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Exploring the use of the conversation starter game QUONVO™ on the soft skills and STEM identity of undergraduate students

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ABSTRACT

A major gap in the research on soft skills is how to efficiently integrate soft skills training that actually aligns with the needs of employers. Game-based learning has become a popular method for teaching knowledge and skills. This project explores the use of a non-digital conversation starter game, QUONVO™, as an informal soft-skills training tool, by measuring how gameplay with QUONVO™ can influence undergraduate STEM majors' perception of their soft skills (specifically communication and critical thinking) and their STEM identity. Overall, this study found that QUONVO™ positively impacted students' STEM identity and soft skills development. Gameplay discussions incorporated personal experiences, course content, and professional knowledge, with students demonstrating independence in expressing their ideas.

Keywords: conversation starter games; game-based learning; higher education; non-digital games; soft skills training; STEM education

INTRODUCTION

To compete in a technologically advanced global society, employers seek candidates with experience in areas such as cross-cultural awareness, communication, global economics, and international business (Stewart et al., 2016). Despite undergraduate students' confidence in their abilities, research shows (as far back as 2016) a significant gap between their perception and employer perception of their soft skills (Stewart et al., 2016). Employers report a lack of specific soft skills like critical thinking, communication, and problem solving in recent college graduates (Stewart et al., 2016). The COVID-19 pandemic has shifted the labor market to what is being defined as the New Normal Era, a "time of collaboration between advanced technology and human creativity to address business, social, and environmental challenges" (Altomari et al., 2023, p. 2). For example, advancements in artificial intelligence challenged corporations to shift focus to non-technical resources to retain a human element in business practices. This requires recruiting, hiring, and retaining quality employees that possess this skill set. The most highly valued are interpersonal competencies, critical thinking, creativity, and ethical awareness (Rizakhojayeva et al., 2025).

The importance of communication skills in the professional and personal world cannot be overstated. Lack of communication between professionals can have disastrous results, such as in the 2010 BP oil spill. This catastrophic event led to the loss of roughly 200 million gallons of crude oil into the Gulf of Mexico, along with eleven deaths (Eichelman et al., 2015). On April 20, 2010, an explosion occurred on a drilling rig named the Deepwater Horizon (Pulham et al., 2010). Investigation into the causes of the explosion revealed bad management practices at the three companies associated with the drilling rig, Transocean, Ltd., BP, and Halliburton Co. Pertinent information concerning risk management and maintenance needs for the Deepwater Horizon were often never communicated to all involved parties (Goldberg, 2010). These constant lapses in communication led to multiple safety issues and delays in much-needed improvements to the systems controlling the drilling rig (Goldberg, 2010). Improvement in communication can increase the quality of discussions, minimize confusion, and decrease conflicts (Adhiatma et al., 2019). Furthermore, improved organizational communication leads to increased collaborative thinking and provides spaces for participation and learning for diverse groups (Jung, 2020). In higher education, communication skills required for academic success involve oral and written skills. Critical thinking is a complex soft skill with multiple elements that are emphasized differently across fields and disciplines. In STEM, critical thinking is viewed as the main tool for reasoning and problem-solving (Stupple et al., 2017). In higher education, developing critical thinking skills is a core learning outcome and is necessary to meet assessment requirements. For graduates and professionals, appropriate critical thinking skills are associated with increased employability and

career advancement. Critical thinking involves both cognition and metacognition, requiring purpose, self-regulation, effort, and consciousness (Stupple et al., 2017).

A major gap in the research on soft skills is how to purposefully and efficiently integrate a soft skills training program that actually aligns with the needs of employers. Issues with coordinating employer needs and training in higher education stem from a combination of a lack of understanding of how to integrate soft skills training, student perception of the importance of developing soft skills, and lack of transparency of employers on the specific skills needed (Stewart et al., 2016). Traditionally, undergraduate STEM curriculums emphasize conceptual knowledge and technical acumen, with soft skills being learned through participation in social and extracurricular activities (Luo & Li, 2025). Stewart and colleagues also emphasize that soft skills cannot be learned solely in the classroom since they are mastered through action (2016). However, informal training opportunities can enhance these skills in a hands-on, active learning environment (Stewart, et al., 2016). Using games as cost-effective and convenient soft skills training tools has become popular. Examples of types of games used include role-playing, psychodrama, and the most common, the tech-based "serious game" (Dell'Aquila et al., 2016). In the digital age, workplace soft skills training relies on technology-based games because of the popularity of mobile devices. However, since higher education also incorporates significant reliance on technology for learning outcomes, this project explores the use of a non-digital conversation starter game, QUONVO™, as an informal soft-skills training tool. The purpose of this project was to measure how gameplay with QUONVO™ can influence undergraduate STEM majors' perception of their soft skills (specifically communication and critical thinking) and their STEM identity.

LITERATURE REVIEW

Informal learning and game-based learning

An informal learning setting is any learning environment with a free, non-linear, personally motivated, and self-directed experience that encourages self-reflection (Barriault & Pearson, 2010; King, 2021). The design of these environments focuses on learning that nurtures curiosity while improving motivation and attitudes toward science (Barriault & Pearson, 2010; King, 2021). Successful STEM informal learning environments cultivate accessible science culture, disseminate science content, and facilitate positive changes in learner identity (King, 2021). Therefore, informal learning environments can be useful for the training of soft skills for STEM undergraduates. In order to create a successful informal soft skills training environment, designers must participate in active reflection about the effectiveness of the environment and make appropriate changes. Reflective practice indicates the "how, why, and for whom" these

learning environments exist (King, 2021, p. 2; Martin et al., 2019). The process also requires a certain mindset that consists of readiness, open-mindedness, wholeheartedness, and responsibility in order to facilitate critical reflection that leads to change (King, 2021; Martin et al., 2019). Successful participation in reflective practice creates environments that encourage voluntary participation, provide engaging content with relevant activities that stimulate curiosity, support diverse students, and build knowledge (Johnson et al., 1999; King, 2021).

Research on the practices of employer soft skills training environments has been valuable for designing the soft skills training environment for STEM undergraduates. Companies use the 70:20:10 learning model, where 70% of learning occurs through experience-based, hands-on, project-based activities on the job, 20% through coaching and mentoring, and 10% through structured formal courses (Succi & Wieandt, 2019). Gamification has been an innovative tool for companies to apply this model to their soft skills training environment. Gamification is defined as "an element of the game that uses a fun concept in the workplace to increase reaction and involvement with the subject matter" (Adhiatma et al., 2019, p. 127). The concept can also be viewed as "the use of game pattern including progress mechanisms (such as point systems), player control, rewards, collaborative problem solving, stories, and competition in nongame context" (Adhiatma et al., 2019, p.129). Along with microlearning, the addition of gameplay as a learning tool has become more popular to address the need of millennials and Gen Zs for more engaging and interesting learning tools. Gamification can integrate technical knowledge with soft skill development using microlearning, or "short, focused, and interactive learning" (Luo & Li, 2025, p. 2). This provides an environment where specific soft skills can be enhanced and measured.

Non-digital games, such as board games, have rarely been used in game-based learning, especially in STEM. Research has shown that using a board game with physical pieces provides tangible and tactile experiences that encourage repeated play, which increases exposure to the knowledge and skills associated with the game (Fjaellingsdal & Klockner, 2020). Fjaellingsdal and Klockner conducted a study using focus group interviews with 17 participants who were recruited to play an environmental board game (2020). Analysis of five focus group interviews using qualitative thematic analysis revealed that users viewed the board games as "simplified environmental simulations" that allowed them to assess the impact of their choices on the environment (Fjaellingsdal & Klockner, 2020, p. 15). Simulated gameplay allows users to explore micro situations that could influence their real-world choices and beliefs (Fjaellingsdal & Klockner, 2020). Furthermore, the social aspect of gameplay contributes to cooperation, collaboration, and healthy competition (Fjaellingsdal & Klockner, 2020). These effects are enhanced when users play in a diverse environment. Research has also

shown that exposure to diverse perspectives significantly impacts tolerance, "deliberative democracy," and socio-political growth (Jung, 2020, p.1).

QUONVO™

In general, successful application of gamification to higher education involves designing a game that aligns with appropriate soft skills training, assesses specific skills needed for job tasks, and engages and challenges college students. Stott and Neustaedter name four components that can be used to measure the success of game-based learning: freedom to fail, rapid feedback, progression, and storytelling (2013; Fouilloux et al., 2025). Research on college students and intrinsic motivation reports that students are often motivated by entertainment, social experiences, and current events; therefore, infusing science information related to these elements will help students build meaningful connections to science (Gormally & Heil, 2022). Furthermore, games not explicitly designed for educational purposes can also be beneficial for promoting engagement and "interest-driven pursuit of learning knowledge" (Jung, 2020, p. 2). The benefits of informal learning environments, microlearning, effective soft skills training, and gamification influenced the decision to modify the conversation starter game QUONVO™ with science elements to be used for soft skills training of STEM undergraduate majors.

QUONVO™ was created in 2022 as a tool to encourage robust, engaging, and thought-provoking conversation through in-person social interactions. Gamecards contain quotes, words, and phrases associated with STEM current events, notable people, and ethical issues. The first game deck produced with general quotes contained 52 unique gamecards; therefore, groups of any size can play. The game deck used for this study contained 26 unique gamecards. Player A is given a game card containing one of these elements and given a specific amount of time (determined by all of the players) to start a discussion about the content of the game card, specifically their affirmative or negative attitudes or beliefs concerning the content. The challenge is that Player A's affirmative or negative stance is chosen by Player B, thereby requiring Player A to use critical thinking, tolerance, and creativity to generate authentic conversation on the content. Gameplay encourages students to challenge themselves and others to think outside of the box and communicate diverse perspectives concerning hot topics in STEM. Students are also required to listen critically and be respectful of different opinions during discourse. The original iteration of QUONVO™ contained general quotes and was successfully tested with multiple audiences, including families, businesses, friend groups, and college students.

RESEARCH METHOD

The central research objective was to establish the conversation starter game QUONVO™ as a game-based learning tool for informal soft skills training. The results of this research will provide insight into 1) the usefulness of game-based learning in STEM undergraduate education, 2) the experience of using a STEM-based conversation starter game in an informal learning environment, and 3) the potential impact of a STEM-based conversation starter game as a tool for soft skills training.

Participants

The target population for this study was science majors enrolled at a large urban public research institution in the Gulf Coast region of the southern United States. Recruitment was attempted using mass emailing and advertisement in the weekly email newsletter sent to the entire campus. However, due to low response rates and time constraints, students were directly recruited from biological science courses through professors. A total of 30 students volunteered to participate and play the game during two sessions held on the evenings of February 28, 2024, and February 29, 2024.The participant sample represented all four classifications (i.e., freshman, sophomore, junior, senior). The participant groups consisted of 22 students on February 28, 2024, and 8 students on February 29, 2024. Therefore, the game was experienced in both a large and a small group, respectively. The study was not officially affiliated with any course as this study focuses on the informal learning space only. However, the QUONVO™ game content used contained genetics topics, including genetic engineering and experimental design, since the participant sample was recruited from a genetics course (quotes used for the game sessions are displayed in Appendix A). As science majors, the participants shared similar academic experiences with those in the formal biological sciences curriculum at the institution. Therefore, participants had a greater chance of understanding the content on the game cards. Furthermore, since the students were all enrolled in the same course, their engagement with the genetics game content provided insight to how engaged students were with the genetics course. Since the students differed in classification and individual major, they brought diverse perspectives from their respective disciplines.

Study Design

A mixed methods approach was used to validate the use of a commercial conversation starter game, QUONVO™, as an educational tool for informal soft skills training. To investigate the research statements, an experimental study design was used where quantitative and qualitative data were simultaneously

collected during gameplay. Students were introduced to the study through an in-class announcement, and interested students committed to a game session. The game was played in a large classroom that is typically used for STEM informal learning opportunities hosted by the researcher's department. Students chose their own seats among chairs placed in a circle so that students could see each other. Before each game session, participating students were explained the QUONVO™ game model and rules. Students completed an informed consent form, agreeing to complete the game session, be filmed, and complete a questionnaire. The participants were allowed to ask questions, share any concerns, and were informed that they could stop their participation at any time. Participants were assigned a number to anonymize students during the data analysis. Players A and B were chosen randomly by pulling numbers using two of the same web-based random name generators. One generator contained numbers for Player A (the player tasked with leading the discussion), and the other generator contained numbers for Player B (the player tasked with choosing Player A's stance). The gameplay ended once everyone had a turn to lead the discussion. Gameplay for session one on February 28, 2024, lasted roughly 90 minutes, and game session two on February 29, 2024, lasted approximately 18 minutes.

Quantitative data was collected through PENS questionnaire, which measures factors associated with user experience and STEM identity (Ryan et al., 2006). The instrument measures self-reported player experiences using 21 items associated with four factors: autonomy, competence, relatedness, and presence/immersion (Johnson et al., 2018). The PENS instrument applies the Self-Determination Theory (SDT), which deals with the potential impact of social experience on satisfying a person's universal needs (Johnson et al., 2018; Ryan et al., 2006). The instrument measures various outcomes of playing video games, including satisfaction of psychological needs and the promotion or hindrance of engagement (Johnson et al., 2018; Ryan et al., 2006). The instrument's reliability and validity were tested in a study of 235 game players, along with correlation studies of the factors. The individual factors' reliabilities (Cronbach's alpha) were presence/immersion = .91, competence/control = .80, relatedness = .79, and autonomy = .63 (Johnson et al., 2018). Johnson and colleagues found correlations between presence and relatedness (r = .40) and between presence and autonomy (r = .39) (2018). The instrument has been tested primarily with video gamers; however, the factors measured by the instrument rendered it useful for this research. The PENS instrument was chosen because the sub-constructs of autonomy, relatedness, and competence are also related to two frameworks used in this dissertation: the Carlone and Johnson (2007) STEM identity model and Stewart's (2022) Communication Theory. Since QUONVO™ is a conversation starter game, items that measured presence/immersion and user controls were not used for this dissertation project. Each of the items on the PENS instrument is weighted equally; therefore, scoring of the instrument is not affected by truncation.

The final version of the PENS instrument used 12 out of the 21 items (three items per sub-construct) that were randomized when administered to participants. Table 1 shows the exact order of questions on the PENS instrument administered to game participants. The final instrument required participants to rate each statement using a 7-point Likert scale (7 = Strongly Agree; 1 = Strongly Disagree). The two questions (Q8 and Q10) marked with (-) were reverse-scored (7 = Strongly Disagree; 1 = Strongly Agree). Participant answers are scored by summing up the item ratings for each subconstruct and forming a composite score. During data analysis, internal consistency tests were conducted on the final version of the PENS instrument used for this study. The Cronbach's alpha statistic revealed internal consistency for three of the four subconstructs: Competence (alpha = 0.823), Autonomy (alpha = 0.487), and Relatedness (0.836). Therefore, the items measuring these subconstructs were used in the final data analysis.

Table 1.

PENS instrument for QUONVO™ game sessions

Question number	Question
1.	The game provides me with interesting options.
2.	I find the relationships I form in this game important.
3.	The game lets you do interesting things.
4.	My ability to play the game is well matched with the game's challenges.
5.	I experienced a lot of freedom in the game.
6.	I feel competent at the game.
7.	The game was emotionally engaging.
8.	I am not impacted emotionally by events in the game (-).
9.	I find the relationships I form in this game fulfilling.
10.	I don't feel close to the other players (-).
11.	When I accomplished something in the game, I experienced genuine pride.
12.	I feel very capable and effective when playing.

Note. Adapted from "Motivational Pull of Video Games: A Self-Determination Theory Approach by R.M. Ryan, 2006, *Motivation and Emotion, 30*, 344-360.

Qualitative data was collected through researcher field notes and the open-ended observations of two independent researchers using a behavioral checklist. The field notes provide a descriptive and reflective view of the students' game experience, their use of soft skills (specifically communication and critical thinking), and their ability to connect with other STEM peers to discuss STEM content. Gameplay was filmed and submitted to two independent researchers who observed the behaviors associated with engagement, communication (verbal and

non-verbal), and the use of metacognitive skills (such as critical thinking). The specific details of the research tools are discussed below. Data from the questionnaire, field notes, and independent observations were analyzed and triangulated to provide a global view of the potential usefulness of QUONVO™ in an informal STEM learning environment. Observation is a common method of measuring engagement at the individual and classroom level engagement (Fredericks & McColskey, 2012). Direct observation was used to support the students' self-assessment of their game experience. First, the researcher collected field notes during game sessions and added personal reflections immediately following game sessions. The purpose of qualitative field notes includes providing additional environmental context, increasing researcher observation awareness, reporting sensory information (e.g., sounds), and promoting unbiased reflection (Phillippi & Lauderdale, 2018). The researcher recruited two fellow senior doctoral students from the major department to be non-participant observers. This was important to reduce observer bias. The independent observers utilized a modified version of the In-class Engagement (IEM) (Appendix B) developed by Alimoglu and colleagues (2014). The IEM is a two-dimensional instrument developed to measure active student engagement through direct observation. The instrument is a revised version of the STROBE, developed and validated by O'Malley and colleagues, to record and detail student and instructor behavior within the learning environment (2003). The STROBE was revised into the IEM to focus on the behaviors of the student and instructor that promote active student engagement (Alimoglu et al., 2014). The IEM was validated through expert assessment and pilot studies in four types of class environments. Inter-rater reliability analysis (Cohen's k statistic, =0.87 [instructor behavior]; =0.71 [observed student behavior]) was used to determine observer consistency (Alimoglu et al., 2014). The IEM contains two sections with five items each (scored 1-5) addressing levels of communication, increasing from non-participation to no communication. Since this project is not associated with a university course, the instructor portion of the instrument was not used. Alimoglu and colleagues describe the observation process as occurring in five-minute cycles, with each observer watching four selected students for 20 sec. each. After the four 20 sec. observation sessions, the rest of the 5 min. cycle is spent noting the number of questions asked by all of the students, both observed and non-observed. Observers are instructed not to repeatedly observe the same student, if possible.

Data Analysis

After data collection was completed, questionnaires were scored according to protocols, and raw video footage was analyzed. Quantitative analysis was completed using statistical software to generate descriptive statistics to ensure a normal distribution and determine any trends in the data. Statistical software, SPSS

(version 29.0.0.0), was used to determine significant relationships between engagement variables by calculating Pearson's correlation (r). Observer questionnaires were scored, and behaviors were tallied.

Qualitative analysis through a hybrid method of deductive and inductive coding was used to reveal findings in the descriptive comments made by observers and the researcher's field notes. The IEM contains a built-in set of a priori codes and themes related to the research statements concerning soft skills and STEM identity. Since the structure of the IEM contains a priori codes and themes, these were also used for the initial coding process of the researcher's field notes. Inductive coding was then used to reveal any unique codes and themes in the field notes that were not captured by the pre-determined codes. Following quantitative and qualitative analysis, triangulation was used to validate the "corroborate evidence from different individuals, types of data, or methods of data collection…" (Creswell & Guetterman, 2019, p. 261).

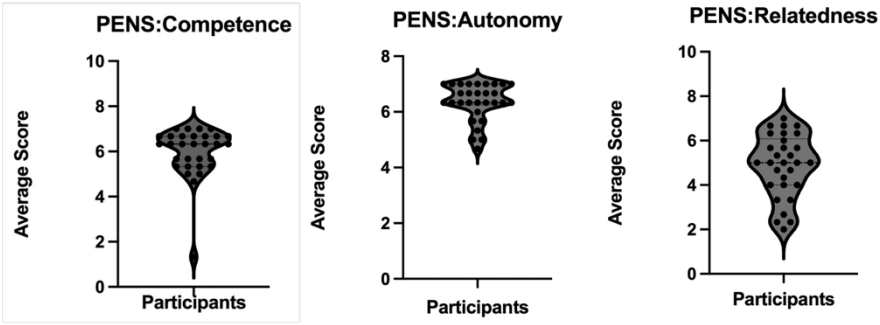
RESULTS

PENS

Once data collection was complete at the end of both game sessions, the questionnaires were scored, and all 30 questionnaires were eligible for analysis. SPSS (version 29.0.0.0) was used to generate descriptive statistics for each item from the instrument. Figure 1 displays violin plots highlighting the distribution of participant scores as well as the mean score for each PENS subconstruct.

Figure 1

PENS Results by Subconstruct

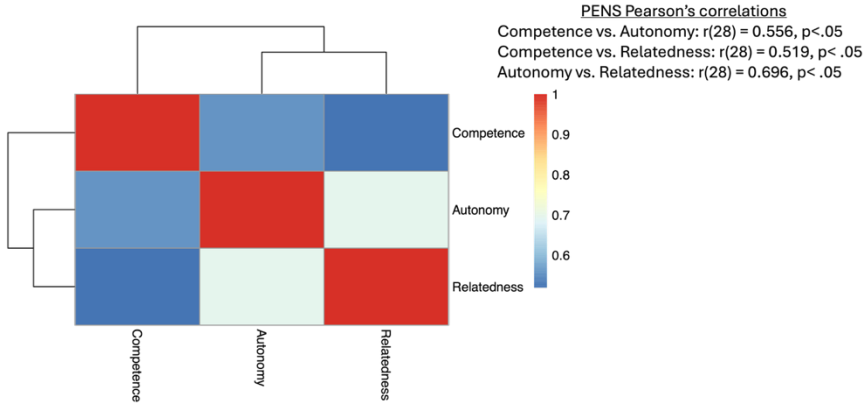


Note. Each table contains the items that measure each subconstruct of the PENS instrument. SPSS was used to calculate descriptive statistics for each item within each subconstruct. Tables also generated using SPSS.

The total means for each subconstruct were also used for further analysis. Using SPSS (version 29.0.0.0), a Pearson's correlation was conducted to determine the strength of the correlations between the PENS subconstructs within the context of playing the STEM version of the conversation starter game, QUONVO™. Prior to conducting the test, assumptions testing was completed. However, according to the central limit theorem, sample sizes ≥ 20 are assumed to have means that are normally distributed. The results of this analysis show a strong and moderate positive correlation between the subconstructs. All of the correlations calculated were statistically significant. The strength of the correlations is based on the r statistic, an integer that can be positive (indicating a positive correlation) or negative (indicating a negative correlation). Correlation values between 0 – 0.3 = weak positive correlation, 0.3 – 0.5 = moderate positive correlation, and > 0.5 = strong positive correlation (Kent State University Libraries, 2023). Figure 2 displays the heatmap and dendrogram visualizing the strength of the correlations between the PENS subconstructs. Dendrograms are useful for showing similarity in the relationships between variables. Based on the hierarchal clustering, the subconstructs autonomy and relatedness are the most closely related, which is supported by the correlation data.

Figure 2

PENS Pearson's Correlation Results Visualized Using a Heat Map and Dendrogram.



Note. The correlation data is displayed in the figure legend. R computing software was used to generate the heat map with accompanying dendrogram.

Overall, the results of the Pearson's correlation indicate there is a moderately strong positive correlation among the subconstructs of Competence, Autonomy, and Relatedness, which are also the subconstructs that relate to STEM identity. Therefore, the data supports that use of QUONVO™ in the informal

STEM learning environment has a positive impact on aspects of undergraduate STEM identity.

Field Notes

Game session 1

On the evening of February 28, 2024, at 6:00 PM, 22 undergraduate STEM majors attended game session 1. Observation of the game lasted for an hour. When the students first entered the room, they were quiet and looked at their phone if they came alone or chatted with the person they came to the classroom with. Most of the students came in between 5:50 – 6:00 PM. The students did not come in visibly excited for the game itself. The students agreed to participate in the game in exchange for four credit points on their next genetics exam. The students sat in no order, although students who came in together sat together. The chairs were arranged in a tight circle; however, students still sat in it. No one sat outside of the circle except the researcher., who did not participate in gameplay. When the researcher explained the rules the first time, students looked confused; therefore, an example was provided. Some students still looked slightly confused; however, some of the previously confused students were now visibly more relaxed. This relaxation was indicated by nodding of heads and verbal "ohs" and "aahs." The first round of the game was slow; but, as the game progressed and students became more comfortable, and the conversations seemed to flow more easily. There were a few students who contributed to every conversation of every round. One student contributed to the conversation by sharing multiple personal stories about her family and herself. Students remained respectful to each other even when disagreeing. A few students discussed the topics from a religious perspective but not from a judgmental one. Humor was often used as time went on. During one round, Player A (male student) didn't understand his quote; therefore, he kept his answer lighthearted and made a joke about eating pizza. During multiple rounds, one female student added to the conversation by repeatedly expressed her frustration with "Chem lab." Several times, students kept talking even when the timer went off, signaling the end of the round. When students began disagreeing with topics, a participant would refer to the card to point out the context of the statement. For example, one gamecard contained a quote by Neil DeGrasse Tyson stating that science is real no matter whether you believe it or not. During a spirited conversation, the student who was Player A at the time pointed to the card and reminded them that the quote is about science being right no matter what your personal beliefs are.

When students were assigned the role of Player B for a round, they often used their feelings about the quote or statement to determine Player A's stance. Another interesting moment was a round where the statement was about generic

medicines. Player A for that round did not have a grasp on what generic medicines were. She didn't ask for clarification but discussed the statement based on what she knew. Her statements focused on using medicine in general, not the difference between generic and brand-name medicines. However, other students who contributed to the conversation did not correct or explain it to her. They simply began discussing the quote with the proper context of generic vs. brand name. The female student who contributed first after Player A's commentary integrated a subtle definition of generic medication that allowed Player A to understand the context of the statement.

The most striking observation was that students did not look at their mobile device for longer than a few seconds to see if there was a call or to check the time. Students also rarely had side conversations with others while the group was talking. Sometimes, the timer would audibly go off, and students would want to continue the conversation. At times, the student chosen to be Player A would often make eye contact with the researcher while explaining their initial statements to start the conversation. Then, when others started chiming in, their gaze went back to the group. Throughout the game, students also referred to themselves as "STEM majors." During his round as Player A, one male student was told that his stance on the statement "science is an art" was negative. He then dramatically stated that to call science art is the "greatest fallacy" because art is "drawing" and "painting." Students would also refer back to statements other students made in previous rounds to build on their commentary or as evidence to support their argument. Table 2 displays other notable quotes from the first game session.

Table 2

Notable Quotes from First Game Session

Speaker	Quote
Researcher	"Do you all talk like this in class? Do you get to have discussions like these?
Students (in unison)	"NO!" "We don't have time!" "It's too many of us!"
Student	"Can I come back tomorrow?"
Student	"If you ask Dr. X for more extra credit, I will come back and play tomorrow too."
Student	"This is hard!"
Student	"We just talked about this one gene in genetics!"

Student	"I'm just gon' take it to church!"
Student	"If you took Zoology, the professor told us how this lineage of this animal used to be this and it's not that anymore. So, (pause) science is always evolving."

Game session 2

Game session two was held on February 29, 2024, at 6:00 PM in the same classroom as the first session. A smaller group of students arrived for the second game session (n = 8). Since this group was much smaller, most of the chairs were removed to form a tight-knit circle. The researcher resumed the same position at the front of the classroom, away from the circle, and only approached the circle when handing players their appropriate game cards. Before beginning the game session, informal conversations with the students revealed some interesting details about the difficulty of recruiting students to participate in studies. One female student remarked that many upper-class students lived off-campus and had jobs; therefore, recruitment methods such as monetary incentives are not as appealing as extra credit. She stated that extra credit in a class is a "guaranteed" way to get students to participate. Another female student agreed and pointed out other professors who might be willing to offer extra credit for students to participate in this study. This smaller group of students appeared more relaxed and discussed campus events amongst themselves.

The game session began with an explanation of the game rules, and the students signed the informed consent form. The researcher used the same random number generation method for determining Player A and Player B. The same protocol for gameplay was also used. Player A read the quote to themselves and then to the group. Player B determined Player A's stance. In contrast to the first larger group, this smaller group did not choose contrarian stances to more controversial questions. Similarly to the larger group, students in this game session supplemented their commentary with personal stories, academic experiences, and STEM content from their classes. There was even a small debate on the use of artificial intelligence (AI) in courses. One female student commented that she used AI in one of her courses to complete homework assignments, which surprised the other students. Another female student asked which class as she wanted to sign up for it. The group discussed courses in which the use of AI could be allowed without the loss of academic integrity. For example, the group agreed that language courses would benefit from the use of AI since communication in the real world often involved the use of AI, such as Google translator, to aid with language barriers. During gameplay, many of the students took their time answering the questions,

and one student even apologized for “rambling.” The other students provided encouragement and reassured her that she was not rambling and there was no need to apologize. This group of students also used humor when explaining concepts, they didn’t agree with or to lighten the mood if a game card introduced a more somber topic. Students related the game content to content they learned in courses as well as other professional experiences such as summer research experiences. One female student added to the conversation using STEM material she had consumed in her personal time. Students also pulled from stories found in the media. For example, the students discussed a story of a man who was so obsessed with youth that he would alter his genetics to retain his youthful appearance. The students discussed the moral implications of this and whether it was an abuse of genetic engineering and modification. Since this game session was smaller, game play was shorter. However, the students' reactions were similar to those of the first group. Students enjoyed themselves and stated that if they hadn't played this game, many of them would not have even met one another due to the large size of the genetics course they were all enrolled in. After the game session ended, a few of the female participants that did not arrive together left together continuing the conversation about their game experience. Further examples of student experience in game session two are provided in the next session.

In-class Engagement results

After the completion of game session two, the footage was reviewed by two independent observers. Each observer chose and observed two students (n = 8) and noted moments of verbal and behavioral examples of engagement displayed by the chosen participant. The observer also noted any significant quotes from chosen participants.

DISCUSSION AND CONCLUSIONS

This project's purpose was to establish a conversation starter game as a tool for informal STEM learning of soft skills such as communication and critical thinking. Furthermore, the project aimed to determine if the use of the game among undergraduate students could help develop a student’s self-perception of their STEM identity. After gameplay, the participants completed the PENS survey to assess if the game experience impacted their self-perception of their competence, autonomy, and relatedness while immersed in the game. Correlation studies showed a strong linear relationship between the three subconstructs of competence, autonomy, and relatedness. This reiterates the Carlone and Johnson (2007) framework, as these subconstructs are needed for the formation of STEM identity. In the context of being immersed in a face-to-face conversation starter game, these elements remain strongly related. Although the content of the questions was

STEM-related, the nature of the questions was interdisciplinary. Therefore, the content provided an intersection of science, humanities, ethics, and even futurism. As a result, when students were discussing their assigned content, they would enhance their discussion with personal stories, concepts learned from classes, and professional experiences. For example, one card had a quote about access to genetic testing. A female participant shared the impact of genetic disease on her family and how genetic testing is an asset to preventive care.

Since this study is the first time QUONVO™ is being used as an educational tool for soft skills training, the In-class Engagement observation checklist provided a guide to determine if the game would be useful for this purpose as well as impact STEM identity. The results of the observation data and PENS scores revealed a positive impact on both soft skills and STEM identity. This research focuses on the Carlone and Johnson 2007 framework of STEM identity that contains the three elements of competence, performance, and recognition. Competence refers to "one's knowledge and understanding of STEM "Stewart et al., 2022, p. 149). The mean composite score for the PENS Competence subconstruct was 5.97, which is close to the highest possible mean rating of 7 (The PENS instrument uses a Likert scale with 7 being the highest possible rating for these items). This indicates that students felt a strong sense of competence while playing the game. The field notes and IEM data also show examples of students exhibiting behaviors that reflect a strong sense of competence. Students used course content and information consumed out of the classroom to discuss the quotes on the gamecards. Their levels of behavioral and cognitive engagement provide examples of their sense of competence. This data also reflects the STEM identity element of performance, which refers to "one's ability to engage in various STEM practices" (Stewart et al., p. 149). Two specific examples include the students that mentioned a gene that was introduced in genetics and how a Zoology professor used the lineage of an animal to show the evolution of a species in response to environment changes. A factor in the literature that impacts performance is autonomy, defined as "acting from interest and integrated values" (Sobieraj et al., 2019, p. 3). High ratings of autonomy have a positive influence on professional performance and satisfaction and can "positively contribute to interest in a subject" (Sobieraj et al., 2019, p. 3). The mean PENS score for the Autonomy subconstruct was 6.36, which is very close to the ideal rating of 7 on a Likert scale. Therefore, students playing the game felt a strong sense of autonomy. The last element of the Carlone and Johnson (2007) STEM identity framework is recognition, defined as "being seen by others and seeing oneself as a STEM person" (Stewart et al., 2022, p. 149). Feeling a sense of belonging and relatedness positively contributes to recognition; therefore, the Relatedness subconstruct of the PENS instrument gives insight into whether students feel recognized by the other students. Unfortunately, Relatedness had the lowest mean score (4.88) compared to the other two PENS subconstructs.

However, the observation data from the field notes provides examples of students emotionally engaging with the group during gameplay. Both independent observers noted that players laughed and smiled with the group as well as extended the conversations. The low PENS rating could be due to the game requiring individual effort and not collaborative. Also, public speaking (even in a small group) can be daunting. This is supported by the example in the field notes and IEM data of the female student, who apologized for "rambling" and was observed fidgeting with her pencil and the game card. Observer A also noted the female student appeared to have "closed body language."

In terms of soft skill development, the gameplay students' communication styles and even conflict resolution styles. For example, although students were instructed at the beginning of the game to practice tolerance and respect, they showed respect and tolerance for differing opinions when discussing potentially controversial topics, even when topics such as religion and politics entered the discussion. Students used multiple communication tools to discuss their points, especially since the game model puts Player A "on the spot." For example, a male participant didn't quite understand the quote; however, he relied on humor to make the other participants laugh to compensate for his lack of knowledge on the topic presented in the quote. Participants also relied on analogies to make their topics palatable for the group. Students' discussion skills and confidence is also revealed in the IEM data from the independent observers. Observer A's behavioral checklist noted several instances where both players they observed showed behaviors related to their discussion skills and confidence.

An interesting finding observed during game play was that some students would address the researcher instead of the group while explaining their quote. A few participants even asked the researcher if their answer was right or wrong, though they were informed during the game rule explanation that this game had right or wrong answers, and thus, no winners or losers. Notably, there were even differences in the group dynamics when the game was played in a larger and smaller group. Within the larger group, some students became more vocal than others, and a few didn't speak until it was their turn to be Player A. In the smaller group, all the students joined the discussion for every topic, even if it was just to agree or disagree with Player A's statements. One participant in the smaller group commented that she was glad to have played with a smaller group because the larger group would have overwhelmed her.

IMPLICATIONS

Game-based learning has become a useful tool for teaching and extending STEM concepts and soft skills, which are necessary for academic and professional success (Tene et al., 2025). However, most research on game-based learning has been on digital or computer-based games. Therefore, the researcher wanted to use

a face-to-face conversation starter game as an alternative education tool that can be used in different educational settings. Another reason this type of game was studied is because research shows that the increased reliance on virtual means of communication has had lasting effects on human communication (verbal and non-verbal) and relationships (Dragomir, Fărcașiu & Simon, 2021). For example, the use of face masks during the height of the pandemic physically obstructed the lower half of faces, thus preventing the proper display of facial expressions. Facial expressions are used to decipher the meaning and feeling behind verbal expressions (Dragomir, Fărcașiu & Simon, 2021). Also, the use of video-conferencing platforms such as Zoom and Microsoft Teams has been found to be mentally and physically exhausting, possibly leading to burnout (Dragomir, Fărcașiu & Simon, 2021). Furthermore, displaying non-verbal cues is more difficult in these virtual worlds, causing users to increase the intensity and duration of eye contact. This level of eye contact is typically reserved for more intimate relationships; therefore, changing the nature of professional relationships (Dragomir, Fărcașiu & Simon, 2021). The arrangement of the user images during these virtual meetings has also been shown to disrupt spatial perception, with the larger user images perceived as violations of personal space (Dragomir, Fărcașiu & Simon, 2021). Studies on student populations have revealed that although students adapted to these changes in communication, they admit that the pandemic had permanent effects on their relationships and communication styles (Dragomir, Fărcașiu & Simon, 2021). For example, students in one study stated that the use of face masks forced them to use the upper half of their face (e.g., eyebrow raises) to convey meaning as well as increasing the intensity of their verbal expressions to compensate (Dragomir, Fărcașiu & Simon, 2021). Since the world has transitioned back to in-person interactions, these adaptations can lead to increased misunderstandings in communication (Dragomir, Fărcașiu & Simon, 2021). Therefore, using tools such as conversation starter games can help students improve their skills or receive verbal and non-verbal feedback on their methods of communication. Furthermore, having informal opportunities to process and practice STEM content and skills increases STEM students' sense of competence, performance, and recognition. These elements are necessary to develop and strengthen their STEM identity.

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