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Building Community: The Effect of Educational Escape Rooms on Construction Management Student Engagement

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Educational Escape Rooms (EERs) are content-specific, cooperative, team-based learning activities designed to be completed within a defined timeframe. They can be complex or simple and can be created using readily available tools such as Google Forms. EER pedagogy blends the thrill of problem solving against a clock with the complexities of teamwork and skill acquisition. Typically driven by an engaging narrative and situational relevance, EERs are well suited to delivering educational content in a coherent theme that is motivating, scalable, and equitable. This mixed-methods study was born from the researchers' concern that post-pandemic, students were disconnected with each other, the instructor, and the content, and sought methods to integrate social engagement with academic learning. The study includes results from the implementation of EERs in construction management and liberal studies courses taught by two different instructors. Forty-six students completed a paired pre and post-survey regarding their learning experiences with this pedagogy and interviews with eight student volunteers were conducted to add depth to the survey data. Exploratory findings indicate that participating in well-designed EERs both enhances academic engagement and deepens inter-student and professor relationships and indicates that the design of EERs may be the most critical aspect of this developing pedagogy.

Keywords: Game-Based Learning, Universal Design for Learning, Equity, Construction Education

Introduction

Higher education is facing a new reality. Student connection with coursework, instructor, and cohort compete with online gaming, screen time, and instant gratification. Pedagogical methods that align student connection and critical thinking in a content-rich environment are important in supporting student learning, sense of community, and emotional health (Ferreira, et al., 2020). This paper explores how the use of educational escape rooms (EERs) can support student learning and learning retention while fostering engagement with each other, the instructor, and the coursework. EERs are content specific, cooperative, team-based learning activities designed to be completed within a short segment of a typical class (Fotaris & Mastoras, 2019). The researchers employed the Theoretical Framework of Activity Theory (Engstrom, 2000) to help analyze the interactions between EER pedagogy, students, instructors, learning goals, and learning outcomes. This provided a structured approach to designing, implementing, and evaluating educational escape room activities within a pedagogical context. Through this lens, the researchers noted that the connection between learning goals, outcomes, student learning teams, and the instructor were strongly influenced by EER design,

setting, content, and modality. These observations, and the researchers' experiences while performing the study, informed the creation of a new conceptual framework (Figure 1).

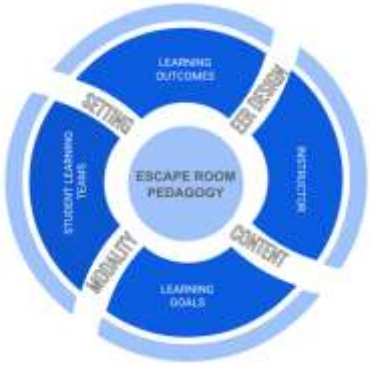

Figure 1. Authors' Conceptual Framework of EER Pedagogy

Escape Room Pedagogy

Overview

The use of escape rooms in higher education is a newer pedagogy, and the research is nascent (Fraguas-Sánchez, et al., 2021). EERs are thematic, immersive, narrative-based games that are designed to engage and educate the participants on virtually any topic. EERs typically follow a similar format to non-educational escape rooms and generally contain a theme or narrative, a main 'problem' to solve related or central to the theme, smaller puzzles that need to be solved as the game progresses, and a time constraint. The thematic narrative of the EER, essentially the hook line or 'why' the game should be played is important (Botturi & Babazadeh, 2020). A well-crafted narrative will be designed to bring in and engage the participant, is present throughout, and sets the stage for final objective: solving a pressing issue or problem central to the theme within a prescribed time frame. In order to progress through the narrative and solve this overarching problem (thereby 'escaping the room'), the participants must solve smaller puzzles (known as 'locks') embedded throughout the storyline. These puzzles can take a variety of formats, and should, in order to stimulate and encourage multiple means of engagement by the players (Makri, et al., 2021).

Good EER design should not be limited to the individual puzzles that are embedded in the EER however, it should also consider the entire user experience (Veldekamp et al., 2020). The design process should promote a visualization of the end user, and the various contexts and forms in which the proposed content might be best experienced, and ultimately, learned (Veldekamp et al., 2020). There is no standardized approach to creating an EER, however the type of inputs that are required to develop quality learning experiences through the use of EERs are proposed through several different pedagogical frameworks. These frameworks generally map out the required components to produce a rigorous learning activity such as escapeED (Clarke, et al., 2017) which identifies six individual areas to be considered when working to create EERs: Participants, Objectives, Theme, Puzzles, Equipment, and Evaluation. Another framework, Room2Educ8 (Fotaris & Mastoras, 2022), proposes nine separate elements: Empathize, Define, Conceptualize, Design, Brief, Debrief, Prototype, Document, and Evaluate, which are presented as steps in a process to use when designing and implementing EERs.

Regardless of any framework or method used to design and deploy an EER, attention must be paid to how to maintain engagement and encouragement of the participant to keep them progressing through the EER. It is this balance and pursuit of the 'sweet spot between frustration and boredom' (Fotaris & Mastoras, 2022) that should push the EER designer to think differently about their subject matter and delivery of the intended educational content.

Study of The Effects of EERs on Student Engagement

Methodology and Overview

Through a mixed-method study that spanned three courses and four semesters, the authors created and deployed simple, content-relevant EERs using Google Forms to several cohorts of students in three separate courses and content areas. The study began in a liberal-studies course and a construction soils class in the Spring semester of 2024. The study continued in the Spring and Fall semesters of 2025, in a construction equipment class. The classroom formats in place for the cohorts during the study were a mix between in-person, online, and hybrid. Students were asked to participate in the study by playing the instructor designed EERs that were founded on relevant coursework. The students were asked to complete pre and post-surveys composed of a set of questions based on their experiences before and after playing the provided EERs. Fourteen of the twenty questions from the Classroom Community Scale (CCS) (Rovai, 2002), a valid survey of classroom connectedness, were adapted and used as a survey instrument. Students were also asked to voluntarily participate in a post-participation interview. Interview questions were developed by the researchers, and included items related to student-student connection, instructor-student connection, content, engagement, equity, and learning in the classroom.

Survey Instrument

The initial survey instrument was developed as an unpaired set of pre and post-evaluations of classroom climate and engagement, that participating students were asked to complete. The question set included 14 questions adapted from the CCS (Table 1) and a Likert-type survey response (strongly disagree, disagree, neutral, agree, strongly agree).

Table 1. Pre and Post-Survey Questions

#	Question
1	I feel confident that others will support me in class.
2	I feel that students in this course care about each other.
3	I feel that I am encouraged to ask questions.
4	I feel connected to others in this course.
5	I feel that it is hard to get help when I have a question.
6	I do not feel a spirit of community.
7	I feel that this course is like a family.
8	I feel uneasy exposing gaps in my understanding.
9	I feel isolated in this course.
10	I trust others in this course.
11	I feel that I can rely on others in this course.
12	I feel that other students do not help me learn.
13	I feel that members of this course depend on me.
14	I feel that this course does not promote a desire to engage with the material.

The unpaired survey was then deployed across two cohorts of students in a construction soils class, and a liberal studies class. The original deployment of the survey yielded results that indicated an overall increase in engagement with the cohort, content, and instructor (Figures 2 and 3).

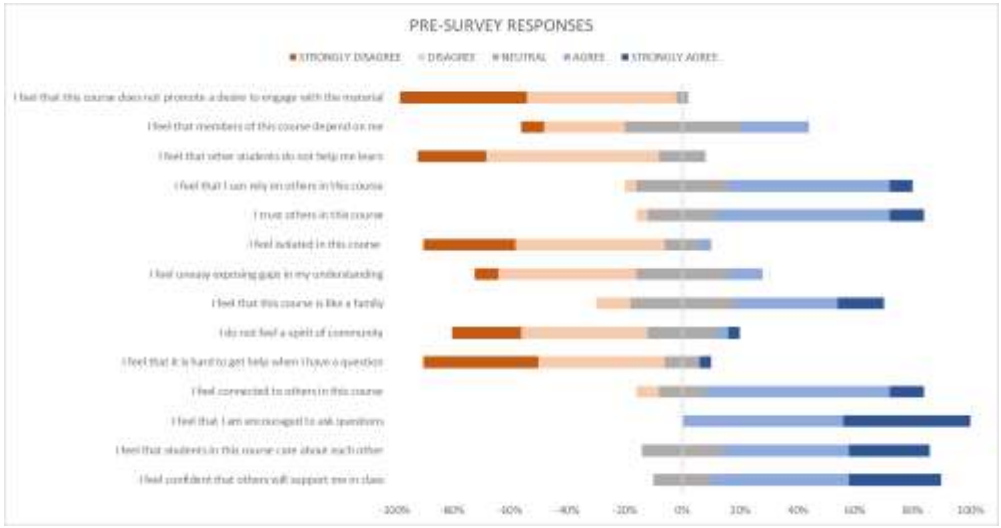

Figure 2. Initial Unpaired Pre-Survey Results

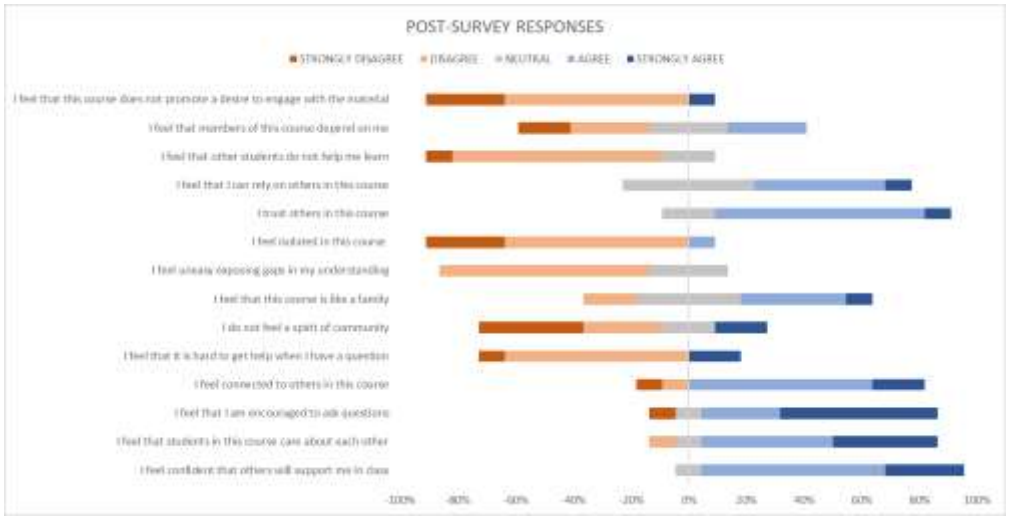

Figure 3. Initial Unpaired Post-Survey Results

Based on these initial findings the authors decided to implement a code-generating pairing system to better measure outcomes from the pre and post-surveys. The pairing system was implemented in a subsequent survey of a cohort of 48 students in a construction equipment class in the Spring of 2025, and another cohort of 55 students in the same construction equipment class in the Fall of 2025. The results from the paired survey yielded n=46 individual complete responses that were then analyzed using a two-sided Wilcoxon signed-rank test (WSRT), coded for a pre-post analysis of any significant changes with a corresponding direction and magnitude. The surveys were administered by inviting the participating students to complete the pre-survey first. Directly after the pre-survey was administered,

two separate EERs were played with construction-related themes. The narrative of the first EER was focused on horizontal measurement and included puzzle locks (questions) about plan reading, measurement conversions, and area calculations. The second EER's narrative was focused on vertical measurement and included puzzle locks about elevation, stationing, and slope. Both EERs presented were simple enough to be completed in under ten minutes given a base level of knowledge from the course. After each EER was played, the students were invited to participate in the post-survey. Participation in the pre or post-survey was not a requirement for being able to participate in the playing of either EER.

Analysis of Paired Survey Results

The survey results analyzed and discussed here only include results from the paired pre and post-surveys administered in the fall and spring semesters of 2025. In order to run the two-sided WSRT, the Likert-type survey responses were assigned numerical values as seen in Table 2.

Table 2. Likert Response Coding

Likert Response	**Numeric Coding**
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

The results were also reverse-coded for 'negative' question items to uniformly indicate an improvement metric when analyzed. The questions that were reverse coded were questions 5, 6, 8, 9, 12, and 14. After coding, the survey results were run through IBM's SPSS 31.0 Statistics Program to analyze the magnitude of any changes from before the EERs were played in the classroom setting, and after. The unadjusted results are presented in Table 3. Questions coded as negative are indicated by (-) after the question name. Significant results are italicized.

Table 3. Pre and Post-Survey Questions ***n*=46**

#	Question	Z Value	p-Value	Effect Size (r)	Interpretation
1	*I feel confident that others will support me in class.*	*-2.294*	*0.022*	*0.613*	*Significant*
2	I feel that students in this course care about each other.	-1.355	0.175	0.362	Not Significant
3	I feel that I am encouraged to ask questions.	-1.414	0.157	0.365	Not Significant
4	I feel connected to others in this course.	0	1	0	Not Significant
5	*I feel that it is hard to get help when I have a question. (-)*	*-2.179*	*0.029*	*0.604*	*Significant*
6	I do not feel a spirit of community. (-)	-0.589	0.556	0.147	Not Significant
7	I feel that this course is like a family.	-1.47	0.142	0.357	Not Significant

8	I feel uneasy exposing gaps in my understanding. (-)	-0.051	0.96	0.012	Not Significant
9	I feel isolated in this course. (-)	-1.225	0.221	0.267	Not Significant
10	I trust others in this course.	-0.474	0.635	0.127	Not Significant
11	I feel that I can rely on others in this course.	-0.907	0.365	0.22	Not Significant
12	I feel that other students do not help me learn. (-)	-0.680	0.497	0.189	Not Significant
13	I feel that members of this course depend on me.	-1.454	0.146	0.343	Not Significant
14	I feel that this course does not promote a desire to engage with the material. (-)	-0.535	0.593	0.161	Not Significant

Acknowledging that the study is still in an exploratory stage, unadjusted p-values may be sufficient in order to gain an understanding of how EERs affect student engagement. With that being said, it is noted that Questions 1 and 5 are significant in their change from pre to post. Coupling these outcomes from the survey with the in-person interviews creates some interesting narratives that are worth additional study.

Interviews

In addition to the survey instrument, the authors also requested volunteers for an optional anonymous interview. The questions for the interview were developed to gain additional insight into how playing an EER could encourage engagement, promote equity, and contribute to the overall effectiveness of the learning experience. Eight individual interviews were recorded using pseudonyms to encourage authenticity and grounded feedback. The interviews were conducted for three of the four cohorts that were part of the study and included one interviewee from the liberal studies course, two interviewees from the Spring 2023 cohort, and five interviewees from the Spring 2025 cohort. The question set included questions on community, equity, and EER effectiveness (Table 5).

Table 4. Interview Questions

#	Question
1	How does the use of EERs in your class provide a sense of belonging?
2	Are the feelings of belonging and engagement sustained throughout the semester? If yes or no, describe how or why/why not?
3	Does the use of EERs in your class provide a sense of teamwork? Describe how it does or does not?
4	Do EERs help you connect with the content? How or why not?
5	Do EERs help you connect with other students or the instructor? How or why not?
6	What specific methods are used by instructor to promote meaningful discussion about equity in an online environment-can you give examples?

The results of the interviews were highly informative, and the Spring 2023 interviews were a contributing factor to the subsequent survey redesign.

Emerging Themes from Interviews

Several themes emerged from the discussions generated from the question set, and ensuing related topical conversations. In general, the participants indicated an appreciation of EER pedagogy, with a noted emphasis on EER design being the key element for successful implementation and integration.

Competition in Small Groups Promotes Comradery. A dominant theme in interview conversation, the idea of competing to win. The format of an EER requires teamwork, and well-designed EERs contribute to a whole-team approach. One interviewee noted "there was a lot of collaboration, a lot of teamwork… we're all in this together." Another noted that the EER "immediately kind of fosters a sense of teamwork… If you're part of a team, then you belong to something." This promotes participation among a cohort organically.

EER Structure May Determine Equity. Some interviewees stated a preference for rules defining roles to enhance structure. This presents a possible trend where not all voices were being heard during the game play which could limit some students in their attempt to participate. In a game-based learning environment that requires the use of multiple levels of cognition, mistaking introspection for lack of understanding could inhibit some players from fully experiencing the learning opportunities presented. In short, introspection should not be mistaken for non-participation and having some ways to ensure this doesn't happen could be beneficial. Embedding varying learning opportunities or turn taking was suggested by interviewees as a possible solution to uneven participation.

Avoiding the Race to Finish. Another indicator of quality puzzle design, interviewees reported the difference between well designed, content relevant puzzle locks, vs those that were non-thematic. Relevant puzzle locks led to increased equity of participation. Participants noted that some students would rush ahead, skimming for buzzwords in locks that required reading, negating any type of deeper learning. One interviewee stated "it could be a little bit isolating… some people just wanted to get it done… they're just clicking… finishing."

Increasing Connections. An emerging theme from the interviews was that of increased connection through the division into small groups. The idea of possibly playing and learning with a student outside of your group appeared as a benefit to participating in EERs. Interviewees indicated that they met and spoke with new people with whom they might not otherwise have engaged, noting that "it… forces you to… be a part of the class." Another indicated that working with a different group ensured they could pool their knowledge and learn from each other, stating "it… enabled me to go back and look at my notes… with… the surveying escape room… I forgot how to read the Philly rod… someone else… [said] 'this is how you read it.'" Building connections also built confidence, as evidenced by this interviewee: "it almost made me feel like more confident in speaking out loud on the Zoom… I noticed that more people were speaking up towards… the end of the semester."

Takeaways and Conclusion

EERs are an emerging pedagogy in higher education construction classrooms. This research indicates that they have the utility to enhance academic experiences in terms of learning and engagement. The data also indicates that students' emotional connectedness, both to each other and the instructor, is positively impacted by the use of EERs in the classroom. The design and timing of EERs appears to be important in producing these positive outcomes. It is possible that the feelings generated from participating in an EER, and the emotions that it elicits, can be most easily likened to a family-style relationship, where friendly competition, bonding, and viscera-based comraderies are the norm.

Limitations to the study include limited interview data from the pre- and post-view survey among the studied cohort. The small sample size (n=46) is also a limitation to interpreting the significance of the findings. Additional samples from across construction courses would be important in learning more about how best to design EERs for this discipline. Interviews were also conducted by the course instructor, so this may have impacted the quality of responses.

The results are important for future research, and for current practitioners. Building connection in classrooms post-COVID is critical not only to learning, but to students' emotional health. Feeling connected to each other and the course, two findings of the research, support this, and are important for students' academic persistence and mental health.

The researchers continue to use and revise EERs in their own classrooms. One area of future research includes asking students to create, share and learn from their own EERs. Learning through teaching and learning from peers with EERs has not yet been studied, however these pedagogical approaches on their own have a strong research base.

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