

Who Learns from City Games? Examining the Role of Motivation, Personality, and Experience

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Abstract: Unlike traditional escape rooms, city games shift from a confined space to an open environment, allowing for greater exploration that incorporates elements of local art, history, and culture into the gameplay. Because of this, city games are often designed to promote learning about specific themes within a city. However, research on players, gameplay, and learning opportunities in city games remains limited. This experimental study examined how individual differences, such as personality, motivation, prior gaming experience, and interest in the game's subject matter, correlated with self-reported experiences and learning outcomes. A total of 23 adult participants, all visitors to Stockholm, Sweden, engaged in a custom-designed city game focused on sustainability and urban planning. Participants completed pre- and post-game surveys to assess their learning. Results showed that participants with higher levels of prior gaming experience reported significantly greater learning. Engagement with the game's supplementary "Did You Know" informational content was strongly associated with reported learning gains. Measures of motivation and personality significantly predicted predispositions toward teamwork and enjoyment during gameplay, but they were not significant predictors of learning outcomes. These findings have implications for pedagogy and learning through play, particularly in game design and education. The study underscores both the potential and limitations of city games in creating inclusive learning experiences.

Keywords: Games, Learning, Pedagogy, Motivation, City games, Education

1. Introduction

The growing popularity of escape rooms has led to the emergence of various adaptations of the escape game concept (The Economist, 2019). One such variation is the city game, which extends the escape game format by distributing puzzles throughout an urban environment. While city games share core mechanics with escape rooms, such as puzzle-solving, teamwork, and time constraints, they differ in key ways (Veldkamp et al., 2020). Unlike traditional escape rooms, which take place in a controlled, enclosed setting, city games integrate real-world locations into their design, encouraging players to navigate and interact with their surroundings as part of the experience. This shift from a confined space to an open environment allows for greater exploration and immersion, often incorporating elements of local history, culture, or education into the gameplay. In this way, city games can be seen as an evolution of escape rooms, blending structured play with the dynamic and unpredictable nature of urban spaces. Because of this, city games are often designed to promote learning about specific themes within a city. However, research on players, gameplay, and learning opportunities in city games remains limited.

1.1 City Games: Escaping the Room

An escape room is a live, team-based game in which players collaborate to solve puzzles and complete storyline-driven missions within a limited time, typically while confined to an indoor setting. In contrast, city games extend the escape game format to a series of puzzles distributed throughout a larger city environment. Players follow a storyline as they solve challenges sequentially. However, while escape rooms are confined to a single space, focusing on puzzles, hidden clues, and time-limited collaborative problem-solving, city games

span urban environments, ranging from exploring a city block to traveling across an entire city. City games combine physical activity with digital or location-based technologies to prioritize exploration, navigation, and real-world interaction. Players progress through the storyline, delivered via an app or physical kit, and solve puzzles collaboratively with friends or family. Some popular city adaptations include *Questo*, *Mystery City Games*, *Amaze Games*, and *Clued Upp*.

City gaming as through the lens of game-based learning leverages the environment of a city as a platform for learning goals (Huizenga et al., 2009; Hanney, 2024; Tan, 2016; De Lange, 2009). In this approach, urban spaces are transformed into interactive learning environments where learners can engage in activities that promote exploration, problem-solving, and critical thinking within real-world contexts. City gaming can encompass a range of activities, from scavenger hunts to location-based challenges that require participants to navigate and interact with their surroundings (Tan, 2016). There is a great deal of variety in the commercial and educational escape and city-gaming space. It is not the intent of our paper to document the breadth and theoretical implications of this diversity, but to highlight the distinction between escape room games and city-games as game categories.

For educational applications, increased immersion in a story through non-fiction can be beneficial for the players by directly involving players in a story or problem, inviting active engagement and participation (Veldkamp et al., 2022). The immersive nature of city gaming helps learners connect educational content with tangible experiences, enhancing retention and understanding (Yang, 2012). City gaming aligns closely with contemporary educational theories that emphasize the importance of situated learning and experiential education that may provide more accessibility to learning (Kolb, 1984). These theories advocate for learning experiences grounded in authentic, real-world contexts; thus, allowing learners to apply knowledge and skills in meaningful ways. City gaming, through utilizing the urban landscape as a classroom, provides such opportunities, making learning both relevant and impactful.

With increased popularity, there has been a rise in research pertaining to the learning outcomes associated with escape rooms as well as how these games may be applied for educational purposes (López-Pernas et al., 2019; Veldkamp et al., 2022; Yang, 2012). While city games are similar in principle and approach to escape rooms, they currently are not as often utilized. One reason may be because while an escape room takes place in a confined and carefully designed indoor space, city games may be subject to greater environmental constraints due to increased variability of a more uncontrolled environment. For example, factors such as weather, construction, or public events could potentially alter a game experience. Nonetheless, city games offer a unique opportunity for players to learn about real-life cultural landmarks and city environments. It may be that these types of games may have more broad appeal and learning outcomes for individuals who struggle in more traditional classroom learning environments (Huizenga et al., 2009). However, because city games reflect a new approach to the 'escape game' concept, there is a lack of research regarding the learning associated with participation in city games.

1.2 Interest, Motivation, and Learning

Central to the effectiveness of learning experiences are motivation and interest, two interrelated factors that play pivotal roles in shaping learner attitude and behavior. Past literature has established this intricate and interconnected relationship between interest, motivation, and learning outcomes. Schiefele and Csikszentmihalyi (1995) characterizes interest as a precursor to intrinsic motivation. In their framework, interest acts as a foundational underpinning to intrinsic motivation, serving as the initial spark that ignites enthusiasm and curiosity for a particular subject or task. In other research, interest has been identified to have a crucial role in educational contexts, acting as a catalyst for involvement, enjoyment, concentration, and activation (Hidi & Renninger, 2006).

Interest leads to involvement by capturing individuals' attention and stimulating curiosity (Hidi & Renninger, 2006). Hidi and Renninger (2017) propose that interest activates cognitive processes by stimulating individual thinking and problem-solving skills. When individuals are interested in a topic, they are more likely to engage in critical thinking, analysis, and synthesis of information. When individuals find topics and subjects personally relevant or intellectually stimulating, their likelihood to actively seek out information and engage in exploration and discovery heightens. This active involvement fosters deeper, more meaningful learning experiences and motivates one to invest more time and effort to furthering knowledge. Moreover, interest promotes enjoyment by creating a positive emotional experience associated with learning. When individuals find themselves interested in what they are learning, they experience feelings of enjoyment, satisfaction, and

fulfillment. This positive affective state enhances the overall learning experience and also reinforces motivation to continue learning and exploring the topic further.

1.3 Individual Personality

Apart from designing for immersion and considering factors related to motivation and interest, it is still possible that individuals themselves may bring with them their own differences to a game. Personality is one such individual difference that may act as a predictor of behavior in a game, and as such has important implications for game engagement and learning outcomes. For example, one study found that low neuroticism and high openness to experience predicted more cooperation in games (Lönqvist, Verkasalo, & Walkowitz, 2011). In escape room settings, personality traits can shape social interactions and individual problem-solving strategies, similar to game-based assessments (GBA; de Hessel et al., 2021). Personality may predict behavior and influence both game experience and learning outcomes. The Big Five personality traits, in particular, have been linked to the use of self-regulated learning (SRL) strategies, which include goal setting, time management, task strategies, and help-seeking. Research shows conscientiousness is the strongest predictor of SRL, while agreeableness also plays a mediating role (Bruso, 2019). Additionally, personality influences goal-attainment strategies: agreeableness and conscientiousness are closely tied to mastery-approach goals, whereas neuroticism correlates with avoidance and performance goals (McCabe et al., 2013). Given these associations, the Big Five traits are likely to shape individuals' experiences in city games through their impact on behavior.

1.4 Current Study

Data on players, gameplay, and learning opportunities in city games remains limited. This experimental study examined how individual differences, such as personality, motivation, prior gaming experience, and interest in the game's subject matter correlated with self-reported experiences and learning outcomes. Understanding individual interest and motivation is essential in educational contexts, as it plays a critical role in shaping learners' engagement, persistence, and learning outcomes. Participants completed a pre-game and post-game survey to assess their learning during a custom-developed city game using the *Questo* mobile app.

We predict that participants with higher prior gaming experience, stronger interest in the game's subject matter, and greater engagement with informational content will report higher learning outcomes in a city game. Additionally, individual differences in motivation and personality will predict enjoyment, teamwork, and learning gains.

2. Method

2.1 Participants

Female undergraduate participants who were on a study abroad program (N = 23) in Stockholm, Sweden, were recruited using convenience sampling methods through flyers, in-person requests, and a campus app. The entirety of the sample identifies as female. Demography consisted of 4% Asian or Asian American (n = 1), 4% Black or African American (n = 1), 74% White (n = 17), 4% Hispanic or Latino (n = 1), and 13% "Other" (n = 3). Participant's university attendance was as follows: 13% attend public universities (n = 3), 43% attend private universities (n = 10), and 43% attend liberal arts colleges (n = 10). All participants were visitors to Stockholm, Sweden, and had not been in Stockholm for more than 8 weeks.

Participants were grouped based on availability indicated in a recruitment survey. Researchers formed groups of 2–4 and assigned them randomly within those availability windows. Access to a smartphone was required to engage with the city game. Although exclusion was possible due to weather or feasibility of outdoor play, no participants were excluded. All participants gave written consent after receiving study information verbally and in writing. Each received a €10 gift voucher for participation. Participants were recruited using convenience sampling, as the study targeted adult visitors to Stockholm who were available and willing to participate during the game's scheduled sessions. Inclusion criteria required that participants be over 18 years of age and proficient in English; no additional exclusion criteria were applied. The small sample size reflects the exploratory nature of the study and the logistical constraints of running a live, location-based game.

The study's methods and protocol were conducted in accordance with the standards specified in the 1964 Declaration of Helsinki and were approved by the local ethics committee of Uppsala University and the Swedish Ethical Review Authority (2022-03420-02).

2.2 Materials

2.2.1 Pre-survey

Consistent of the following questions:

- Have you ever played a city game before?
- Have you ever done an escape room before?
- Do you enjoy escape rooms?
- What games do you like to play? Select all that apply.
- [Ten Item Personality Measure (TIPI)]
- [The General Motivation Scale (GMS-28)]

2.2.2 Ten item personality measure (TIPI)

Personality was assessed using the Ten Item Personality Measure (TIPI; Gosling, Rentfrow, & Swann, 2003), a brief instrument designed to measure the Big Five personality dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience. Participants rated themselves on 10 items using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The TIPI is widely used in research contexts requiring a short, time-efficient assessment of personality.

2.2.3 The general motivation scale (GMS-28)

Motivation was measured using the General Motivation Scale (GMS-28; Howard et al., 2021), which assesses different types of motivation based on Self-Determination Theory. The scale includes 28 items covering intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. Participants responded using a 7-point Likert scale ranging from 1 (not at all true) to 7 (very true). The GMS-28 is a validated tool for capturing a broad spectrum of motivational orientations across contexts.

2.2.4 Questo game storyline description

Participants used *Questo*, a mobile app that delivers location-based, gamified urban exploration through narrative-driven tasks, clues, and puzzles requiring physical navigation to specific sites. Each quest follows a thematic storyline, often historical, cultural, or fictional, encouraging interaction with the environment.

In this study, participants completed a custom-designed *Questo* quest (*Sabotage! Prevent sustainability sabotage with the Planet Protectors*) set in a predefined area of Stockholm, themed around sustainability and urban planning. They used their personal smartphones to download and access the app. Before starting, participants received instructions on app usage and were asked to enable GPS. No additional guidance was provided during the quest to maintain naturalistic engagement.

The custom developed *Questo* contained the following storyline, provided to participants at the start of the game: "Agent Green, You are a covert operative with the Planet Protectors, a secret United Nations agency charged with protecting Earth's environment. You're a spy on behalf of the planet. Your goal is to ensure a livable planet for future generations. Today's mission: secure the sustainability assets at the Stockholm Royal Seaport (SRS), one of Europe's most important sustainable development sites. A UN delegation of world leaders will visit SRS tomorrow. Use any means necessary to ensure the tour is a success."

1.1.5 Game and city map

See Figure 2.

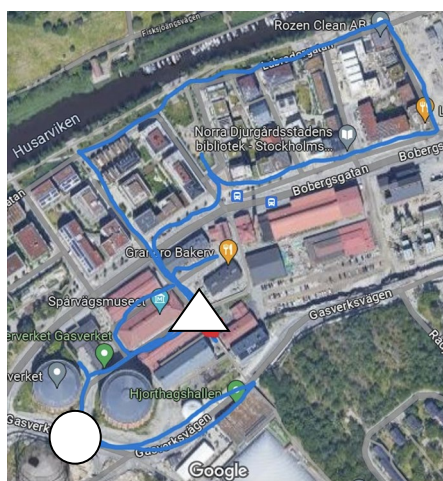


Figure 2: The bottom circle marks where participants started, the triangle is where participants ended. The drawn line is where participants would have to walk or the typical path they'd take to complete the game

2.2.5 Puzzles

A total of 14 puzzles were completed across the game map. The puzzles could not be accessed after completion or when not on location. See Table 1 for a list of the puzzle types.

Table 1: The order of puzzles with a brief description of the task and the learning mechanisms that task used to solve the puzzle

Puzzle Order	Puzzle Description & Learning Type
Puzzle #1	<i>How many steel vertical supports?</i> Matching visual elements to real-world contexts.
Puzzle #2	<i>Look around and find the name of the threatening organization.</i> Word puzzle, matching visual elements to real-world contexts.
Puzzle #3	<i>Find the SDG that speaks to teaching and learning, and report the code number.</i> Location task and reporting.
Puzzle #4	<i>What is the reading on the large and small gauge?</i> Location task and reporting.
Puzzle #5	<i>Heat and electric ducts, find which post holds a password, alphanumeric code.</i> Locating in a physical environment and reporting.
Puzzle #6	<i>Walk through the drainage system path and order images provided.</i> Matching visual elements to real-world contexts.
Puzzle #7	<i>Inspecting construction of the building, which image shows the renewable source from which this building was made?</i> Image recognition and matching.
Puzzle #8	<i>Locate statue pictured, confirm the security of this social value space by documenting which UN SDG spaces like this contribute to.</i> Visual search and analysis.
Puzzle #9	<i>From your position at the location in the image you can see a number of sustainability assets. Use a</i>

Puzzle Order	Puzzle Description & Learning Type
	<i>checklist to identify which SDG goals are observable at location.</i> Systematic observation and recording.
Puzzle #10	<i>Compare the given image to real signs and order the modifications.</i> Visual comparison.
Puzzle #11	<i>Waste management: order the number of images of the color-coded receptacles so they match the order of the symbols in the image.</i> Pattern recognition and sequencing skills.
Puzzle #12	<i>Find playground equipment visible in the images, which UN SDG do they refer to and report code from the checklist.</i> Observational and reporting.
Puzzle #13	<i>Blue and white markers with numbers/ symbols/ letters, find 7 symbols and use them to decode message.</i> Pattern analysis, visual search, logical reasoning, and problem solving.
Puzzle #14	<i>Look below (letters on floor) and decode the message.</i> Spatial skills, lateral thinking.

2.2.6 Post-survey

Immediately following the completion of the game, participants completed the following questions:

- Describe anything you learned during the game. Please be as specific as possible.
- Did you read the "Did you know?"
- My team worked together on every puzzle.
- Which role did you take during the game?
- I participated (e.g., read/listen to the questions, think through a possible solution, work together, etc.) throughout the whole game?
- I liked the game and had an enjoyable time playing it.
- Describe anything you learned during the game.
- Did you experience any difficulties or technical issues during the game?

2.3 Assessments

2.3.1 Personality

To determine personality information, each participant answered the Ten Item Personality Measure (TIPI; Gosling, Rentfrow, & Swann, 2003) as part of the pre-survey. Respondents indicated on a seven-point scale how well each item resonated with them (from 1 = "disagree strongly" to 7 = "agree strongly"). The TIPI measure comprised 10 survey items. Each item is delineated by the five personality domains, established by the Five Factor Model (Costa & McCrae, 1992). These include (1) extraversion, being sociable and active, (2) agreeableness, being soft-hearted and trusting, (3) conscientiousness, being organized and reliable, (4) emotional stability, being calm and relaxed, and (5) openness, being curious and creative.

2.3.2 Motivation

The Global Motivation Scale (GMS-28), completed during the pre-survey, was employed to assess motivations for participating in city games (Guay, Mageau, & Vallerand, 2003). The scale assesses behavior shaping motivation using 7 constructs: (1) intrinsic motivation, (2) motivation toward knowledge, (3) accomplishment and stimulation, extrinsic motivation subclassified, (4) identified, (5) introjected, (6) external regulation, and (7) amotivation. Participants responded to 28 items on a 7-point scale (from 1 = "does not correspond accordingly" to 7 = "corresponds accordingly").

2.3.3 Experience

Prior experience of participants was measured in the pre-survey and answers were recorded on a 5 point likert scale (ranging from 1 = "No, never" to "Yes, more than 10 times"). These questions included the following: (1) have you ever played a city game before and (2) have you ever done an escape room before.

2.3.4 Interest

Participant interest was measured in the pre-survey. Answers to the first interest question were recorded on a 5 point likert scale (ranging from 1 = "No, never" to "Yes, more than 10 times"). This question asked: "Do you enjoy escape rooms?" The second question measuring interest was a multi-select question, asking: "What games do you like to play? Select all that apply."

2.4 Procedure

Participants were contacted prior to arrival and given details about the game starting point, where they met the researcher(s). Upon arrival, the researcher(s) explained the study instructions and obtained written participant consent. Participants were guided through downloading the city games app, *Questo*, and locating the game within the app. They then completed a pre-survey. The researcher instructed the group to begin and left the group. The participants followed in-app instructions to complete 14 puzzles around the Stockholm Royal Seaport neighbourhood. Once the participants finished the game, they met the researcher to complete a post-survey. Player progress and performance statistics were tracked in the app.

2.5 Study Design

This study was a within groups quasi-experimental design. All participants experienced the game in groups of 2-4 for a duration of roughly an hour. Quasi-independent variables included personality, motivation, prior experience, and interest. The quasi-dependent variable in this experiment was self-reported game-based learning.

2.6 Analysis Approach

Data were analyzed using SPSS (v.31) to explore relationships between individual difference variables and game-related experiences. Pearson correlation analyses were conducted to examine associations between personality traits (as measured by the TIPI), motivational constructs (as measured by the GMS-28), and key game-related variables, including teamwork, enjoyment, prior escape room experience, and engagement with in-game content. These analyses were used to identify potential patterns and predictors relevant to participants' subjective experiences during the city game.

In addition to correlational analyses, independent samples t-tests were used to compare group differences in reported participation based on whether participants indicated that they had learned something from the game. A one-way analysis of variance (ANOVA) was also conducted to assess differences in reading engagement across groups categorized by the type of content participants reported learning. Effect sizes and confidence intervals were reported where appropriate to contextualize the strength and reliability of findings. All significance thresholds were set at $p < .05$.

3. Results

Pearson correlation analyses were conducted to examine the relationships between motivational constructs, personality traits, and game-related experiences. Intrinsic motivation was negatively correlated with teamwork, $r = -.467$, $p < .05$, and positively correlated with openness to experiences, $r = .525$, $p < .05$ (see figure 3). Intrinsic motivation was also positively associated with escape room enjoyment, $r = .44$, $p < .05$. These findings suggest that individuals with higher intrinsic motivation may report lower levels of teamwork, but greater openness and enjoyment during the escape room activity.

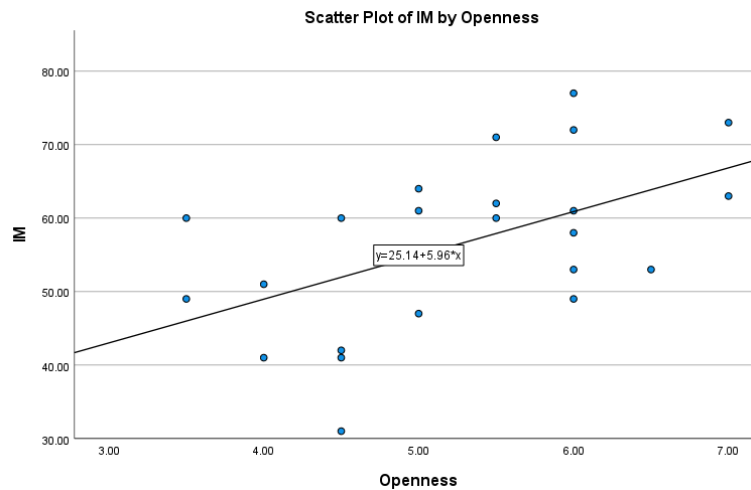


Figure 3: Depicts positive correlation between the personality trait “openness to experiences” and intrinsic motivation (IM)

A significant negative correlation was found between teamwork and openness to experiences, $r = -.550, p < .01$, indicating that participants who scored higher in openness were less likely to engage collaboratively with others.

Additional correlations revealed that amotivation ($r = .628, p < .01$) and introjected extrinsic motivation ($r = .503, p < .05$) were both positively associated with time spent reading game content. This suggests that participants with either amotivated or introjected motivational styles were more likely to engage with the game's reading components.

Further analyses showed that prior experience with escape rooms was positively associated with escape room enjoyment ($r = .505, p < .05$), but negatively associated with teamwork ($r = -.505, p < .05$).

An independent samples t-test was conducted to compare participation levels between participants who reported learning something from the game and those who did not. Results indicated a significant difference, $t(19) = -2.288, p < .001, F(1, 19) = 14.672$, with higher participation reported by those who indicated learning.

A one-way analysis of variance (ANOVA) was also performed to assess whether reading behavior differed based on the topics participants reported learning. The results demonstrated a significant effect, $F(3, 17) = 9.359, p < .001, \eta^2 = .623, 95\% \text{ CI } [.199, .741]$, indicating that reading engagement varied meaningfully depending on the content learned. Figure 4 shows the distribution of reading effort on learning.

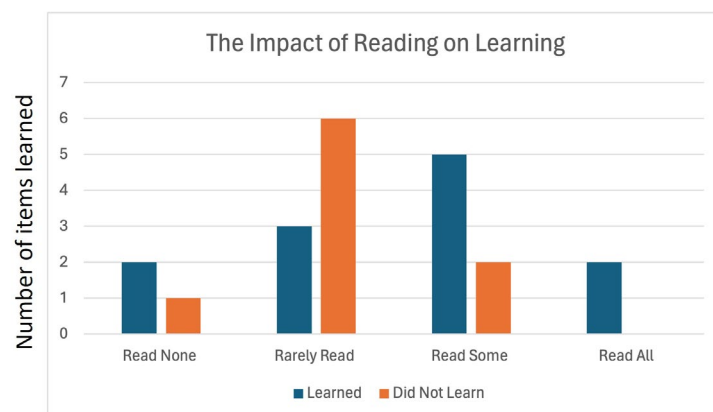


Figure 4: Depicts the distribution of reading effort on learning

4. Discussion

The central research question guiding this study was: to what extent does learning occur through participation in city games? More specifically, we examined whether factors such as participation, reading behavior,

personality traits, and motivational orientations predict learning outcomes in game-based contexts. We proposed two hypotheses: first, that participation in city games would lead to self-reported learning, and second, that individual differences, including personality, motivation, prior experience, and interest, would influence the quality of learning derived from gameplay.

Those who reported learning something, especially about sustainability or urban planning, also reported higher participation, supporting the hypothesis that engagement enhances learning and the absorption of educational content. A notable and unexpected finding was the negative correlation between intrinsic motivation and teamwork. This challenges the assumption that intrinsic motivation universally enhances collaboration, suggesting instead that intrinsically motivated individuals may prefer independent problem-solving. A similar pattern was observed for openness to experience, which was also negatively associated with teamwork. Contrary to prior research linking openness with collaboration, this suggests that, in exploratory games, openness may reflect a preference for individual exploration (Juhász, 2010).

Another key finding was the positive relationship between intrinsic motivation and enjoyment of the city-based escape game. This highlights the intrinsic rewards of gameplay and suggests that individuals driven by personal growth and achievement also derive enjoyment from such experiences. Further research into the interplay between intrinsic motivation and enjoyment could inform the design of immersive games that enhance engagement and satisfaction. Analysis of participants' prior escape room experience revealed that experienced players reported higher enjoyment but lower teamwork engagement. This suggests experienced players may prefer autonomy over collaboration. Designing games that account for varying skill levels can better accommodate both novice and experienced players, improving overall enjoyment and team dynamics.

A unique feature of the study was the inclusion of optional "Did you know?" sections, offering educational content on sustainability and urban development in the Stockholm Royal Seaport. These segments paused the in-game timer to promote stress-free reading. Interestingly, reading engagement positively correlated with both amotivation and introjected extrinsic motivation. Although typically associated with low engagement (Hulaj et al., 2020), these motivations may have been influenced by more engaged teammates, indicating group dynamics at play. These findings suggest a need to explore how less productive motivational styles can still support educational engagement in games.

4.1 Limitations

It is important to acknowledge several limitations of this study. The relatively small sample size ($n = 23$) limits the generalizability of the findings, and the sample's homogeneity, composed exclusively of women, most of whom were white, restricts the ability to explore how gender, race, or other demographic differences may influence experiences and learning outcomes in city games. Additionally, the small group size limited the exploration of group dynamics, which are particularly relevant in collaborative, team-based gameplay. The reliance on self-reported measures for constructs such as motivation, personality traits, and learning also introduces potential response biases, which may affect the accuracy of the results.

One important limitation of this study is the reliance on self-reported learning outcomes, which may be subject to biases such as social desirability, memory recall, or personal interpretation of what constitutes "learning." Without objective assessments to validate these reports, the findings should be interpreted with caution. Future research would benefit from incorporating independent or performance-based measures to more robustly evaluate learning outcomes in city game contexts.

4.2 Conclusions

City games, by incorporating engaging, hands-on learning activities, may support learners who are intrinsically motivated and prefer self-directed exploration, as well as those with lower intrinsic motivation who benefit from group influence to engage with reading materials and factual content. The negative correlation between intrinsic motivation and teamwork found in this study suggests that independent exploration may be more rewarding for some learners. This insight can inform city game design by allowing for independent tasks or optional collaborative elements, which could increase accessibility for learners who thrive on autonomous learning, such as introverts or students with social anxiety. Tailoring game design to accommodate such individual preferences could broaden participation in educational activities, fostering an inclusive learning environment for students with diverse engagement needs.

The study highlights how reading sections embedded within city games can support information retention and learning for certain types of players; Those with higher amotivation or introjected extrinsic motivation were

more likely to engage with these sections. This insight underscores the potential of city games to create multiple pathways to engagement and learning, allowing players to acquire knowledge through different modalities, which may especially benefit students who process information more effectively through reading than interactive play alone. Given these findings, city games could be designed with an understanding of diverse motivation styles, creating opportunities for knowledge acquisition through both self-driven and group-facilitated interactions. Embracing such flexible design strategies would allow city games to be more accessible, providing meaningful educational experiences to students with varying personality traits, learning preferences, and motivational profiles.

The findings of this study can be meaningfully interpreted through the lens of Self-Determination Theory (SDT; Deci & Ryan, 1985), which differentiates intrinsic motivation, engaging in an activity for inherent satisfaction, from extrinsic motivation, driven by external rewards or pressures. Our results show that intrinsic motivation was positively associated with openness to experience and enjoyment during the game, but negatively correlated with teamwork. This may suggest that intrinsically motivated individuals value personal exploration and autonomy, which aligns with SDT's emphasis on autonomy as a fundamental psychological need. Conversely, extrinsic motivational styles, such as introjected regulation, were linked to greater engagement with the game's informational content, indicating that external or internal pressures can also drive participants to seek knowledge, albeit through different motivational pathways. These distinctions show the importance of designing city games that support intrinsic motivation to enhance enjoyment and foster meaningful engagement, while recognizing that extrinsic motivators can play a role in promoting specific learning behaviors.

This study's contributions to games-based learning opens the door to further research on the educational potential of city-based escape games, particularly in relation to long-term knowledge retention, transfer, and real-world application. Future investigations might also examine how instructional strategies, such as debriefing sessions and scaffolding techniques (Friedrich et al., 2019), can be optimized to support learning outcomes in these environments. By expanding on the insights gained here, researchers can continue to refine our understanding of how game-based experiences shape learning and contribute to the design of more effective and engaging educational tools.

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Ethics declaration: The methods and protocol of the study were conducted in accordance with the standards specified in the 1964 Declaration of Helsinki and were approved by the local ethics committee of Uppsala University, The Swedish Ethical Review Authority (2022-03420-02).

AI declaration: No generative AI tools were used in the preparation, writing, editing, or analysis of this paper. All content reflects the original work and intellectual contributions of the authors.

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