations, and personal interests, but also to learning success and experience with offered learning materials. For our purpose, we implement a sociogram ice-breaking activity that we call *Self-Reflection Questionnaire*s (SRQ), which allows our learners to share their experiences and emotions. The SRQs also enable course instructors to provide feedback and additional guidance depending on the learners' answers. With our implementation, we aim to answer the following research questions:

RQ1 Which effects have self-reflection sociograms on the sense of community within a MOOC?

RQ2 Are self-reflection sociograms a suitable tool to increase the social presence in MOOCs through quantitative details?

RQ3 Do self-reflection sociograms offer a way to provide qualitative feedback regarding the course content?

C. Implementation

To implement the SRQs, we used the regular quiz feature that our learners know from self-tests and weekly assignments, thus creating a low-barrier offering. As quizzes do not provide statistics for the learners, we had to provide those in an additional course item. In the course structure, questionnaires were positioned right before this results page. Hence, the navigation flow led the learners to answer questionnaires first before viewing the answers of all learners. Answering each questionnaire was allowed only once to reduce the influence on self-perception after seeing the community results. All questionnaires and results were optional course items. We manually analyzed the results from each questionnaire, updated the results regularly, and provided them to learners in the form of an info-graph with varying scopes, feedback, and presentation styles.

We conducted the experiment in four courses related to Computer Science. We asked various questions concerning the course content, encouraging learners to reflect on their knowledge regarding the weekly content, their experience with the course materials, or their learning behavior in general. The first experiment iteration was conducted in a four-week Python programming course. The structure and questions of the Python course SRQs can be found in Table I (more details on the results can be found in Section III-A). Subsequently, we refined the SRQ concept according to our first research results and experimented with presenting the results in a three-part course series on cybersecurity of two weeks each. The structure of this course series can be found in Table II.

The manual effort to evaluate and update the results was very high in all courses. Several questionnaire results had to be updated regularly during the course period — on the first day of the questionnaire, the results were updated two to four times to simulate real-time answers as much as possible. Afterward, we updated the questionnaire results less frequently until the course ended. Information on when the results were updated last and how many learners already voted was included on the results page, often also an estimate of when to expect the next update (see Figure 1b top). Power-users are usually doing

TABLE I
OVERVIEW OVER ALL SELF-REFLECTION QUIZ QUESTIONS (Q) IN THE PYTHON COURSE AND ANSWERS GIVEN BY PARTICIPANTS (P); RESULTS PRESENTATION WITH GRAPHICS (G) AND TEXTUAL FEEDBACK (F)

Course Position	Q (N)	Topic	Results		P (N)
			G	F	
Intro	10	Previous knowledge on programming, Python, and experience with the programming platform used in the course	✓	(✓)	4098
W1 Start	12	Learning preferences and course goals	✓	✓	4348
W2 Start	10	Feedback on the SRQ format, help-seeking behaviour, and challenging lectures from Week 1	✓	✓	2986
W3 Start	11	Communication with other course participants, help-seeking behaviour, feedback on reflection task from Week 2, and challenging lectures from Week 2	✓	–	2126
W4 Start	10	Help-seeking behaviour, programming support, feedback on special exercise, and challenging lectures from Week 3	✓	–	1917
W4 End	7	Overall learning gain, challenging lectures from Week 4	✓	–	1529
Feedback	16	Final Feedback on community and support (other learners and teaching team), discussion forum, and SRQ format	✓	✓	940

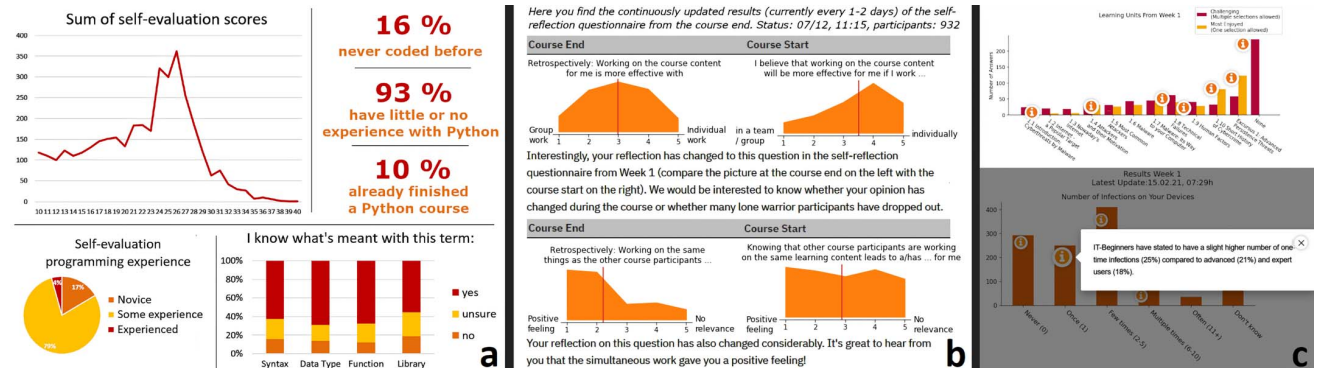

Fig. 1. Different SRQ result presentation styles in the Python course (a and b) and the cybersecurity courses (c)

better with the learning materials and often are the first ones to answer the questionnaires. Thus, updating the early results regularly was essential to reflect a broad user base, including results from advanced learners and beginners.

To prepare the user-facing results, the answers given for each questionnaire were downloaded, analyzed in a Jupyter notebook, exported as graphs, and uploaded back to the platform. As the experiment progressed, we automated this process increasingly. Nonetheless, a high manual effort was required from the teaching team to prepare the graphics. The existing teacher-facing quiz results page could not be used: its presentation style did neither match our requirements to provide easy-to-understand graphs to the learners, nor could we include additional feedback text.

D. Limitations

The SRQs were available for all learners in all four courses. Thus, we were unable to measure the effect the SRQs had on the social presence, the sense of community, or the general learning outcome and behavior. To determine these effects, an A/B test is required. Before conducting the A/B test that requires higher technical effort, we wanted to create a first experiment with as much learner feedback as possible.

The presentation of results differed, allowing us to identify which presentation style the learners benefit from most. The infographics have been reduced to the relevant details to be easy to understand for all learners. Thus, we partially skipped axis labels when the relevant information was easily accessible (see Figure 1b). Also, the included text feedback on the results page differed fundamentally. With our current research setup, we must rely on the survey result feedback to identify the learners' needs and improve the presentation styles.

Although we ordered the course item so that learners answer the questionnaire first before seeing any results, we cannot enforce this order. Thus, some learners might have visited the results page first before answering the questionnaires by themselves, which might have influenced their given answers. However, this has only a small impact on the conducted research, as most results from the questionnaires do not present feedback on the SQR format.

As the results were not updated in real-time, the learners' perceived influence on the questionnaires might have been reduced. However, this should only refer to their perceived direct influence, as the results have been updated regularly throughout the whole course period. For future research, automating the calculation of the results closer to real-time will reduce this effect.

Last but not least, the learners only received a rough estimate of upcoming result updates. If they were interested in the update, they needed to check the results page regularly. This behavior could have led to a higher interest in the results pages than if the results were updated at fixed times.

III. Results and Discussion

A. Presentation of Results

The results for each SRQ were presented to the learners in graphical format, sometimes including additional text feedback. Different visualization examples can be seen in Figure 1. The graphics included statistics about answers to all questions, sometimes in a summarized format (e.g., see Figure 1a). Textual feedback contained an interpretation of the results from the teaching team along with suggestions for the learners (e.g., see Figure 1b and c bottom). We tried to provide individual feedback depending on personal skill levels once, but technically the process was so counter-intuitive that we refrained from continuing this approach and provided the same information to all learners.

B. Learner Perception

For the data analysis, we considered all learners that visited at least one course item. Learners who achieved at least 50% of all points in graded assignments, e.g., weekly exams, final exams, or programming assignments, received a Record of Achievement (RoA). A Confirmation of Participation (CoP) is issued to all learners who viewed at least 50% of the available course materials. When comparing the numbers of issued RoAs and participation in the SRQ at the end of all examined courses, we see an average ratio of about 66% (compare certificate numbers in Table III with participants in Table I and II). The usage number of the SRQs drops proportionally with the general lecture item usage numbers.

Overall, the numbers indicate that the SRQs were well received and regularly used. On average, from all four courses,

TABLE II
OVERVIEW OVER ALL SELF-REFLECTION QUIZ QUESTIONS (Q) AND PARTICIPANTS (P) IN THE CYBERSECURITY COURSE SERIES: (CS1) CONFIDENTIAL COMMUNICATION IN THE INTERNET, (CS2) DIGITAL IDENTITIES, AND (CS3) CYBERTHREATS BY MALWARE; RESULTS PRESENTATION WITH GRAPHICS (G), TEXTUAL FEEDBACK (F), AND OF TYPE (T): INTERACTIVE EXERCISE (E) OR TEXT (T)

Course Position	Q (N)	Topic	Results			P (N)
			G	F	T	
CS1 W1 Start	9	Usage of online banking; IT and Computer Science background; most awaited course topic; enrollment motivation; study group preferences	✓	–	E	2393
CS1 W1 End	10	Learning units worked on (number and time); help-seeking behavior; forum discussion opinion; most enjoyed and most challenging learning units of Week 1	✓	–	E	1221
CS1 W2 Start	6	Previous experience with cyber attacks; opinion on more detailed course material / deep dive; opinion on hands-on exercises for the course series; sense of learning community by SRQ	✓	–	T	1302
CS1 W2 End	5	Most enjoyed and most challenging learning units of Week 2; feedback on learning time, number of learning units and covered topics for Week 2	✓	–	T	1042
CS2 W1 Start	7	Number of (actively used) accounts on the Internet; usage of two-factor authentication; Internet usage confidence; most awaited course topic; enrollment motivation	✓	–	T	1540
CS2 W1 End	2	Most enjoyed and most challenging learning units of Week 1	✓	–	T	1074
CS2 W2 Start	4	Previous experience with identity theft and leaked personal data; sense of community by SRQ	✓	–	T	1159
CS2 W2 End	11	Most enjoyed and most challenging learning units of Week 2; feedback on learning time, number of units, and covered topics for Week 2; opinion on hands-on exercises for the course series	✓	–	T	1003
CS3 W1 Start	7	Experience with malware; Internet usage confidence; most awaited course topic; enrollment motivation	✓	✓	E	1931
CS3 W1 End	2	Most enjoyed and most challenging learning units of Week 1	✓	✓	E	1336
CS3 W2 Start	6	Known malware; experience with cybersecurity trainings	✓	–	T	1434
CS3 W2 End	11	Malware infections; most enjoyed and most challenging learning units of Week 2; feedback on learning time, number of units, and covered topics for Week 2; opinion on hands-on exercises for the course series	✓	–	T	1223

71.89% of learners rated the SRQ positively, 21.56% neutral, and 6.55% negatively.

The adoption rate of the SRQ feature was higher than the active forum participation. Compared to courses with similar course topics that did not use SRQs, offering SRQs did not result in more participants actively engaging in forum discussions. Nevertheless, learners indicated that they perceived themselves to be rather part of the course community (3.59 on a Likert scale from (1) not at all to (5) very much) and were quite satisfied (91.06%) with their sense of community (SoC). Most learners stated that their SoC did not change during the course runtime (61.09%), whereas 36.98% stated it increased, and 1.93% felt a decrease. Of those learners that felt a change in their SoC, 71.25% stated that their SoC was influenced by the SRQs (while the SRQ did not influence 28.75% of learners with an evolved SoC), which was the highest influence type. The second highest influence type was the forum that 44.07% of learners that felt their SoC changed during the course selected as an influence. All other options are not worth mentioning at less than 15%. With these results, we conclude that the SRQ positively influenced the learners' sense of community (RQ1).

In the Python course, we asked which elements should be included in the SRQ result presentation. Learners rated the implications of the teaching team and recommended actions highest. But also, providing reasoning for each question, showing the own answer in relation to all responses, and providing additional information depending on the individual answer were selected often. The learners slightly preferred graphics for each question compared to summarizing images. The number of overall questions was considered slightly too much, so we reduced the number of questions per SRQ from an average of 10 questions in the Python course to an average of 6.67 questions in the cybersecurity course series. Simultaneously, the average number of questions per course week increased from 10 in the Python course to 13.33 in the cybersecurity series, where we included a questionnaire at the beginning and end of each course week. We did not receive feedback that the number of questions was too high.

When asking for the learners' preferred SRQ topics, the course-related questions about the individual experience (e.g., experience with malware) were consistently ranked highest, along with the IT skill level. The learners were least interested in general questions like working style or enrollment motivation. The overall time spent in the course, most enjoyed, and most challenging lectures were ranked in the middle.

In the cybersecurity series, we experimented not only with regular text page results but also provided some results with an interactive exercise tool (H5P) where learners could click on particular parts of the images to receive more details (see Figure 1c). While the learners slightly preferred text pages over H5P items, many learners did not even realize any difference between both formats. We suggest sticking to text pages that are easier accessible in future research.

C. Discussion

The presented research results indicate that SRQs can increase the perception of being part of the course community and the awareness of fellow learners. With regard to RQ1, we can thus conclude that the use of the SRQs seems to have a positive influence on the sense of community. We expect that the feeling of membership has increased with this format while

TABLE III
COURSE OVERVIEW WITH LEARNERS, CERTIFICATES, AND SRQ FEEDBACK FOR ALL FOUR COURSES EVALUATED

Course	Learners (N)	Certificates		Forum		SoC		Change of SoC			Influence by		Perception of SRQ		
		RoA (N)	CoP (N)	Act. (N)	Pass. (N)	Level ($1-5$)	Satisfied (%)	positive (%)	neutral (%)	neg. (%)	Forum (%)	SRQ (%)	positive (%)	neutral (%)	neg. (%)
Python	7,558	2,702	4,778	925	4,237	3.60	–	–	–	–	–	–	82.49	15.17	2.34
CS1	3,614	1,545	2,231	189	2,391	3.59	89.35	38.23	59.80	1.97	40.63	75.00	65.80	25.87	8.33
CS2	2,461	1,356	1,924	172	1,443	3.61	91.55	33.97	64.13	1.90	43.90	72.47	66.45	24.72	8.83
CS3	3,093	1,840	2,353	249	1,770	3.56	92.28	38.73	59.33	1.94	47.67	66.28	72.81	20.46	6.73

also improving the shared emotional connection through the different course-specific but personal questions. The primary goals of warm-up activities like creating a positive atmosphere or reducing anxiety have been met with the design of our ice-breaker activity. The preliminary results and this hypothesis need to be proven in the next step in an A/B test.

Also, for the teaching team, the results of the SRQs represent a substantial added value, as they can get direct feedback from the learners on specific content or methods used. Such an opportunity did not yet exist; the content could only be reflected and indirectly evaluated via the course forum. Through the SRQs, we have created a low-threshold offer allowing instructors to ask which weekly content was perceived as particularly successful and which topics may still require in-depth details in this course or a later course revision.

The learners actively participated in the social ice-breaking activity. The usage numbers were slightly higher than passive forum usage (reading) and much higher than active forum usage (writing), even though the SRQs were purely optional offerings that had no relevance to either a RoA or a CoP. The use of SRQs thus appears to be a suitable method for providing quantitative information to our learners about active course usage numbers (RQ2). We have shown that learners can also provide qualitative feedback by voting on their experience with the course materials. Furthermore, course instructors can provide additional qualitative feedback to learners. Thus, we were able to show that RQ3 can be covered with the SRQ format. These positive preliminary results show that further effort is reasonable to refine the concept of SRQs and verify the actual effect in A/B tests.

IV. SUMMARY AND FUTURE WORK

The experiment described in this paper represents the first step toward ice-breaking activities in MOOCs. We have shown that learners perceived the Self-Reflection Questionnaires (SRQs) as a positive addition to the course. SRQs can provide a form of social interaction in MOOCs that does not require active participation in the course forum and, due to the social activity, foster a sense of community and social presence. In addition, SRQs offer low-barrier feedback for teaching teams, enabling them to better support their learners during the current or preceding courses.

To receive as much feedback as possible, we presented the SRQ to all learners in a total of four courses. We did not evaluate to which extent SRQs have an actual influence on the sense of community, the social presence, or the learners' course success in general in this first experiment, as the significance is relatively low without an A/B test. We plan to conduct such an A/B test to evaluate the effect of this form of ice-breaking among learners in the next step.

We also plan to conduct multiple expert interviews to specify the complete feature requirements. We will interview both learners and instructors to identify the most relevant information and functionalities for both user groups. Before implementing the full complex feature, we will conduct a content-level A/B test to prove our hypotheses from the preliminary results. The test will offer SRQs in a similar format as described in this paper but only provide the questions and results for randomly selected users. The results obtained from this experiment will help us proceed with the planned future work. They prove that sociograms in the form of self-reflection questionnaires are a valid format of an ice-breaking activity for MOOCs, supporting learners to feel the presence of others without the anxiety of actively using the course forum.

REFERENCES

[1] Alessandra Antonaci, Roland Klemke, Johan Lataster, Karel Kreijns, and Marcus Specht. Gamification of MOOCs Adopting Social Presence and Sense of Community to Increase User's Engagement: An Experimental Study. In *Transforming Learning with Meaningful Technologies*. Springer, 2019.

[2] Franka Grünewald, Elnaz Mazandarani, Christoph Meinel, Ralf Teusner, Michael Totschnig, and Christian Willems. openHPI - A case-study on the emergence of two learning communities. In *IEEE Global Engineering Education Conference, EDUCON 2013*. IEEE, 2013.

[3] Charlotte N. Gunawardena and Frank J. Zittle. Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. *American Journal of Distance Education*, 11(3), 1997.

[4] Christiane Hagedorn, Jan Renz, and Christoph Meinel. Introducing digital game-based learning in moocs: What do the learners want and need? In *2017 IEEE Global Engineering Education Conference (EDUCON)*, 2017.

[5] David McMillan and David Chavis. Sense of Community: A Definition and Theory. *Journal of Community Psychology*, 14, 1986.

[6] Sebastian Serth, Ralf Teusner, Christiane Hagedorn, and Christoph Meinel. Help-Seeking Behavior and Demographic Differences in Programming Courses. February 2022. Manuscript in preparation.

[7] Thomas Staubitz and Christoph Meinel. Collaborative learning in moocs approaches and experiments. In *IEEE Frontiers in Education Conference, FIE 2018, San Jose, CA, USA*. IEEE, 2018.

[8] Karen von Schmieden, Lena Mayer, Mana Taheri, Hanadi Traifeh, and Christoph Meinel. Razors for Arctic VIP Travelers: Using Warm-Up Games in MOOCs. In *Design Thinking Research*. Springer, 2021.

[9] Parisa Yeganehpour. The effect of using different kinds of ice-breakers on upper-intermediate language learners' speaking ability. *The Journal of International Educational Sciences*, 3, 2016.