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An online escape room used to support the growth of teamwork in health professions students

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ABSTRACT

Effective teamwork in the online environment is essential to patient care and safety. The need for training health professionals to work together on a virtual interprofessional team has become even more important since the start of the COVID-19 pandemic as telehealth, or the provision of virtual healthcare to patients, has become more common. This resource describes the development of an online escape room activity using free online resources. The activity aimed to enhance health profession students' abilities to communicate effectively, work together to complete a task, and develop knowledge of the unique roles of healthcare team members in a course dedicated to interprofessional education. Teams of five to seven students met online and completed seven puzzles to escape a virtual room. Results obtained from the pre-post surveys of 176 students across six disciplines showed the activity aided in increasing participants' perceptions of their ability to communicate respectfully and work together to complete a task, while developing knowledge of the unique roles of members of the healthcare team, all components of the Interprofessional Education Collaborative (IPEC) Core Competencies. This activity lays the groundwork for collaborative, interprofessional activities, such as telehealth, which students will be exposed to in their futures, and the results infer that the activity can help to build collaboration among team members, even team members that are not in the same physical space.

1. Format

Online escape room activity used in a virtual classroom environment for the "Interprofessional Healthcare Teams" course.

2. Target audience

Six healthcare disciplines were represented in an online course, including dietetics, health services, nursing, pharmacy, radiologic sciences, and respiratory care. Health services is a unique degree that prepares students for entry-level healthcare employment or graduate or professional degree programs. All students were in the first or second year of their program, except for nursing and dietetics, who were in their third or fourth year. The course was designed to foster interprofessional teamwork.

3. Objectives

The objectives of this study were two-fold. First, student learning objectives for the escape room aimed to enhance interprofessional students' perceptions of their ability to communicate effectively and respectfully, work together to complete a task, and to develop knowledge of the unique roles of members of the healthcare team.

Second, the research project objectives, in addition to the student learning objectives, were to evaluate students' perceptions of the usefulness of the online escape room and to assess students' attitude towards gaming as an active learning strategy.

4. Activity description

4.1. Background

The importance of the ability to work as an interprofessional healthcare team in the online environment has been well documented, particularly since the start of the COVID-19 pandemic.¹⁻³ Virtual interprofessional meetings have been shown to be an effective way to manage patient care.¹ An 'interprofessional healthcare teams' course was adapted from a traditional, face-to-face delivery format to an online course format to meet the changing needs of the university and to fit with the trend in healthcare to conduct meetings virtually during the pandemic.⁴ A paper-based escape room previously used in the face-to-face classroom setting was adapted to fit the online classroom space as a part of the course conversion.

Escape rooms are "live-action team-based games where players discover clues, and solve puzzles [...] in order to accomplish a specific goal, usually escaping from the room, in a limited amount of time."⁵

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Escape rooms are typically timed and often introduced with orientation to the escape scenario. Thus, they simulate a stressful environment, similar to what is often experienced in the workplace.⁶ Escape rooms have been used and studied as a part of interprofessional education to increase knowledge, interprofessional skills, and collaboration.⁶⁻⁹ There is a lack of data currently available evaluating the use of an online interprofessional escape room activity. The student learning objectives of this activity were derived from the Interprofessional Education Collaborative (IPEC) Core Competencies of *Teamwork and Team Based Practice, Interprofessional Communication, Roles and Responsibilities and Values/Ethics*.¹⁰

4.2. Activity

Six healthcare disciplines were enrolled in an online interprofessional healthcare teams course comprised of 195 total students, including dietetics, health services, nursing, pharmacy, radiologic sciences, and respiratory care. Prior to the first day of the course, students were assigned to teams of five to seven members that they would work with for the entirety of the semester. Most teams included one to two nursing students, one to two pharmacy students and two to three students from the remaining disciplines.

The virtual escape room involved an opioid overdose patient-case scenario and a total of seven puzzles which each team needed to solve to save the patient. Each puzzle highlighted one discipline from a healthcare team including, but not limited to all disciplines enrolled in the course. Knowledge specific to each individual discipline was not required.

The escape room activity was developed by one faculty member who was responsible for teaching the course content on *roles and responsibilities of the interprofessional team members*. Prior to the COVID-19 pandemic shifting course delivery online, the escape room was delivered in the classroom setting as a paper-based activity. Each team was stationed at a table and given a printed case, puzzle pieces, and distractors. Distractors are additional puzzles or pieces that do not contribute to the task at hand. For example, a Sudoku puzzle which has no bearing to the escape room locks or puzzles may be included. Students were also provided a QR code with a link to a Google Form which served as the lock for each of the puzzles. Each Google Form had a description of a different team member's role along with a question or puzzle to be solved using the printed materials. The role descriptions were drafted by the activity creator and approved by interprofessional faculty to align with the opioid overdose case. In conversion to an online activity, the materials were converted to PDF format and arranged with the correct

role. Additional distractors were added at the time of conversion to ensure that each team member had a potential piece of the puzzle. Google Form links were continued from the previous iteration.

For the online escape room activity, each student joined the class platform through a Zoom link using their smart device or computer. Students were given time to complete a pre-activity survey. Then, similar to a traditional escape room, a faculty member provided students with a brief overview including how to access the escape room, move from one puzzle to the next, and ask for a hint. Next, an introduction to the case was read by the faculty member and students were provided a weblink to a Google Form. Students were subsequently moved into pre-assigned virtual breakout rooms and given 60 min to complete the activity.

The first page of the Google Form instructed members of the interprofessional team to each select one of six colors (red, orange, yellow, blue, green, or purple). Clicking on the color opened a piece of the puzzle, unique to that individual/color. Students used the same color throughout the activity to obtain their unique piece of information or distractor for every puzzle, as shown in Table 1. If a team had more than six members, two team members were instructed to select the same color. Conversely, if teams had fewer than six members, it was recommended that one person open two colors and that this role be alternated for each puzzle as not to overburden one team member.

4.3. Puzzles

The first puzzle focused on the role of the nurse. A description of the nurse's role within the given case scenario was provided along with a question that needed to be answered to move past the first 'lock' represented by a locked Google Form. This format of providing a role description and question was repeated for each lock/role. To solve the nurse's role puzzle, students needed to use a decoder, patient specific vital signs from the case scenario, and a vital signs worksheet to determine a 3-digit code. This code was input into the Google Form as a virtual key to move to the next puzzle. Distractors were included for some participants so that each color or team member had what could potentially be a necessary piece to the puzzle. The use of distractors continued for all puzzles and was rotated through the colors to ensure parity among team members.

The second puzzle highlighted the role of the provider (physician or advanced practice clinician). Students were asked to identify two orders placed by the provider. These orders could be found in the patient case but were a mixture of nonsensical letters. Students needed to use an electronic cypher-wheel to decode the letters. A weblink to the cypher-

Table 1
Interprofessional escape room puzzles.

	Role	Blue	Purple	Green	Red	Orange	Yellow
Puzzle	Nursing	Alphabet/symbol decoder	Nursing role description	Patient case	Vital signs worksheet	Random letter number code	Sudoku
Puzzle	Physician or Advanced Practice Clinician	Scenario update and Provider role description	Word maze	Web link to cypher wheel	Word search	Patient case	Random letter code
Puzzle	Pharmacist	Memo containing phone number	Phone number decoder	Phone keypad	IV bag label	Scenario update and Pharmacist role description	Patient case
Puzzle	Radiologic technologist	Radiologic image with playing card embedded	Image of four playing cards	Radiologic image with playing card embedded	Radiologic image with playing card embedded	Radiologic image with playing card embedded	Scenario update and radiologic technologist role description
Puzzle	Respiratory Therapists	24 letter/number combinations	15 letter/number combination	Link to instructions for the game Battleship®	Scenario update and Respiratory therapist role description	24 letter/number combinations	Battleship® game board template
Puzzle	Dietician	Morse Code	Cypher code	Scenario update and dietician role description	Cypher code	Morse Code Key	Cypher Code key
Puzzle	Social Worker	Scenario update and social worker role description	Rebus part 5	Rebus part 3	Rebus part 4	Rebus part 1	Rebus part 2

wheel was provided to one team member. Another team member was provided a two-letter code to correctly align the cypher-wheel.

Puzzle three provided information on the role of the pharmacist and asked teams to determine what message the pharmacist communicated to the quality assurance (QA) department after discovering a medication error. Using a memo providing the QA department's phone number, a phone keypad, and a phone number decoder, teams were able to reveal a 10-digit message that when input into the Google Form, unlocked the next puzzle.

After reading the role description, teams were asked to determine the word that the images collected by the radiologic technologist spelled in puzzle four. Students were given four radiologic images of various types and body parts. Each image had a playing card embedded onto it. One student was given a picture of four playing cards arranged in a hand. By arranging the images into the order depicted by the four playing cards and abstractly evaluating the images, students were able to assign a letter to each image that would spell a 4-letter word. No radiologic knowledge was required for image interpretation.

The fifth puzzle emphasized the various roles of the respiratory therapist. For this puzzle, students were given a link to the directions for the game Battleship®, a blank grid simulating a Battleship® gameboard, and three sets of letter-number pairs. By marking each letter-number pair on the gameboard, teams revealed a word which could be input into the Google Form to unlock the next puzzle.

Puzzle six focused on the role of the registered dietician and asked students to decode the patient's favorite meal. To achieve this, teams needed to decode three different phrases, two using a cypher and one using Morse code. Each member of the team either received the cypher key, Morse code key, coded phrases or the scenario update and role description. Again, students input the patient's favorite meal into the Google Form to advance to the next and final puzzle.

The final puzzle, puzzle seven, described the role of the social worker. Five separate rebus puzzles were used to create a teamwork centric phrase. This phrase was used to officially escape the virtual room.

As they worked through the puzzles, teams had the ability to ask the faculty instructor for hints using the "ask for help" feature in the Zoom breakout rooms. The instructor would then navigate to the breakout room and provide guidance as needed. One faculty member was able to facilitate up to 17 teams simultaneously, eliminating the need for additional facilitators and associated training. All teams successfully completed the escape room within the allotted time. As teams completed the escape room, they would navigate back to the main Zoom room for a short debriefing and administration of the post-survey.

5. Assessment

Via electronic link, an 8-item pre-survey was administered in class immediately prior to the escape room activity and a 26-item post-survey was administered immediately following the activity. The pre-survey asked students to indicate their degree program (nursing, pharmacy or other), and past participation in an escape room (yes/no). All remaining pre-survey questions were measured with a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*) and based on the IPEC Core Competencies.¹⁰ Students were asked to rate their confidence in their team's ability to work together, communicate as a team, use respectful language, and successfully complete the final simulation. The final two questions asked students to indicate if they can explain the roles and responsibilities of other health care professionals and if they feel they bring unique qualities to a team.

The 26-item post-survey included all the questions from the pre-survey and seventeen additional questions. Of the seventeen questions, 10 questions asked students to evaluate the effectiveness and usefulness of the activity. Seven questions measured students' attitudes toward gaming. The additional questions evaluating effectiveness and attitude towards gaming questions were measured with the same 5-point

Likert scale. Surveys available upon request. The study was approved by the Institutional Review Board of North Dakota State University.

6. Evaluation

Of the 195 students in the course, 176 completed the surveys (Response Rate = 90.3%). Of the students who responded, 95 (54%) indicated that their major of study was nursing, 57 (32.4%) pharmacy, 24 (13.6%) other type of health profession students including dietetics, health services, radiologic sciences, or respiratory care.

Six questions related to team activity perceptions were administered to students on both the pre- and post-surveys. Mann-Whitney U tests were conducted to determine whether there were differences in the pre-post responses of students. Data were analyzed using a 5% significance level. Results of that analysis indicated that there were significant differences in responses before the activity to after the activity for the questions: I feel confident in my team's ability to work together to accomplish a task ($z = -4.780, p < .001$); I feel confident in my team's ability to communicate effectively as a group ($z = -5.222, p < .001$); I feel confident in my team's ability to use respectful language appropriate for a given difficult situation ($z = -2.514, p = .05$); I feel confident in my team's ability to successfully complete the final simulation ($z = 5.158, p < .001$); I can explain the roles and responsibilities of the members of a healthcare team ($z = -7.137, p < .001$) and I bring unique qualities to my team ($z = -5.617, p < .001$).

One hundred seventy-six students completed the post-survey as shown in [Table 2](#).

7. Impact

The virtual escape room activity aided in increasing participants' perceptions of team dynamics based on the IPEC Core Competencies.¹⁰ Students who participated in the activity were not only more confident in their team's ability to work together to accomplish a task but also successfully complete the final simulation later in the semester. This increase in teamwork perception among students is important for their future interprofessional team situations, both in and out of the classroom.

Additionally, students felt more confident in their ability to communicate effectively as a group and use respectful language when participating in a difficult situation. The ability to communicate effectively in the online setting is useful given the ever-changing roles of healthcare providers who are now incorporating virtual visits into their workflow. This activity also helped to increase the student's confidence in their ability to explain the roles and responsibilities of the members of a healthcare team as well as identify unique qualities that they bring to the team, fulfilling the student learning objectives of the activity and a major component of the IPEC Core Competencies.

Students, overall, had a positive attitude toward gaming following the activity, with 92% ($n = 162$) of students agreeing they would recommend the virtual escape room to other students. One challenge that has been identified in the implementation of activities into interprofessional coursework is the development of activities at an appropriate level of learning for all the students involved based on their previous course work and progression within their program.^{11,12} This online escape room activity had 96% ($n = 169$) of students agree the activity was appropriate for their level of training indicating this was appropriate for the wide variety of learners in the course.

There were several limitations to the study. The first is that while the study measures perceptions of teamwork and gaming, there was no formal assessment of actual teamwork, gaming ability or patient outcomes. Additionally, increases in knowledge were not assessed based on the design of the virtual escape room. Changes in student knowledge while working as part of an online interprofessional team and associated patient outcomes may be beneficial to study in the future. Finally, while there was a high response rate, this study was conducted at one

Table 2
Post-activity survey (N = 176).

Item	Strongly disagree (%)	Disagree (%)	Neither agree or disagree (%)	Agree (%)	Strongly agree (%)	Mean (SD)
The virtual escape room promoted interprofessional teamwork and communication ^{a,b}	0	2	4	54	116	4.6 (.59)
The virtual escape room was a beneficial relationship building activity for my team ^b	0	3	6	56	111	4.6 (.65)
The virtual escape room was appropriate for my level of training	0	3	4	67	102	4.5 (.63)
The virtual escape room is a valuable component of the interprofessional education curriculum	0	2	12	62	100	4.5 (.68)
This activity simulated the time constraints and pressure that I expect to feel during the final simulation ^{a, b}	0	4	14	62	96	4.4 (.74)
The virtual escape room encouraged me to think about material in a new way	0	1	6	67	102	4.5 (.59)
I would recommend this activity to other students	0	4	10	57	105	4.5 (.71)
I learned from my teammates during the virtual interprofessional escape room ^b	0	4	8	63	101	4.5 (.69)
The escape room was an effective way for me to review the roles and responsibilities of the interprofessional team members ^c	0	10	9	68	89	4.3 (.82)
The escape room was an effective way to learn new information related to the roles and responsibilities of other members of the healthcare team ^c	1	10	13	62	90	4.3 (.88)
I prefer assembling information from a variety of sources when learning new material	2	5	18	64	87	4.3 (.85)
I learn better in a game format than in a didactic lecture	3	17	43	54	59	4.0 (1.1)
The virtual escape room was an effective way to assist my learning of the value of teamwork to accomplish a task ^b	0	5	9	72	90	4.4 (.72)
I feel I was able to engage with my teammates to learn new material ^b	2	5	11	58	100	4.4 (.82)
It was difficult for me to focus on learning because I was feeling stressed or overwhelmed	24	50	28	34	40	3.1 (1.4)
The non-educational portions (ex. Cyphers, puzzles, etc.) distracted me from learning about the roles and responsibilities of the interprofessional team	21	37	34	43	41	3.3 (1.3)
In general, I enjoy playing games (eg. Video games, board games, social media games, etc.)	0	5	20	72	79	4.3 (.78)

1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, 5 = strongly agree.

^a Learning objective: Enhance student's perception of their ability to communicate effectively and respectfully.

^b Learning objective: Enhance students' perception of their ability to work together to complete a task.

^c Learning objective: Develop knowledge of the unique roles of the members of the healthcare team.

institution during a single year during the ongoing COVID-19 pandemic. Students were receptive to the online format during the pandemic but may prefer an in-person format in the future.

This escape room activity was originally a paper-based activity that used Google Forms for the locks. This aided in the ease of adapting the activity to the online format and allowed for minimal need for student oversight. One unanticipated benefit was the ability to utilize the activity in future years without having to do any additional set-up or preparation. Adapting other types of escape rooms may prove to be challenging and time consuming for faculty but could have a similar pay off in subsequent years.

This activity lays the groundwork for collaborative telehealth students will be exposed to in their futures and the results infer that the activity can help to build collaboration among team members, even those not in the same physical space. It also shows that virtual escape rooms can be an effective activity to increase interprofessional teamwork perceptions in the online classroom environment and could prove to be useful in other online interprofessional settings.

8. Required materials

This activity can be replicated using a small budget in about 15–20 h. A Zoom or similar video conferencing software that allows breakout rooms and screen sharing is required to host the class as well as allow each team to have a breakout room. Google Forms are necessary to serve as the 'locks' and can be created by anyone with a Google account. Google accounts can be obtained at no cost. All of the puzzles and distractors were generated utilizing free online tools. Links available upon

request.

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Allison Hursman: Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Review, & Editing. **Lisa M. Richter:** Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Review & Editing. **Jeanne Frenzel:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Review, & Editing. **Joni Viets:** Writing – original draft. **Elizabeth Monson:** Writing – original draft, Writing – review & editing, and Review, Editing.

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