Use of games to teach teamwork and communication skills to engineering students

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***Abstract*—The use of video games in education is nothing new, but often these games are specifically designed for one or more specific learning objectives. These games focus on maximizing the learning outcomes and are paired with a curriculum designed to cover the selected materials. However, that does not always translate to fun games or games played outside of the classroom. Students will associate these educational games as part of the class, not something they would do for fun. These games can be beneficial, but they can also be limited in scope. Since these games have a limited purpose, they are often used for that purpose and not used for anything else.**

This paper will review a trial run conducted in Fall 2020 using a popular and mainstream puzzle-solving game to teach engineering students teamwork and communication skills. First, we will outline our methodology for conducting this trial and the plan we followed in executing the trial using teleconference tools due to COVID-19. Next, we will discuss both pros and cons of using this game and the lessons we learned from this trial. Finally, we will review the data collected from this trial and the future work to continue using these games as an educational tool.

***Index Terms*—education, video games, game based learning**

I. Introduction

In this paper, a trial is conducted to examine if using non-educational games can teach engineering students professional development skills. This trial, conducted during COVID-19, also used online tools, like Microsoft Teams, to conduct a trial while keeping all participants safe. We will show our methods and reasons for conducting this trial and the preliminary data collected from this trial. The hope is that this will lead to further research in engaging students in the learning process and obtaining new skills they can take to the workforce.

II. Problem Statement

Engineering students need additional skills outside of the core material learned in their respective majors [1]. These skills are often referred to as "soft skills" or "professional development" skills, and in this paper, we will refer to them as professional development skills. Specific professional development skills taught in engineering courses include leadership, communication, and teamwork. While there are additional skills beyond these, these are often taught the most. These skills are also expected to be taught in the engineering curriculum and are required for ABET accreditation [2].

This trial is part of ongoing research in teaching engineering students professional development skills using games and virtual reality under the Game-Based Learning framework [3]. For this trial, the focus will be on communication and teamwork skills. Many professional development skills have value for students, and there are many different professional development skills. These skills were selected as they are common skills currently taught in many engineering curriculums; they are well-researched skills. It was determined they could be taught with the video game selected for this trial.

This approach aims to teach students these skills using video games and virtual reality to provide an interactive and engaging environment. Playing games and having fun can help the students learn and retain information taught to them [4]. By learning these skills in an enjoyable learning environment, there will be an improvement in learning these skills [5]. The interactivity and immersion through virtual reality using this game helps to create positive emotions for learners. The role of positive emotions can broaden the player's ability to learn. Players can have fun and solve complex tasks together. Players promote collaborative learning, problem-solving, and experiential learning and offer innovative ways of addressing different learning styles.

Virtual reality in teaching is not new; both gaming and virtual reality have focused on more recent research. Many courses have used virtual reality to teach students skills in an environment that may otherwise be hazardous [6]. Similarly, the use of games to teach students is also not new. However, the recent advent of video games has been utilized to teach students new skills [7]. As virtual reality and augmented reality technology have continued to evolve, virtual reality games have become more accessible. High-end graphics combined with improved controls have allowed for virtual reality games to have a realistic feel. This realism has opened up a new avenue to using virtual reality and games in the teaching environment.

The game, *Keep Talking & Nobody Explodes*, is not explicitly designed for teaching students these professional development skills. However, research shows that video games are useable to teach these skills even if not designed to do so [8]. By utilizing a game that students may be familiar with and is enjoyable to play, students can focus on the experience, which

includes learning and trying out their skills in a controlled manner and have instant feedback as they play. With this instant feedback, students will know if what they are trying is working or not working. This feedback allows for a continuous cycle of learning by doing and checking if the action is correct. The use of virtual reality also allows us to immerse students in an interactive environment. The immersive environment of virtual reality engages the student in the learning process to learn these skills.

As the users play the game multiple times, they could improve their teamwork and communications skills and choose higher-level challenges. These game mechanics combined could result in a flow experience, characterized by complete immersion in and focused concentration on the activity [9]. Furthermore, since the learners can strategize their collaboration to achieve a common goal through gameplay, we expect them to find the learning experience satisfying and enjoyable.

III. Methodology

In Fall 2020, a trial evaluation of using one of the games, *Keep Talking & Nobody Explodes* was conducted. This trial was done as part of the EDUC 504 course taken in the Fall of 2020. The trial used a tiny sample of students, only five students participated. Still, it helped determine if the combination of video conferencing and online gameplay could be used to conduct the study needed. At the time of the trial, the COVID-19 pandemic caused many universities to switch to online classrooms. Therefore a safer method was needed to conduct this trial. A safer option to conducting these studies would be to use video conferencing and online gameplay instead of running these face to face and in a single room, which was the original plan before the pandemic hit. Another reason for conducting this trial was to test out instruments developed before the course was taken. This test included the pre and post-surveys. It also allowed for feedback from people outside of this research that could give constructive feedback in improving this research.

In order to evaluate a non-educational video game as an educational tool, we needed tools to form our evaluation questions. We chose to frame our evaluation questions based on flow theory [10], one of the more popular theories to describe the playing experience [11], [12]. Flow theory proposes that when one is engaged in an activity where their skills balance with the activity's challenge level, they reach a flow zone. However, a mismatch between the skills possessed and the challenges, anxiety, or boredom may arise, as shown in Fig. 1. Flow refers to the experience or the state of complete absorption or engagement in a goal-driven activity [10]. This complete absorption or engagement could lead to learning and satisfaction [10], [13], [11].

Expanding on the original dimensions that produce flow experiences: activity, concentration, challenge level of the activity, control, clear goal, feedback, and immersion, researchers have developed multiple game evaluation instruments based on the flow theory [14], [13], [15]. The literature search referred to three validated scales measuring users' flow experience to

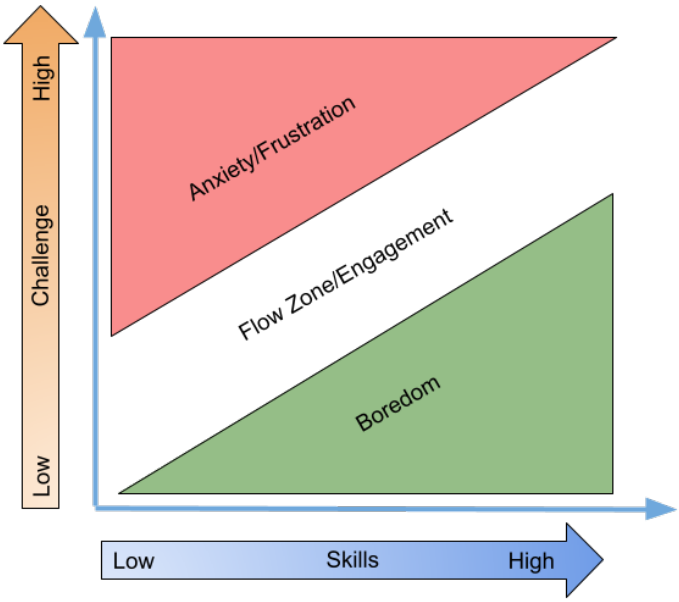

Fig. 1. Graphical representation of flow during gameplay.

develop our evaluation questions. The three scales include the GameFlow model [16], the scale of EGameFlow [13], and the 9-item GameFlow questionnaire [15]. All three scales include the following dimensions: concentration, challenge, feedback, control, and clear goals. The unique dimensions in the GameFlow questionnaire have playability, time distortion, rewarding experience, and loss of self-consciousness. Simultaneously, immersion and social interaction are included in the GameFlow model and the EGameFlow scale. The EGameFlow scale also consists of the knowledge improvement dimension.

Based on the dimensions commonly measured in the literature and our interests in how the game of our choice engages and potentially helps the students, we specifically focus on concentration, challenge, feedback, immersion, social interaction, and knowledge improvement shown in Table I. We asked three questions, as shown below.

1) Does the game engage the learners?
2) How do users perceive the usefulness of the game in terms of improving teamwork skills and communication skills?
3) Does the game support social interaction among the users?

Question one addresses if the game engages the player. Though engagement has been widely researched in the literature, there is no consensus on its definition. One paper, for example, describes engagement as the first level of involvement leading to total immersion [17]. In comparison, another paper considered immersion as a later stage of engagement [18]. Our study grouped immersion, challenge, feedback, and concentration under a general "engagement" question, which measures whether the learners can experience a sense of flow through playing the game. Based on the knowledge improvement dimension from the EGameFlow scale, we also ask,

TABLE I
MATRIX OF EVALUATION QUESTIONS.

	Instruments			
Questions	**Pre-test**	**Observation**	**Focus Group**	**Survey**
1		X	X	X
2	X		X	X
3		X	X	X

"How do users perceive the usefulness of the game in terms of improving teamwork skills and communication skills?" This question aims to gauge learners' perception of how playing the game could enhance their teamwork and communication skills. For the third question, we ask, "Does the game support social interaction among the users?" This question pertains to the second question because significant interaction is essential in developing teamwork and communication skills [19].

We used surveys, observation of the players, and a focus group for our instruments to address the questions we outlined. The presurvey asked learners to provide necessary demographic information such as age, gender, and digital gameplay experience. The learners also self-report their perceived level of teamwork skills and communication skills. We decided to use observation of the activity to answer the first question and third question because observation can avoid self-report biases and learn about participants' reactions, behaviors, and interactions [20].

The post-game survey is used because surveys can be easily distributed and used to assess the construct of interest. These surveys can also take advantage of existing surveys designed to canvas the topics of interest. Our survey is developed based on the EGameFlow scale [13]. We chose this specific scale for two main reasons. First, the scale has been validated in terms of construct validity, divergent validity, convergent validity, criterion-related validity, internal consistency reliability, and test-retest reliability [21]. Second, the scale contains the knowledge improvement dimension that is of interest. On the original scale, 42 items are covering eight dimensions. We omitted the "goal clarity" criterion since it is straightforward—do not blow yourself up and the "autonomy" goal since the authors had deleted most of the questions after validity and reliability testing.

To suit the purpose of our evaluation, we deleted non-applicable items in the dimensions we measure. For example, we deleted the item "The game provides online support that helps me overcome the challenges" in the challenge section as our game does not have online support for the learners. We also retrieved two items from the Game Usability Heuristics survey [22] for the challenge and immersion sections to clarify the questions. For example, we added the item "Easy to learn, harder to master" to our challenge section. Also, we adapted the items in the knowledge improvement section to reflect the focus on teamwork skills and communication skills. We believe the focus group is appropriate for our evaluation because the focus group allows us to explore learners' judgments, let participants build on each other's inputs, and ask in-depth follow-up questions if needed [20]. However, there is also concern that the focus group interviews might lead to groupthink. We considered this unlikely in our study because the responses from the participants were not high-stake (e.g., participants' final grades would not be impacted because of the responses they gave).

A. Game selection

Keep Talking & Nobody Explodes is a multiplayer game where players collaborate to defuse a bomb. The defuser can view the bomb and carry out steps to defuse it under the other players' guidance – the "experts". Experts are not able to view the bomb but can read the manual. The game runs on various virtual reality (VR) platforms, console devices, and mobile devices. Only the defuser needs to run the video game. The experts play by reading a bomb-defusing manual and telling the defuser what they need to do to defuse the bomb. The defuser and experts can meet in person or through an online meeting platform such as Microsoft Teams. The manual is available as a free download from the game developers' website.

This particular game was selected for a variety of reasons. The first reason was due to cost. The game can be picked up at most online game stores for $15 or less. The game has also been out on the market for some time and is relatively popular. The popularity was intentional, as other students may have played the game before. The game is also stable, with very few bugs being reported. The game has a simple but effective interface that most players pick up very quickly. Finally, a feature planned for future work is that the game can be customized with custom puzzles instead of built-in puzzles.

B. Software and hardware setup

The pilot test run conducted used a computer setup with the *Keep Talking & Nobody Explodes* game installed and configured for virtual reality with an HTC Vive headset and Steam VR. Microsoft Teams was used to allow the player in VR and the players who play "experts" to communicate. The experts, however, can not see the VR player's screen, which is by design. Each expert was given an electronic copy of the "Bomb Defuser Manual" before starting the activity. They were allowed to read through the manual before the activity.

Players are given a fixed time to defuse the bomb. Some bombs also have a strike indicator, which counts the number of errors the defuser can have. If the defuser exceeds the number of strikes or exceeds the time allocated, the bomb explodes. Bombs have from three to 11 modules, which can be defused in any order. Each module is a mini-puzzle that the defuser must solve to defuse the bomb with the experts' help. A screenshot of the view of the bomb, shown in Fig. 2, is from the defuser's perspective. The game has multiple difficulty and skill levels that determine the number and types of modules and the time allowed to defuse the bomb.

Each module presents different types of puzzles that need to be solved by the defuser. Some involve simple operations such as cutting wires in the correct order or pushing a button

Fig. 2. A screenshot of the game during gameplay from the VR player perspective.

at the right time. Others involve more complex actions such as interpreting flashing lights as Morse Code, navigating mazes, or decoding passwords. In all cases, success depends on the defuser's ability to communicate what they are seeing and the experts' ability to follow and communicate the complex sequence of steps needed to defuse the module safely.

Due to COVID-19, an online communication platform was used to keep all participants and observers safe during the pandemic. Microsoft Teams was selected since it supported video, voice, and text communication. It also allowed those who were overseeing the activity to share documents during and after the activities. The game itself did not require any network connectivity since all interaction between players took place using Microsoft Teams. This interaction included the players being able to talk to each other and see each other. However, the "experts" were not allowed to see the screen of the player in VR.

C. Data collection process

Data collection was completed through the use of surveys, observations, and focus groups. The surveys used Qualtrics to obtain the data and to aid with analyzing the data. Observations used several observers that observed and recorded their observations. Each observer used a "Guidelines for Observers" document. In that document, the observers wrote down any notes and used the questions to guide them in what to observe. The activity was recorded using Microsoft Teams, which allowed for a reexamination of the activity if something was missed.

D. Session Set-Up

We performed two sessions with three players each. In both sessions, the players and team members met on Microsoft Teams. The players for each session consisted of one "defuser" who controlled the bomb in a VR environment but could not see the manual and two "experts" who could read the manual but could not see the bomb. The team members consisted of one moderator and three observers. The VR system used by the "defuser" was set up by the moderator in his home. Copies of the manual were e-mailed to the "experts" before the game.

E. Pre-activity

The pre-activity survey, sent before the activity, obtained demographic information such as age, gender, and digital gameplay experience from each participating player. The demographic information gave us background information on each player. Two additional questions were asked to ascertain the player's self-assessment on their teamwork and communication skills. These questions used a Likert-type scale to compare the differences between the pre and post-survey.

F. Game Play Activity

The moderator introduced the players and observers. After introductions, the observers turned off their video and muted themselves. Then the moderator explained the game to the players and helped the "defuser" with the VR setup. Finally, the observers used the Observer Guidelines instrument for taking notes during gameplay.

The players played two games. First, the players played one round of the game and then were given some time to strategize how they would like to play on the second round. During this time, the players developed new methods, including having "experts" research different puzzles in parallel and working on one side of the bomb to make it easier on the "defuser". Once they were ready, they then played an additional game, incorporating the new strategies.

G. Focus Group Activity

After gameplay, the moderator held a focus group with the players. The focus group was held according to the Focus Group Guidelines and Questions instrument, which includes:

- the script explaining the purpose and ground rules for the focus group,
- prepared questions on the gameplay experience, usefulness in terms of learning teamwork and communication, and social interaction,
- an open-ended question was asking for any additional observations or recommendations.

The moderator and observers took notes during the focus group session. The session was recorded with Microsoft Teams for examination at a later time. This video included participants' reactions but did not include a video of the gameplay. Data from the focus group was collected using the "Focus Group Guidelines and Questions" document. The form includes questions that will be asked and provides some of the discussion guidelines and rules. The moderator and observers will record the responses from the players.

H. Post-activity

The players were thanked for their participation and asked to fill out the Qualtrics post-survey, sent via e-mail. The post-activity survey will ask the same questions as the pre-activity survey regarding where the players think their communication and teamwork skills are. This survey will be sent to the players after the activity via Qualtrics. The survey will also ask questions on how they felt the game and virtual reality experience went. This information will provide feedback on

how the activity went and what they liked about playing the game. It will also ask if they felt they learned anything from playing the game.

After the players signed off the Microsoft Teams session, the team met to debrief the activities. The group compared notes and discussed how the activity went. Once all group members were happy with the notes taken, the meeting adjourned.

IV. Data analysis plan

A. Survey Data

The survey data contained quantitative data from the participants. This data can then compare the results and look for patterns between the players. For the Likert-type scale questions, we calculated the average and looked for patterns in the data. Next, we compared the participants' answers and found out similarities and differences. Finally, we summarized the data and turned the results into findings.

B. Focus Group

We stored, organized, coded, sorted, and retrieved data collected from the moderators and observers. A secondary data analysis process was employed using a spreadsheet, which involved the researcher's manual extraction of themes from each player's focus group transcription. Creswell and Clark identified that this method consisted of extensive reading, color coding, and transcribed focus group responses and notes obtained by the researcher [23]. First, we compiled a summary of major emerging themes developed by performing a hierarchical analysis of the coded responses. Next, we reviewed focus group questions, transcribe and verbally record responses to compare and contrast participants' comments. Finally, the data was used to explore, examine, and formulate explanations that describe the players' experiences from their perspectives. Finally, we presented our findings and feedback in a narrative format.

C. Observation

When we observe the participants, we used the "Guidelines for Observers" document. This document provides some guiding questions for the observers to keep in mind. A sample of some of the questions is listed below.

- Did everyone participate equally?
- Were people cooperative or competitive?
- How well did they follow instructions in the manual?
- Did the defuser have problems using the simulation?
- Did experts have problems with the manual?

We reviewed what was witnessed and recorded and synthesized it with the players' observations and words when analyzing the data. The researcher began by reading a situation as a text and compare the observational data. The analysis may reveal convergent data or metaphors that evolve from thematic analysis. Key themes are examined for their significance and interrelationships. We revised the test based on the observational data.

V. Results

Both qualitative data and quantitative data were collected for the second run. For the first run, only qualitative data was collected during the focus group time. This mistake was due to an error in sending out the surveys, and it was not caught until much later.

The data collection took place using Qualtrics for the survey data and analyzing the focus group recordings to extract keywords and phrases. The sample size for this data is tiny. Therefore while the initial data result showed a positive response, it should be noted that the results would be inconclusive with such a small data size. The trial's goal was not to collect data but rather to test the procedures and instruments to be used. There is, however, useful information in the data collected.

A. Pre and Post Survey Comparison

Those who participated were given a pre-survey and post-survey that included a self-assessment in their knowledge of teamwork and communication skills. The first skill examined was the communication skill. Here, students self-identified that on a scale of 1 to 10, with ten being very confident and one is not confident that before the activity, they had an average score of 7.00. After the activity, the participants took the post-survey, and the average score increased to 7.33. While this does show a positive increase, the increase is not significant.

However, looking at the teamwork scores showed a more significant increase. Again, participants were asked to rank on how confident they felt they were with their teamwork skills. Overall, many thought they were reasonably confident with teamwork skills, with an average score of 7.67. However, after the activity, this score jumped to 8.67. This increase in score seems to indicate a positive effect on the participants, even though they seemed pretty confident in knowing how to operate in a team. Fig. 3 shows a graph of the participants' average scores for both the pre and post-survey.

While this is a small sample size, it shows promising results that the game did impact the participants and that at least they felt that they improved both their communication and teamwork skills. For this group, it can be seen that teamwork skills had a more significant impact and that score increased by one whole point. However, while there was an increase in communication skills, the increase was minor, with only a 0.33 point increase. In both cases, though, with the sample size being small, a definitive conclusion can not be made at this time.

Part of the post-survey asked participants to provide additional information on the effectiveness of the activity and game was. In Fig. 4, 67% of the players feel that the game effectively teaches participants teamwork and communication skills, 33% of the players feel the game is moderately effective in teaching some skills. If they used the VR headset, all the players agreed or strongly agreed that virtual reality helped them learn teamwork and communication skills and made the activities engaging and fun. If they did not use the VR headset, all participants agreed it helped in the activities being

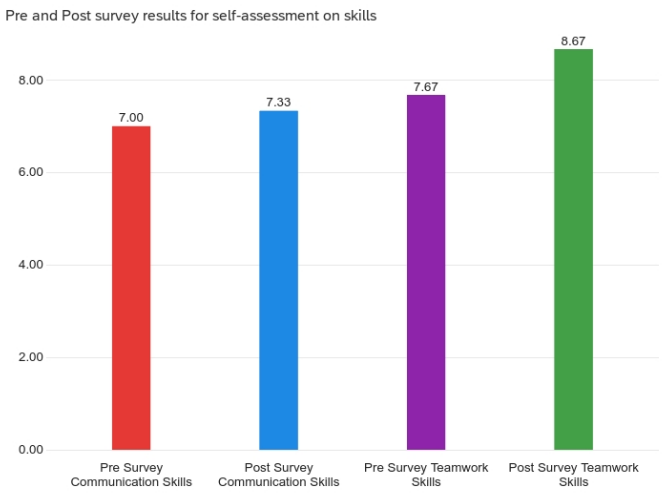

Fig. 3. Average scores of the self-assessment participants did on teamwork and communication skills in the pre and post survey.

engaging. However, all the players strongly agreed that they had fun participating in these activities and learned something while doing so.

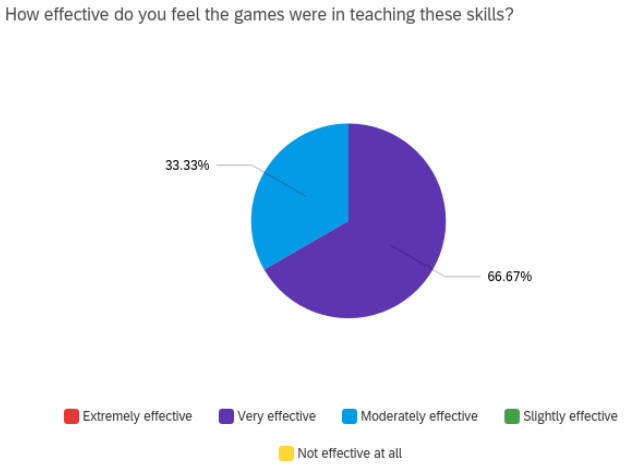

Fig. 4. Responses to the effectiveness of teaching teamwork and communication skills using this game.

A Likert scale was used for determining how the participants felt about concentration during gameplay. This part of the survey asked them to agree or disagree on four topics. These topics were on if they could remain concentrated during the activity if they were not distracted, if the workload in the game was balanced and if they felt burdened during gameplay. Participants either agreed or strongly agreed that the workload was balanced, they were not burdened during gameplay, and they were not distracted (Median (M)=6.33). Participants ' responses varied a little more for the ability to remain concentrated during gameplay, with one participant only somewhat agreeing, and the rest were either agree or strongly agree (M=6.00). Fig. 5 shows the data in a bar chart format.

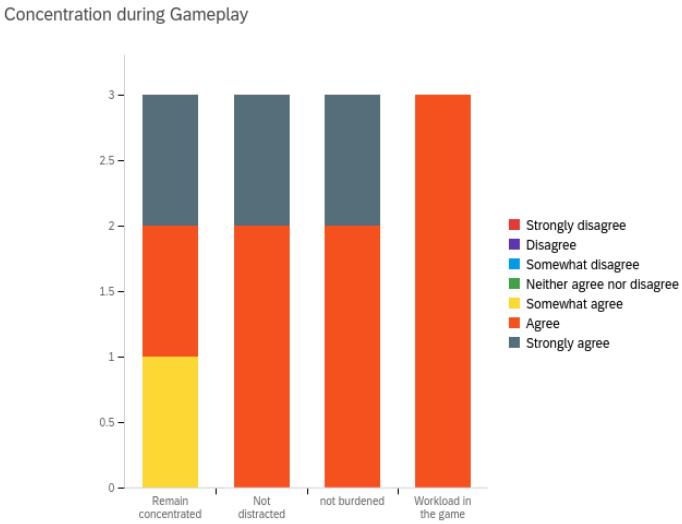

Fig. 5. Chart showing how much participants could concentrate during gameplay.

Another Likert scale was used to determine how challenging the gameplay was. Here, one player agreed, one player strongly agreed that the game was paced to apply pressure without frustrating the players (M=6.00). In addition, one player agreed, and two players strongly agreed that the game was easy to learn (M= 6.67). Finally, two players agreed, and one player strongly agreed that the challenges had a positive game experience (Mean=6.33).

All the players agreed that the game was fun with no repetitive or tedious tasks (M=6.00) and they felt immersed in the game. One player somewhat agreed, one player agreed, one player strongly agreed that gameplay was exciting and enduring and kept their interests (M=6.00). Two players strongly agreed that they forgot about time passing while playing the game (M=6.67). One player somewhat agreed, one player agreed, one player strongly agreed that they temporarily forgot worries about everyday life while playing the game (M=6.00). One player strongly agreed that they experienced an altered sense of time while playing the game (M=6.67). Two players agreed that they were emotionally involved in the game (M=5.67).

For social interaction, all the players agreed that they felt cooperative toward other players while playing the game (M=6.00). Two players agreed, one player strongly agreed that they intensely collaborated with others while playing the game (M=6.33). All the players agreed that the game supports social interaction between players (M=6.00).

Fig. 6 shows responses from participants on the effectiveness of learning in the game. In these questions, participants were asked to use a Likert scale if they felt the game was effective in teaching communication and teamwork skills using games. Most participants thought the game was very effective in teaching these skills. However, one participant stated that they thought it was moderately effective. When asked how

they felt about using virtual reality in teaching these skills, all participants responded that they felt it was moderately effective.

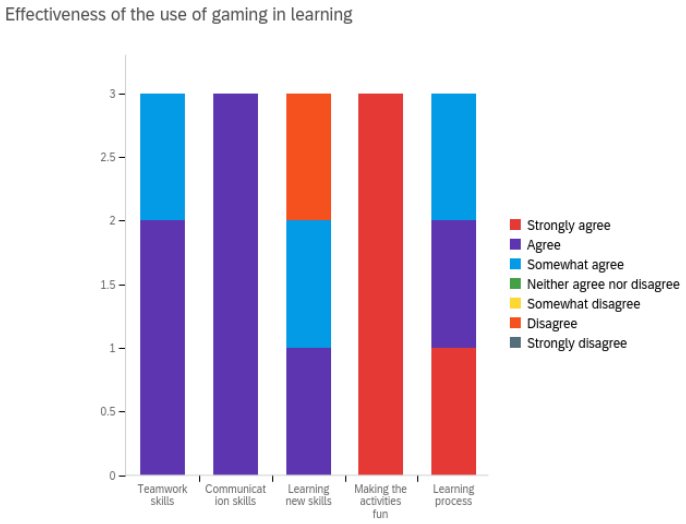

Fig. 6. Chart showing responses from participants to how effective the game was in teaching teamwork and communication skills.

B. Focus Group Data

After the participants completed the activities, we then asked the participants a series of questions. Next, we will discuss the key things we gathered from the focus group discussions. Each named paragraph outlines the key topic we were asking about and has data from both focus groups.

a) Challenges: We asked the participants what challenges they had in playing the game. Many of the participants noted challenges with using the bomb defusal manual that the game makers provided. It should be noted that the makers of the game did this on purpose. Part of the challenge with the game is using a manual that is not set up in any logical order. One participant responded that they needed more time with the manual in order to become familiar with it. This request was something we did consider and planned to offer more time before and between activities so that they can look through the manual. This request is an example where flow theory comes into play. The game should be challenging so they engage with the game, but if it is too hard, then players may disconnect from the game due to frustration.

b) Social Interaction: Participants were asked how they felt the social interaction was during gameplay. Responses from participants indicated that the real-time gameplay encourages social interaction and that the teamwork aspect of the game requires there to be social interaction. All participants interacted with each other to achieve a common shared goal. All participants responded that this is a cooperative interaction process, and they learned how to collaborate cohesively in a competitive environment.

c) Teamwork Skills: Participants were asked if playing this game was suitable for practicing teamwork skills. Responses included that team members can better know each other and achieve the same goal through playing this game. Another participant responded that playing this game can help him manage roles and responsibilities, build quick, concise, and clear communication between people whose tasks rely on each other. Another participant responded that this game could improve teamwork skills and help him understand how people think. A final participant responded that the planning portion was helpful, which is the most vital aspect of developing teamwork. Through this game, they understand what they learned and how they used this for the next game.

d) Communication Skills: Participants were asked if playing this game was suitable for practicing communication skills. One participant responded that although they only had a few minutes to build a game plan and execute it, this game made it easier to communicate. Participants were able to solve more challenging situations after playing the game for a few minutes. Another participant responded that the more they played it, the more effective they got. This game provides him with enough information without overloading it. A participant responded that problem-solving could help him develop communication skills. For instance, during the game, the second player needs to describe the characters and transfer detailed information to the bomb diffuser. This process can then help in their communication skills.

e) Perceived Usefulness: Participants were asked how helpful the game was in teaching teamwork and communication skills. All the participants agreed that this game is suitable for teamwork. One participant responded that having the players set up one goal and figuring out how to achieve that goal was very useful. Another participant responded that having multiple rounds is one of the best aspects of this game. The game encouraged players to build up more skills through the game and taught them how to tackle more complex challenges. Another participant pointed out that this game could be an effective ice-breaker activity. Many thought that this activity was a better tool than other activities they participated in to teach teamwork. One participant noted that they had participated in team-building activities at NASA and thought this was better than some of those activities.

f) Feedback: In the first group, all players responded that this game could help them understand how people operate, especially in a large group. For the second group, all players think it is a valuable part of team building when everyone is playing together. The players also responded that the manual provides enough information for them to work together.

C. Positive traits of using video games education

The use of video games in education can have a positive effect on those that are participating. In our short trial, our game selected appears to have been effective in teaching both communication and teamwork skills. This game needs a quick and accurate exchange of information with another player. The game experts, who have access to the manual, need to use effective and efficient communication skills to progress through the game. By playing this game, players can practice listening, questioning, describing, and clarifying

critical communication skills. With the combination of virtual reality and a game environment, students were engaged and having fun while learning.

D. Negative traits of video games for education

A negative trait of using video games and virtual reality in education can be frustration. As can be seen in Fig. 1, there is a point where frustration or a lack of challenge will result in those not being engaged in the game. Frustration also brings with it more negative emotions, and this can be detrimental to the learning process. In our game, there was some frustration with using the provided manual. While this is part of the challenge, it can create frustration for some. The game is also designed to have some stress involved. The game is timed, and the person defusing the bomb can see and hear the clock ticking down. While some stress can be helpful, too much stress can hurtful and not create a good learning environment.

This game utilizes the exchange of information between the VR player and non-VR players to defuse a bomb in the VR world, and only non-VR players can access the manual. Although this spoken-only communication is attractive to both VR and non-VR players, non-VR players will have inadequate immersion in the game. For this reason, other games where all players will be in VR are being considered for further study.

VI. Lessons learned

It was discovered that some questions were either confusing or misleading through this pilot test. For example, one question, "Do you have any feedback after playing this game?" caused confusion on what type of feedback was sought. The question was to obtain information if they got feedback from the game, and instead, the players interpreted the question as feedback in general for the activity. Another question asked, "During the game, are you able to have social interactions with other users?". This question confused the players on whether it referred to learning more about their teammates or how they interacted. Both questions were revised when we did the second round to make the intent more clear.

Some questions in the focus group discussions were open-ended. A better way to address this for future focus groups is to re-write the questions so that a simple "yes" or "no" answer can be used. Due to time, we did not re-write the questions for our two sessions, but we did have the moderator encourage that the answers go beyond a simple "yes" and "no" answer. If a yes or no answer was given, the moderator asked the participant to explain why they answered that way. However, for future work, the questions will be adjusted.

Another lesson learned was to set aside the player in the virtual reality headset time to adjust and learn the controls. For example, a player who has never played in virtual reality may have difficulties with the controllers, which caused a delay in the game's start. So when we completed the next round, we made sure the player in VR had more time to get used to how the controls work.

VII. Recommendations

Since the game we evaluated is not designed for educational purposes, our recommendations will focus on integrating the game in a college engineering classroom to enhance students' communication and teamwork skills. The following recommendations are based on our findings from the learner tryout. Participants' real names are not used in order to protect their identities.

a) Give students time to strategize: In both of our focus group interviews, the participants pointed out the importance of planning sessions. This planning is crucial for both teamwork and communication. Allowing the teams to strategize can further build up working as a team and even develop better ways to communicate. For example, one participant from the first learner tryout mentioned that understanding the situation and developing a plan was helpful. A second participant from the second focus group was more specific and said that the planning session after the first round of play helped their team be more effective by reflecting on the setbacks and failures. Given that the planning session promotes collaborative planning and reflection, it should be essential when integrating the game in future classrooms.

b) Let learners rotate their roles: In our tryout sessions, participants did not rotate their roles. One participant mentioned that it would be fun to alternate roles and on the bomb-defusing side. A second participant, who was always on the bomb-defusing side, also mentioned that she felt she got off a little easier because everyone was helping her. Alternating roles would be helpful for teamwork as they can share the experiences of being a "defuser" and the "experts".

c) Modify the game for more challenges: The participants reported that the game might not be as exciting after playing several rounds. However, the game itself does allow the players to customize the modules to adjust the challenge level. When implementing the game in the future, the instructor should consider allowing the players to decide on the modules' configuration to have more control and find the sweet spot between challenge and skills. This control fits well with flow theory and helps to make sure that the participants remain in that flow.

VIII. Conclusion

Through this trial study that was conducted, it was learned that non-educational games could be utilized to help teach professional development skills to engineering students. These games are often engaging and, so far, have shown a positive impact on teaching these skills. In addition, even with the extra challenges of conducting this gameplay during COVID-19, communication tools like Microsoft Teams can be used to conduct the learning session. Of course, this trial was minimal, and while promising, further work is warranted to gather more conclusive data. As this is part of ongoing research additional studies will be conducted. This trial however was able to lay some of the foundation for future studies.

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