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Pandemic Pedagogy in Online Hands-on Learning for IT/IS Courses

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Abstract:

Due to the coronavirus disease of 2019 (COVID-19) pandemic, many educational institutions have transitioned to online instruction. As a result, instructors need to investigate online small group learning opportunities to bond with their students who feel isolated from their peers due to social-distancing guidelines. In this paper, we discuss three key issues in online hands-on learning: 1) interactions, 2) equity and inclusive participation, and 3) students' readiness for hands-on or higher-level cognitive learning. We reflect on our teaching experience during the COVID-19 pandemic and offer suggestions to help instructors plan and implement online small group hands-on learning.

Keywords: Hands-on Learning, Online Communication, Equity and Inclusiveness, Readiness Assurance.

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1 Introduction

The coronavirus disease of 2019 (COVID-19) pandemic has changed everyone's lives in 2020. In March, 2020, two months after the United States (US) reported its first case, numerous K-12 schools, universities, and colleges (both in the US and across the world) had to shift their existing courses online to prevent the virus from spreading on campuses (Burke, 2020; Young, 2020). Due to the closures, institutions and teachers scrambled to put together learning continuity plans and had little time for preparation and training. This abrupt transition resulted in students' dissatisfaction with their experiences at the beginning (Lederman, 2020). Barnes & Noble (Brown, 2020) surveyed 432 college students in the US on their perceptions about switching to online courses. The company found students cared most about lack of interaction with their fellow students and feeling isolated as a result. The transition meant that students also lacked a hands-on learning experience as they could not access lab equipment and devices due to the school closure and cleaning and sanitizing regulations. In addition, instructors new to online learning found it difficult to organize an effective online hands-on learning. This difficulty may lower the educational quality and student satisfaction as studies have showed that students with quality hands-on learning experience outperform their counterparts without experience on key metrics such as engagement, exam scores, and self-efficacy (Baele, 2017; DeBoer, Haney, Atiq, Smith, & Cox, 2017).

2 Online Collaboration Hands-on Learning Suggestions

In this section, we reflect on our own teaching experience during the COVID-19 pandemic and propose suggestions that could help improve students' interactions and collaborations in online IT/IS courses.

2.1 Strengthen Interaction with Students

These days, instructors have access to many different synchronous and asynchronous communication tools. However, each tool adopts a pedagogical belief, and no one tool fits all. For example, Zoom offers an easy setup, a simple interface, and multiple connection methods. We used it for class and small-group discussions. But, in collaborative writing or note-taking activities, we switched to Google Docs as it allowed real-time collaboration and chat. When we assigned students pair-programming exercises, we had to switch to other real-time collaborative programming tools. Overall, we need to understand the core function that a communication and interaction technology offers and examine whether it aligns well with our core learning objectives.

Compared with traditional on-campus classes, we found that students had better in-depth reflections when using asynchronous tools, such as discussion boards or blogs, in online courses. Our experience echoes findings from prior research that asynchronous communication encourages reflective and critical thinking to a degree that students may not reach in real-time discussions (Gillingham, Eggleton, & Goodyear-Smith, 2020; Hudson, 2014; Testa & Egan, 2015). However, the interaction and deep reflection did not occur naturally—we provided prompts and facilitation to foster students' development of critical thinking skills.

2.2 Ensure Equitable and Inclusive Participation in IT/IS Courses

Equity and inclusion issues have received much attention during the pandemic since some students have reported facing more challenges after courses went online (Digital Promise, 2020). We implemented several strategies to build an equitable and inclusive online learning environment.

First, we often used peer-assisted small group learning strategies. We found that, if we implemented small group learning as free-form interactions and collaborations, some students would not make active contributions and learn as much as other members due to group dynamics or individual differences, which findings from prior studies have endorsed (Wolfe & Alexander, 2005; Zha, Moore, Browning, Fetner, & Ortiz, 2019). To ensure each student had equitable access, we used the process-oriented guided inquiry learning (POGIL) approach, a collaborative and student-centered instructional method that researchers have found as effective for technology students (Hu & Avery, 2015; Kussmaul, 2012; Mitchell & Hiatt, 2010; Yuan et al., 2019). Using this approach, we assigned four students to a group or online breakout room. Each group member had specific roles in a POGIL activity (see Table 1). Each role had its own responsibilities and did not depend on others' contributions. Students followed the instructions and discussed and answered questions listed on the sheet. The instructors and teaching assistants rotated between different breakout rooms and facilitated synchronous group discussions. Students used the

asynchronous tools, such as discussion boards, to post and share reports and summaries. We found that POGIL encouraged students to raise questions and participate actively in group discussions. In doing so, it provided equal opportunities for every group member to contribute in group discussion and intellectual collaborations, which, in turn, improved their academic performance and critical-thinking skills, which many studies have also found (Hein, 2012; Myers et al., 2014; Trevathan & Myers, 2013; Yuan et al., 2019; Yang, Yuan, He, Ellis, & Land, 2019; Yuan et al., 2017).

Table 1. Team Roles in POGIL (Hu & Avery, 2015; Mitchell & Hiatt, 2010)

Team roles	Responsibilities
Recorder	Recording answers and questions and providing copies to team & facilitator (instructor)
Speaker	Communicating with the facilitator and other teams
Manager	Monitoring time and ensuring every group member contributes appropriately
Reflector	Summarizing and reflecting on how group members could improve their work and learning

We offered more flexible learning strategies during the COVID-19 pandemic than we did in prior online teaching. Some students in our courses reported that they faced various technology, mental, and physical challenges. Due to these challenges, they found it difficult to comply with the rules and deadlines that we used in traditional classes. Therefore, we diversified collaboration approaches. First, students could choose to work alone if they could not catch up with the group meetings or collaborations. Second, we offered flexible make-up opportunities. Students could submit their assignments late without penalty if they informed us ahead of time with appropriate excuses. We even encouraged students to set up the new deadlines on their own to improve their learning autonomy. Third, we used flexible assessment opportunities. All of our assessments had low stakes, which resulted in multiple assessment points in each assessment method. For example, in one course, we asked students to submit 14 weekly practices throughout the semester. However, we counted only the 12 practices with the highest points in their final grades, which helped students to reduce stress during the transition and adjustment period. We did not find perceivable differences between students who took the flexible learning opportunities and those who did not regarding their performance on the assignments. However, students appreciated the extra offerings and reported that they would not have learned as much as their fellow students without them.

2.2.1 What Worked

Based on students' assessments, we found that assigning each group member a specific role proved a key to inclusive learning. In our courses, after students experienced this role-assigned group learning several times, students who initially stayed quiet began to raise their own questions and offer answers voluntarily. When students actively engaged in content learning, their performance in the assignments improved.

In peer-assisted small group learning, we emphasized that each role had equal responsibilities, especially in groups that had some roles whose names indicated authority over others, such as managers or student leaders. In one of our early studies on online peer-led discussions, we required student leaders to ask content-related questions and provide constructive feedback rather than creating an equal discussion environment (Zha & Ottendorfer, 2011). We found a problem from this study: student leaders focused on creating and explaining the content, which, in turn, made them and other members believe that they were supposed to be content experts. As a result, student leaders and other participants differed in performance and the interest they showed. Most students thought they learned more as leaders than responders. As a result, we changed students' roles to focus on group dynamics rather than content in the courses we taught during the COVID-19 pandemic. In addition, we clarified at the beginning and throughout the sessions that we randomly assigned the roles. We expected no one in a group to be the content expert, and they should discuss and solve the problems together. In our courses, students did not have fixed roles. They rotated among the group members. By the end of a course, each student in a group had at least one opportunity to take on all roles. The role rotation enabled them not only to view different aspects of the group dynamics but also to learn to collaborate effectively. We observed an equal access to the discussion content in small groups and students' active participation in collaboration.

We trained students in order to prepare them for the peer-assisted small group learning before we assigned learning activities. When courses moved online, we used the online orientation that our university's centers offered to train students on the technology they needed to use for the rest of the semester. In addition, we verbally and visually explained their responsibilities and provided a checklist to help them to adhere to their responsibilities. We also trained students about online interaction and communication strategies. For example, students learned to use the think-aloud technique to inform other group members since not everyone owned a webcam or had enough bandwidth to keep the webcam on all the time. The first small group learning activity in our class was usually a practice session during which we observed students' behaviors in group interaction and communication and offered suggestions for them to improve their role performance. With sufficient training, we seldom received questions from students regarding what they should do in group projects.

The flexible learning strategies did not work the same way in every student. Based on our experiences, some students could set up and complied with their own make-up plans. But when we asked other students to set and notify us of their make-up plans, we did not receive a follow-up response. Thus, we had to work with them proactively and set the new deadlines for them. We did not solicit reasons from them; however, possible reasons include different competence level and different time-management skills. All in all, we need to remain flexible with flexible learning strategies and adapt them on an individual basis.

2.3 Ensure Students' Readiness for Hands-on Learning

In our courses, hands-on learning activities usually started after students acquired the key concepts and theories via lectures and textbook readings. However, we found it challenging to reinforce this sequential order unless all learning activities occurred synchronously in online classes, which non-traditional students found difficult due to their changing life and/or work commitment. Hence, we adopted the readiness assurance strategy from team-based learning to improve students' readiness for hands-on learning, which prior we have found to effectively improve how well students understand concepts and theories in a prior study (Zha et al., 2019). Before the synchronous learning meeting, the instructor deployed an individual quiz, which required students to read the assigned articles and textbook chapters before the quiz. After students submitted the quiz, they discussed the answers to the same quiz questions in small groups. In the end, students had an appealing opportunity to defend their own answers in front of the whole class. Then, the instructors clarified the confusion and misunderstanding in students' answers.

In our POGIL courses, we wrote guided inquiry questions from lower- to higher cognitive-learning levels. The first half of the questions focused on strengthening how well students understood concepts and principles, while the second half required students to apply the concepts or principles and solve real-world cybersecurity problems. We found that students taking the POGIL lessons outperformed their peers who did not in other sections in the knowledge test.

2.3.1 What Worked

Students' participation in clarifying their expectations played an important role in enhancing their performance. In the undergraduate course using the readiness assurance strategy, we found that group dynamics varied and was associated with individuals' performance. For example, if students stayed quiet or conformed easily to others' answers, they had a lower likelihood to improve their conceptual understanding. However, if students showed their disagreement and strived for clarifications in group discussions, they had a higher likelihood to improve their conceptual knowledge. To address this issue, we conducted a synchronous discussion session before we deployed the readiness assurance strategy in the second iteration. We presented those scenarios as cases, sought students' answers, and initiated a whole-class discussion before students reached consensus on what they should perform in small group discussions. Thereafter, we observed an improvement in group dynamics.

Overall, our experience suggests that we can use readiness assurance quizzes to encourage students to read and watch assigned materials before class. However, we found an online synchronous discussion beneficial to consolidate students' lower-level cognitive learning. The discussion enabled students to exchange their understanding, identify misconceptions, clarify confusing concepts, and, thus, discuss and solve problems at higher cognitive-learning levels.

3 Lessons Learned

Sometimes, we found our strategies did not work out as we expected. Students' availability emerged as a big issue in online synchronous meetings. In our experience, we could not host a meeting at a time when every student in a course could attend. We always received students' emails saying that they had other commitments at those times and could not meet. Therefore, we planned to switch the class meeting to group meetings in our future iterations. One can find a meeting time for a small group more easily than for a whole class. At the same time, smaller groups may help students to bond with their group members.

In our online synchronous meetings, students sometimes disabled their webcams and lost contact. The whole class went into an embarrassing silence when they did not respond to questions or other inquiries. Furthermore, when a student disabled their webcam, the course instructors and group members lost the facial cues. We then had to use more verbal communication to understand whether the student had become confused, bored, or still engaged. Therefore, we recommend keeping the webcam on during small group sessions to keep the whole group engaged and focused on discussing course content. In the cases where students cannot turn on their webcams, we suggest requiring them to use the think-aloud technique to stay connected with other group members.

4 Conclusion

In this paper, we discuss three key issues in conducting an online IT/IS course that involves small group hands-on learning: 1) interactions, 2) equity and inclusive participation, and 3) students' readiness for hands-on or higher-level cognitive learning. We also explain how we used the evidence-based approach to explore effective solutions to them. For the first issue, we explain the advantages of synchronous and asynchronous communication tools and suggest that educators use them for different purposes. For the second issue, we suggest that educators give individual group members a specific role so that they each develop individual accountability and interdependence. We also share our experiences of offering flexible learning opportunities with students. For the third issue, we suggest that educators use a readiness assurance test and follow-up discussions to strengthen students' conceptual understanding and prepare them for the higher-level cognitive learning in hands-on activities. In the end, we summarize the lessons we encountered and offer suggestions accordingly.

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