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# The Game Element and Mechanic (GEM) framework: A structural approach for implementing game elements and mechanics into game experiences☆

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ABSTRACT

Existing research in player typologies has presented theories to try and explain players' behavior during gameplay. Many typologies are context or genre specific and therefore are potentially limiting their practicality in other contexts. To date, no existing research categorizes players based on their explicit preferences for game elements and mechanics (GEMs). To this end, an analysis of three surveys (n = 279, n = 231, n = 162), using exploratory factor analysis (EFA) revealed practical insights towards players' preferences for GEMs, specifically three game elements and four game mechanic factors. These results provide the foundation for what is described as the GEM Framework. To investigate their practical use, a game design tool known as Gamicards was modified to accommodate the GEM Framework. Lastly, a workshop (n = 47) assessed the use of the GEM Framework with Gamicards as a tool during the game design and prototyping process. This work extends the current understanding of what GEMs players prefer and discusses the practical implications of using the GEM Framework with Gamicards and player modelling techniques.

## 1. Introduction

The use of gaming experiences has become ubiquitous, multi-platform, and within variety of contexts. Many industries from entertainment, education and enterprise, are reaching out to integrate games to extend user/client interaction or to improve employees' daily lives. For example, the use of loyalty programs (e.g. Flybys) integrate "gamified" strategies to playfully encourage customers by incentivizing them to buy certain products. Often, this occurs through an ongoing accumulative point-based system that the consumer can then use at a later stage to exchange the points that they have collected for various rewards (e.g. magazine subscriptions, discounts, products, etc.). In addition, and along the same lines, corporations are using games and gamified experiences to encourage workplace productivity and boost morale, while educational institutions are applying game-like approaches to their educational software (e.g. Blackboard, Moodle) to improve students engagement towards curriculum content and assessments. To this end, while users are engaging with systems that provide such an incentive-based service it is necessary to investigate what players of these experiences prefer when it comes to game elements and mechanics (GEMs). In this way, game designers can then utilize this information towards the design of more tailored (game and gamified) experiences based on what players prefer, with the potential for producing more meaningful interactions for the player.

Ideally, for game designers to design and connect with a player's needs, they need to create meaningful experiences. Personalized and tailored game experiences have been the focus of many studies [1–5], from adaptive game play, such as Dynamic Difficulty Adjustment and player modelling [6,7], human computer interaction (HCI) [4,8], persuasive strategies [9,10], psychology [5,11–15] and motivation (8,10). Many approaches to the topic of player-centered design have resulted in the development of player typologies to understand the kind of experiences that draw in players and how players behave towards and within them. Player typologies range from a small number of types (e.g. three types/models) [16] to larger ones (e.g. up to twelve types) [17,18], while offering different context, opinions, and approaches to classify players (e.g. enterprise, education, marketing).

At present, many of these typologies encourage game designers to use these models as part of their design (e.g. [19]) or at least to consider their aspects as a lens to view the experience (or parts of it) through. This is often with the intention of improving customer engagement and motivation (i.e. via gamification) with an experience or product; or a theoretical understanding of gamers in a traditional context [20]. Many player typologies appear to have been conceptually conceived, often showing processes that relate to fundamental attribution theory – in the sense that players are observed on how they behave and interact with the game and others and are consequently categorized from it. As a result, many typologies are developed based on such observations and

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conceptual assumptions, without factoring in whether notions about players behavior are dispositional (because of who they are) or situational (because of the game environment). This is also a point raised by Yee [21] among others [22]. In this way, such an approach could lead towards some typologies/beliefs underestimating the impact of the situation and overestimating the impact of disposition, resulting in attribution error. Over time, we have seen this become known with criticism over existing typologies being unrelatable to contexts outsides of their conceptions, such as Bartle's [16] not being applicable outside of Multi User Dungeons (MUDs), or Yee's [21] outside of Massively Multiplayer Online games (MMOs), and so on. Therefore, taking a step back and asking players what they prefer when it comes to the GEMs of games appears to be the prerequisite step before developing typological structures, free from a psychological context. In this way, researchers can understand the groups that players prefer GEMs in, *and then* seek out *causality*. It is likely that it could result in more wholesome player typological models and understandings. In a similar vein, this is a relevant issue that is raised by Hamari and Tuunanen [22, p. 45], in which case they argue that the behavior of a player may differ from one game to the next depending on the game itself – that "motivations and behaviors of a player might not fully transfer between different types of game", which could often stem from the design or genres themselves.

The practical use of these typologies at a game design level or their use as a tool during the game design process appears to be lacking in the current game (including gamification) literature. Furthermore, while we may have or work towards a better understanding about players, we also need to consider how to design for them using more adaptive and user-centric design processes. While player typologies theorize about what GEMs players may align with or prefer, it appears that very few seek out to find what players prefer in games *and* ways to apply/use this knowledge during the game design process. As a result, this information could aid game designers in a range of contexts, if not all of them, by providing them with information towards making more meaningful choices about what GEMs to add or remove to improve their game's appeal to players.

To address this problem, this study has worked toward three goals. Firstly, it proposes a list of GEMs that were based on earlier gameplay experience and additional gameplay carried out to determine what GEMs are relevant. Secondly, it uses exploratory factor analysis (EFA) to figure out if players preferred GEMs in combinations. Thirdly, to validate the practical use of the GEM Framework, a game design tool called Gamicards was modified to include the GEM Framework (via design changes) and used in a game design workshop. The latter was to evaluate the framework's potential during the game design process. Overall, the results show positive outcomes in both the development of the GEM Framework, its use with Gamicards, and its use during the game design process.

This work contributes to the field of player modeling and human–computer interaction (HCI) with the following outcomes:

- A preliminary GEM list based on an investigation of various gaming experiences.
- A framework based on player's preferences for GEMs.
- The practical use of the GEM Framework through a game design tool Gamicards [23].

This study does not cover or tries to explain causation for these results. It discusses what they may mean so that it offers context and direction for future research that may aim toward expanding the work presented here. In addition, to the best of the author's knowledge, this study is the first to explore and offer data based on a player's preferences for GEMs.

## 2. Related work

This section presents a brief review of the main approaches to understanding players within gaming experiences via the construct of play types. This section concludes by presenting a refined lexicon with a brief overview of how these studies have presented an opportunity to develop our understanding of player's preferences in gaming experiences regardless of their behavior and motivations.

### 2.1. Player typologies

For many years, game designers and scholars have tried to categorize gamers into "player types" based on how a player may behave within a game environment and/or with players. Therefore, player types, similar to personality types aim to categorize players based on behavioral traits that they demonstrate during game play. For example, some player typologies have demonstrated similarities between player typologies and pre-existing personality types (see: [5,11]). On the other hand, others typologies [22] suggest the existence of four overarching categories that players are segmented into (geographic, demographic, psychographic, and behavioral). A list of current player typologies has been synthesized by Hamari and Tuunanen [22]. where they discuss the different ways that players have been categorized such as geographic, demographic, psychographic, and behavioral. In addition, other approaches focus on motivations (e.g. [21,24]), which have also contribute to the development of this field.

The work on player typologies is consistently ongoing, with many of its foundation based on Bartle's four player types. These are often the most used, critiqued, and iterated types in player typology literature. They were created from data collected about what MUD users experienced as "fun". From this, Bartle identified four categories - *Achiever*, *Socializer*, *Explorer* and *Killer* [16,17]. Not long after the development of the four player types, Bartle saw that players fluctuate between the types. In an attempt to cater for these fluctuations, he added another dimension to the traditional model, establishing a further eight player types [16,17].

In more recent times, and with a more modern approach, addition player typologies that are similar to Bartle's model have been made such as that by Marczewski's [18]. In addition, Marczewski has incorporated the domain of psychology (personality and motivation) to help explain player's motivations with what he refers to as RAMP: *Relatedness, Autonomy, Mastery and Purpose.* This work has been further iterated upon by Tondello et al. [28] where they too have included additional considerations towards the presence of GEMs (e.g. Leaderboard, Badge, Points, etc.) in a gamified environment. This is an approach that has also been echoed by other research [3,29–32]. Lastly, while still focused on human motivation, Chou's Octalysis Framework [36] sees gamification design with an emphasis on human motivation in the process. The framework consists of eight core drives represented by each side of an octagon that appeals to certain core drives within players to motivate them towards certain activities such as *Meaning, Accomplishment,* and *Social Influence.*

However, while many investigations and frameworks aim to conceptualize a player, who she is and how she is likely to engage with a system, it makes it difficult to maintain a balance between players and between the player and the environment. In addition, within the context of psychology, Malone was one of the first psychologists to explore intrinsic motivation in the context of computer games. In a study conducted in 1981 [33], Malone asked children about (out of a series of games) the ones that they preferred. He then correlated these features towards the children's preferences for features within these games. His findings showed that there *were* differences between the games that the children like and that features such as goals, scores, audio effects, randomness, and speed (efficiency of response), were some of the highest preferred. With this information, he created six versions of the popular game *Breakout*[1] that had or omitted three features: breaking

[1] Breakout is a single player arcade game released in 1976 that needs a player

bricks, bouncing ball, and the player's score. In these variations, he implemented different combinations of the preferred features. The results of this study revealed that players significantly preferred the version of *Breakout* that had all three features. Malone's [33] study presented an important finding with regards to the overall design of the game *Breakout* in terms of how the *combination* of the game's features impacted its overall rating. What this could mean in modern times is that a game's success *or failure* could be attributed to the GEMs (and combinations thereof) that it has *or does not* have – that affect player's preferences and overall enjoyment of a game. Lastly, Malone conducted a second study, with children playing (different versions of) the game Darts[2]. As a result, the produced equivalent results to the earlier study of *Breakout*. In this way, his work showed promising results with regards to the roles that certain game features played on a player's overall enjoyment and that modifying such combinations resulted in a less preferred experience.

It is clear, player typologies have and still tend to fluctuate despite existing typologies undergoing many iterations to accommodate instabilities. The realization of these variations and the interdisciplinary use of gaming experiences suggest that with gaming experiences existing in varying contexts, these typologies will continue to go through many iterations with limited stability. This is not necessarily a negative attribute considering that as technology advances so too will the ways of interaction; therefore, it is important for them to adapt accordingly. However, by observing the commonalities between these typologies, it appears that the focus should not necessarily begin with how players behave within gaming experiences but what is it about these experiences that they prefer or find appealing. From this, a reversed engineered approach, like Malone, could lead to a better explanation about why player typologies fluctuate and whether it is due to variables such as technological/interactive changes or the actual user's behavior. In this way, game designers and scholars can begin to refine their focus and iterate existing typologies to create a more stable classification of players altogether.

### 2.2. Defining game elements and game mechanics (GEMs)

Despite their context (e.g. entertainment, gamification, education, etc.), games consist of many components, and many game scholars will use varying terms, with and without consistency. Therefore, this paper is centered on (and defines) two fundamental game components. The first being ***game elements***, which is defined like the Greek word "stoikheion", meaning component or part. Game elements include *Badges, (Progress) Bars, Points,* and *Leaderboards*, among others. The second being **game mechanic**, which refers to the definition of the late Middle English term "mechanic" meaning "relating to manual labor." Game mechanics include *Trading, Using, Making,* and *Finding*, among others. The full list of GEMs used within this paper, and their definitions are in the Appendix in Tables 8 and 9

### 2.3. User and designer centered game design tools and approaches

The design of a gaming or gamified experience has many different approaches depending on what the aim of the experience is intended to be. Just like player typologies, many game and gamified design framework exists. Some notable examples, some of which have been previously mentioned, include the 6D framework developed by Werbach and Hunter [35], RAMP and GAME by Marczewski [18], the Octalysis Framework by Yu-Kai Chou [36], the Gamification Model Canvas by Jiménez and Escribano [37], MDA Framework by LeBlanc et al. [38], Game Ontology Project (GOP) by Zagal et al. [39] among others that are also discussed extensively by Almeida and da Silva. [40], and Mora et al. [41]. Many of these taxonomies, methodologies, and reviews contend similar issues such as the need for a common lexicon. However, regardless of their context (i.e. game or gamification) these taxonomies explore different elements of gameplay and stages thereof. For example, GOP is a multi-layered approach that has various considerations such as the input method (e.g. game software), input device (e.g. a gamepad), and more personal aspects such as manipulation (locus, direct, indirect, and method). On the other hand, the Octalysis gamification framework has eight core drives of gamification that focus on drives and their relationship with GEMs, effects (e.g. Aura Effect, Alfred Effect) and additional concepts (e.g. Status Quo Sloth, Rightful Heritage). As a result, while there are many differences between the taxonomies/frameworks/models/methods, they all work towards improving the gaming experience for the player.

Among the discussions of player typologies and game design methods, there is evidence to support the practical use of these typologies as part of the game design process has many different approaches. For example, game designers can use each of these typologies in ways to identify certain player types via observation (e.g. [18]), or to predict player's motivations within a gaming experience (e.g. [24,26]). Often, these implementations require that players are then surveyed prior, so that game designers can choose "adequate" design elements for a specific user. Not only does this become cumbersome and resource heavy, it becomes an inherent problem when you are designing for hundreds of thousands and even millions of players, and for different genres and contexts. However, in these cases, the fundamental direction is based on behavior and *how* a player is or likely to behave and to design for it. Of course, such limitations may eventually be solved with artificial intelligence and machine learning approaches that can learn from a player's behavior over time.

Beyond taxonomies and frameworks, many game (and gamification) design tools exist that can prompt game designers with various considerations (e.g. Schell's Lenses [42]) to brainstorming a game (e.g. Grow-a-Game [43]), and then the process as a whole (e.g. Game On! Gamification Toolkit [44], and Gamification Inspiration Cards [45]). Each has a focus on a particular component or process to facilitate game design. For example, many tools orientated towards gamification focus on reward schedules and motivating the user, while game design tools focus on the game itself. However, while some game (and gamified) design tools and frameworks (e.g. Hexad [18], Vroegop [46], Octalysis [36], MDA [38]) take into consideration how to design for players and their likely behavior, none actually consider (specifically) what a player does (via mechanics) in a game and what they get (e.g. elements) for doing it, and then adapt a framework in such a way that is usable by game designers.

#### 2.3.1. Gamicards

To give context for the final study, the prototyping tool Gamicards [23,29],it is briefly described below. Gamicards consists of four different kind of cards [23]: *User, Context, Game Element,* and *Game Mechanic cards*. It should be considered that the cards within Gamicards that reflect the GEM Framework are only *Game elements* and *Game mechanics*. The User and Context cards are provided (in the context of this research) as part of the brainstorming process for developing scope for their idea but were not assessed as part of the study of the GEM Framework.

1. **User Cards**
   a. *User:* The person(s) and their demographic that you are targeting your experience for.
   b. *Aim:* What is the aim of your experience?

(*footnote continued*)
to move a paddle to hit a ball into breakable tiles (bricks) with the aim to destroy them all. If the player misses the ball with the paddle, she loses a life. If she loses all her lives, she will need to begin the game again.

[2] This is not the traditional game of Darts with a circular board but rather the game *Darts* that was designed to teach elementary students about fractions [34].

c. *Objectives:* What do players need to do to reach the outcomes?
d. *Outcomes:* What are players expected to achieve by the end of your game?
e. *Rules:* Set of guidelines that tell a player what they can and cannot do.
f. *Schedule:* At what interval(s) do players obtain game elements?
g. *Motivation*
 i. *Intrinsic:* Will players be reinforced by internal element(s)?
 ii. *Extrinsic:* Will players be reinforced by external element(s)?

2. **Context Cards**
 a. *Business*: Interaction designed for use within a business context.
 b. *Education*: Interaction designed for use within an educational environment/context (e.g. educate a user, academic environment, school/university).
 c. *Personal*: Interaction designed at a personal level (e.g. productivity, professional/personal development).
 d. *Game (Entertainment)*: Interaction designed for an enjoyable experience. Regardless of whether the game is based on real events, the main aim is for the player to have fun.
3. **Game elements (Part of the GEM Framework):** all the game elements with description and icon.
4. **Game mechanics (Part of the GEM Framework):** all the game mechanics with description and icon.

### 2.4. Methodology

The findings within this paper report a significant contribution based on a larger study conducted. This part of the research project was designed to investigate (a) if players prefer game elements and/or mechanics in combinations, (b) what are those combinations and (c) how can this be used as part of a game design tool. In this section, I first describe how we developed the research instrument followed by data collection methods and validation.

We conducted our work in six sequential phases:

1. **Survey scale construction:** develops a standard survey response scale for player's preferences of GEMs;
2. **Data collection (Surveys):** gathers responses from an online survey with questions related to player's demographics, preferences for GEMs, and psychometric analysis (not included in this paper due to relevancy);
3. **Data analysis (Surveys):** analyzes the responses to via exploratory factor analysis (EFA). This results in the GEM Framework;
4. **Practical application:** in which Gamicards was modified to include the GEM Framework;
5. **Data collection (Workshop):** gathers data via qualitative methods: observation and semi-structured interviews;
6. **Data analysis (Workshop):** analyzes the responses using thematic analysis.

### 2.5. Survey construction

To collect data for the framework, a preliminary questionnaire was developed. Once the survey was made available, a link to it was distributed across many online social networking sites such as Twitter, Facebook, Reddit, and LinkedIn, as well as various mailing lists. To take part, participants must first have read the information sheet about the study and acknowledge that their responses to the survey were voluntarily, thus giving consent for their responses to be recorded. Lastly, participants were informed that they could withdraw from the survey at any moment prior to submitting their results. An overview of the questionnaire is described below.

1. **Demographic questionnaire:** age (in the following increments 18–25, 26–35, 36–45, 46 – 54, over 55; gender (male, female, other); location (North America, South America, Asia, Europe, Oceania, Africa; and general gameplay questions such as preferred genres;
2. **Games Elements Preference questionnaire:** asked participants to rate how much they prefer twenty-one different game design elements on a 3-point Likert Scale (Survey 1) and a 7-point Likert scale (Surveys 2 and 3);
3. **Games Mechanic Preferences questionnaire (surveys 2 and 3 only):** asked participants to rate how much they prefer twenty-six different game design elements on a 7-point Likert scale (Surveys 2 and 3). This was included as part of Survey 2 because of the consideration about how a player obtains an element may have an impact on what they receive.

It should be noted that two more components were also featured as part of these surveys, which assessed the Australian Personality Inventory (API) type and Basic Psychological Needs Scale (BPNS) of participants. However, the results of these did not have any impact on the results presented within this paper and therefore are omitted.

#### 2.5.1. Developing the list of game elements

To develop the list of game elements, many games were played, and existing references were examined. To refine the list, game elements that were consistent among resources were kept, those that appeared sporadically were assessed on their implementation within gaming experiences. For example, what actions did players perform to obtain a game element?

#### 2.5.2. Developing a list of game mechanics

To develop the list of game mechanics, the same process was used as developing the list of game elements. Many games were played, and existing references were examined. To refine the list, game mechanics that were continually present across different resources were kept. The list of game mechanics used within this paper and their definitions are in the Appendix.

It should be noted here that the GEMs observed were only relevant at the moment of gameplay in the games played. Other GEMs may be present in other parts of the game that were not played and hence, not recorded/included. Therefore, the GEM lists presented in this paper require future development.

### 2.6. Developing the GEM Framework

The development of the GEM Framework went through several iterations based on the results of the three surveys. The first survey provided a preliminary framework, which results from subsequent surveys were compared against. In each iteration, consistent results were identified and their loading scores (based on EFA) were considered. Once the framework was established, a previously developed game design resource known as Gamicards [23] was iterated to reflect the GEM Framework.

### 2.7. Adaption of Gamicards

Gamicards [23] is a game design tool, which consists of four different types of cards, as previously mentioned in 2.2.1. Gamicards incorporated the GEM Framework by the redesign of the GEM cards. This process is described in more detail in Section 3.5.1.

### 2.8. Workshop

The main purpose of the workshop was to evaluate the practical use of the GEM Framework with workshop participants by using a modified version of Gamicards. Participants were notified about the workshop across many online social networking sites such as Twitter, Facebook, Reddit, and LinkedIn. Upon arriving to the workshop, participants were given a consent form to sign, which explained the workshop and the nature of data collection (observations and semi-structured interviews). Participants who did not sign the consent form did not take part in the workshop. Participants who could take part were provided with a "brief" with information about what they had to design during the workshop . The brief was to pick something (e.g. a task) that is mundane and/or boring and then turn it into a game. An overview of the workshop is listed below:

1. A 30-minute introduction to game design and the GEM Framework, explaining how it relates to and can be used with Gamicards.
2. Participants were then divided into five groups and then asked to use the cards to develop the gaming experience based on something that they find mundane for the remaining two-and-a-half hours of the workshop.
3. During the workshop participants were observed and semi-structured interviews took place after 30, 60 and 90-minutes during the workshop.
4. At the end of the workshop, participants were asked to present their group's work to the rest of the participants of the workshop. They were also encouraged to come up and share their thoughts about their game design experience.

### 2.9. Participants

In total, six hundred and seventy-two participants took part in the three surveys. Survey 1 (n = 279: male 56%, female 44%), Survey 2 (n = 231: male 62%, female 38%), and Survey 3 (n = 162: male 52%, female 48%). On average participants were mostly aged between 26 and 35 years old. Participants were located across five contents (North America, South America, Asia, Europe, Oceania) with no participants reporting as being located in Africa, across all three surveys.

In terms of the workshop, forty-seven participants took part in the workshop (male 58%, female 42%) and came from various backgrounds such as corporate (public/private sectors), education (teachers, staff, students), and independent design studios and start-ups.

### 2.10. Analysis procedure

For the studies carried out with this research, different analysis procedures were used. These procedures and described in more detail below.

#### 2.10.1. EFA

Exploratory Factor Analysis (EFA) was conducted with a maximum-likelihood method and an Oblimin rotation with Kaiser normalization, using the program FACTOR. The use of EFA helped to classify and analyze user preferences with categories

#### 2.10.2. Scale reliability

To decide on the validity of the GEM list within the surveys, by calculating the Cronbach's α for the game element and mechanic questionnaires.

#### 2.10.3. Workshop

Data was collected from participants within the workshop in two ways. Firstly, through observation of the participants on how they were using the cards during the game design process; and secondly, through semi-structured interviews to obtain more specific data. Lastly, the data was analysed using thematic analysis.

1. ***Observations:*** Participants were observed during the workshop on how they interacted with the cards as well as each other during the design process. These observations were recorded in note form and compared against other participant's behaviors during the workshop to find out if other participants behaved in similar ways or not. The focus of the main criterion was (a) were the cards a useful game design resource and (b) did participants find the GEM Framework was helpful and/or improved their design. Observations were made by walking around the workshop space and noting (on paper) the way that participants were engaging with Gamicards and their use of the GEM Framework.
2. ***Semi-structured interviews:*** semi-structured interviews were used as a way to facilitate dynamic conversations to gain better insight into the participant's experience [47]. The responses from each participant were written down on paper. Moreover, semi-structured interviews provided a way to gain more data about the observations that were made previously.
3. **Thematic Analysis:** Data obtained from both the observations and semi-structured interviews was analyzed using thematic analysis [48]. Based on measures that were employed during this workshop, thematic analysis appeared the most appropriate because it is a method used for "identifying, analyzing, and reporting patterns (themes) within the data" [95]. To this end, behavioral patterns were observed so identify how the participants were using Gamicards and the GEM Framework, while also discussions relating to this were then recorded (via note-taking). In this way, conclusions relating to the aims of the workshop could be made based on either correlating or dissociative observations and responses.

## 3. Results

The analysis included the measures and procedure as reported in the Methodology section. The results are presented below.

### 3.1. GEM list

In total, the following 39 games were used to develop the GEM lists: *Oddworld: Abe's Odyssey* [49], *Army of Two* [50], *Assassin's Creed* [51], *BioShock* [52], *Borderlands 2* [53], *Braid* [54], *Catherine* [55], *Clash of Clans* [56], *Clash Royale* [57], *Don't Starve* [58], *The Dream Machine* [59], *Defense Grid: The Awakening* [60], *Fran Bow* [61], *Grand Theft Auto IV* [62], *Hay Day* [63], *Lifeline* [64], *Lost Planet* [65], *Machinarium* [66], *Mass Effect* [67], *Medal of Honor: Warfighter* [68], *Metro 2033* [69], *Munchkin (card game)* [70], *Pokémon GO* [71], *Portal* [72], *Portal 2* [73], *Reigns* [74], *Sid Meier's Civilization V* [75], *Skyward* [76], *Small World (board game)* [77], *Stack* [78], *Super Hexagon* [79], *Thomas Was Alone* [80], *Tomb Raider: Underworld* [81], *Uncharted 2: Among Thieves* [82], *Warcraft III: Reigns of Chaos* [83], *Wii Fit* [84], *Wolf Among Us* [85], *World of Goo* [86], and *ZombieU* [87].

Of the 39 games, some were free, previously owned, or purchased. They were each played at different stages and for approximately 30–60 min each (if played for the first time) and approximately 30 min if they had been previously played. In addition, informal discussions with colleagues also helped to further refine the list. Lastly, beyond gameplay, existing literature, and resources (including discussions with colleagues and online communities) help to finalize the GEMs used in the study.

In total, 21 game elements were found: *Achievement, Avatar, Badge, Bar, Bonus, Chance, Collectable, Combo, Currency, Difficulty, Item, Leaderboard, Level, Permadeath, Points, Quest, Rewards, Status, Story, Timer, Unlockables*

Followed by 26 game mechanics: *Building, Celebrating, Collaborating, Collecting, Communicating, Creating, Customizing, Disabling, Enabling, Finding, Keeping, Losing, Making, Obtaining, Punishing, Repairing, Revealing, Scheduling, Sending, Shooting, Sorting, Targeting, Trading, Using, Voting, Winning*

Both these lists were featured in the first version of Gamicards [23], and included within the GEM component of the surveys, and eventually the GEM Framework. Lastly, a full list of games and their GEMs can be found in [29].

### 3.2. Survey 1

An EFA was performed with the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy 0.75, and the Bartlett's test was significant,

**Table 1**
EFA loading scores of Game elements in Survey 1 (n = 279).

| Element | GE-M1 | GE-M2 | GE-M3 |
|---|---|---|---|
| **Story** | 0.86 | | −0.42 |
| **Quest** | 0.84 | | |
| **Currency** | 0.52 | | |
| **Item** | 0.42 | | |
| **Difficulty** | 0.42 | | |
| **Unlockables** | 0.42 | | |
| **Avatar** | 0.39 | | |
| **Chance** | 0.32 | | |
| **Badge** | | 0.83 | |
| **Achievement** | | 0.77 | |
| **Bar** | | 0.64 | |
| **Rewards** | | 0.55 | |
| **Points** | | 0.50 | |
| **Level** | | 0.49 | |
| **Collectable** | | 0.41 | |
| **Status** | | | 0.86 |
| **Timer** | | | 0.73 |
| **Leaderboard** | | | 0.73 |
| **Combo** | | | 0.60 |
| **Bonus** | | | 0.53 |
| **Permadeath** | | −0.59 | 0.43 |
| **Cronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha(per factor)*** *values when excluding negative loading values* | 0.53 | 0.50<br>0.66* | 0.52<br>0.60* |

**Table 2**
EFA loading scores of Game elements in Survey 2 (n = 231).

| Element | GE-M1 | GE-M2 | GE-M3 |
|---|---|---|---|
| **Quest** | 0.68 | | |
| **Item** | 0.63 | | |
| **Avatar** | 0.63 | | |
| **Story** | 0.62 | | |
| **Rewards** | 0.61 | | |
| **Difficulty** | 0.51 | | |
| **Level** | 0.50 | | |
| **Bonus** | 0.37 | | 0.44 |
| **Unlockable** | 0.36 | | |
| **Bar** | 0.34 | | |
| **Status** | −0.55 | 0.35 | 0.83 |
| **Leaderboard** | −0.64 | 0.60 | 0.67 |
| **Achievement** | | 0.90 | |
| **Badge** | | 0.87 | |
| **Points** | | 0.41 | |
| **Permadeath** | | −0.31 | 0.58 |
| **Collectable** | | 0.31 | |
| **Timer** | | | 0.56 |
| **Chance** | | | 0.53 |
| **Combo** | | | 0.51 |
| **Currency** | – | – | – |
| **Cronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha(per factor)** ** values when excluding negative loading values* | 0.67<br>0.73* | 0.62<br>0.72* | 0.64 |

p < .001. The results of the EFA are presented in Table 1, with loadings less than 0.30 omitted to improve clarity.

Cronbach's α were calculated for each of the factors, the results are also presented in Table 1. Overall, given the results of the alphas for the factors, they present a low reliability (i.e. below 0.6). However, the reliability increased but at least 0.1 where factors with negative loading scores were removed from the analysis.

Each Game Element Model (GE-M) is titled with a corresponding number: 1, 2, or 3. The choice to use this naming convention instead of more descriptive titles was to classify the factors in a more simplistic way, which would be identifiable when discussing them among literature and avoid confusion among other similar game terms. For example, giving the title *Achiever* would cause confusion among elements such as *Achievement* and other typologies who refer to the player type "*Achiever*". In saying this, adjectives are provided for context, beside the factor's names.

1. **GE-M1** *(adventure)***:** featured elements that one would see in *adventure* or role-playing games – in general, games that focus on the story and exploration.
2. **GE-M2** *(quantifiable)***:** featured elements that provide *quantifiable* outcomes to players. In that, their progress, success, and even failure is likely to be demonstrated to them via several measures (e.g. *Points*, *Achievements, etc.)*.
3. **GE-M3** *(dexterity/skill)*: featured elements that reflect those that would acknowledge *dexterity* and *skill*. For example, *Timers* requires players to know the right moves and when to complete tasks within a time limit. The same can be said for *Combos* and *Bonuses,* which are often associated with timed interactions and extra displays of dexterity within a gaming environment. It is likely that the element *Story* being negatively correlated could suggest that it would inhibit the opportunity for a player to engage in such gameplay.

### *3.3. Survey 2*

Survey 2 investigated both Game Elements (using the improved 7-point scale) and Game Mechanics (first instance using a 7-point scale). EFA was conducted twice for the game element and mechanic questionnaires.

Tables 2 and 3 display the items and component loadings, with loadings less than 0.30 omitted to improve clarity. A second reliability analysis was carried out on both the game element and mechanic questionnaires. Cronbach's α has been calculated for each of the factors, and the results are also presented in Table 2. Unlike Survey 1, the alphas presented with slightly more reliable values, especially when factors with negative loading scores were removed from the analysis.

The same factors (and names) were given as per Survey 1. While more items cross loaded across 2 and even 3 factors, most of the elements loaded in their initial factor.

EFA results for the game mechanics questionnaire presented with a significant Bartlett's test, p < .001. and the KMO statistic, 0.80 presented as good. The results of the loadings are presented in Table 3, with loadings less than 0.30 omitted to improve clarity. Cronbach's α were calculated for each of the factors, the results are also presented in Table 3. Unlike the Game Element analysis, the reliability of the Game Mechanic factors presented with much stronger results.

Following the same name conventions as game elements, game mechanics used *game mechanic model* (GM-M), followed by numbers, to differentiate the factors.

1. **GM-M1** *(efficacy)***:** featured game mechanics that stood for a sense of *efficacy*. Where players try to construct or show use/usefulness within the gaming experience either with the world, players, or AI (artificial intelligence)/NPCs (non-playing characters).
2. **GM-M2** *(activism)***:** featured game mechanics that showed a sense of *activism* in the sense that the player would be engaged/involved with the gaming experience.
3. **GM-M3** *(communal)*: featured game mechanics that demonstrated a more *communal* theme in both a negative (e.g. through *Punishing* other players) or positive (e.g. through *Enabling* or *Trading*) sense.

### *3.4. Survey 3*

EFA results for the game element questionnaire revealed the Bartlett's test was significant, p < .001 and the KMO statistic, 0.75 being again, fair. Table 4 presents the items and component loadings for the rotated components, with loadings less than 0.30 omitted to

**Table 3**
EFA loading scores of Game Mechanics in Survey 2 (n = 271).

| Mechanics | GM-M1 | GM-M2 | GM-M3 |
|---|---|---|---|
| Creating | 0.78 | | |
| Making | 0.77 | | 0.33 |
| Finding | 0.72 | | |
| Using | 0.71 | | |
| Building | 0.69 | | 0.30 |
| Obtaining | 0.66 | | |
| Collecting | 0.61 | | −0.34 |
| Keeping | 0.60 | | |
| Sorting | 0.50 | | |
| Repairing | 0.36 | | |
| Collaborating | | | 0.71 |
| Communicating | | | 0.77 |
| Trading | | | 0.55 |
| Sending | 0.39 | | 0.45 |
| Targeting | | 0.71 | |
| Punishing | | 0.68 | |
| Shooting | | 0.65 | |
| Disabling | | 0.63 | |
| Enabling | | 0.59 | |
| Revealing | | 0.52 | |
| Voting | | 0.50 | |
| Winning | | 0.49 | |
| Customising | | 0.42 | |
| Celebrating | | 0.40 | |
| Losing** | – | – | – |
| Scheduling** | – | – | – |
| Cronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha(per factor) | 0.84 | 0.73 | 0.74<br>0.77* |

* values when excluding negative loading values
** Indicates game mechanic values that did not load above 0.3

improve clarity.

Cronbach's α has been calculated for each of the factors,and is presented in Table 4. Unlike the first two surveys, the alphas presented with far higher alphas (i.e. above 0.6) with the exception of GE-M3, presenting with a unreliable value.

**Table 4**
EFA loading scores of Game elements in Survey 3 (n = 162).

| Element | GE-M1 | GE-M2 | GE-M3 |
|---|---|---|---|
| Story | 0.90 | −0.50 | |
| Quest | 0.85 | | |
| Avatar | 0.66 | | |
| Level | 0.45 | | |
| Points | 0.41 | 0.40 | |
| Item | 0.41 | | |
| Difficulty | 0.39 | | |
| Unlockable | 0.37 | | |
| Badge | | 0.87 | |
| Achievement | | 0.85 | −0.31 |
| Status | −0.53 | 0.82 | 0.34 |
| Leaderboard | −0.58 | 0.78 | |
| Rewards | 0.40 | 0.56 | |
| Bonus | | 0.44 | |
| Collectable | | 0.41 | |
| Currency | 0.34 | 0.36 | |
| Combo | | 0.32 | 0.31 |
| Bar | | 0.30 | |
| Permadeath | | −0.35 | 0.78 |
| Chance | 0.35 | | 0.57 |
| Timer | | | 0.46 |
| Cronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha(per factor) | 0.63<br>0.69* | 0.67<br>0.77* | 0.34<br>0.40* |

* values when excluding negative loading values

**Table 5**
EFA loading scores of Game mechanics in Survey 3 (n = 162).

| Mechanics | GM-M1 | GM-M2 | GM-M4 |
|---|---|---|---|
| Making | 1.03 | | |
| Creating | 0.94 | | |
| Building | 0.89 | | |
| Obtaining | 0.72 | | |
| Keeping | 0.66 | | |
| Using | 0.57 | | |
| Finding | 0.57 | | |
| Sending | 0.55 | | |
| Trading | 0.43 | | |
| Collecting | 0.39 | | 0.39 |
| Celebrating | | | 0.77 |
| Scheduling | | | 0.77 |
| Customising | | | 0.76 |
| Enabling | | | 0.63 |
| Repairing | | | 0.51 |
| Sorting | | | 0.49 |
| Revealing | | | 0.41 |
| Collaboration | 0.33 | 1.03 | |
| Shooting | | 0.87 | |
| Punishing | | 0.80 | |
| Targeting | | 0.71 | |
| Disabling | | 0.61 | 0.30 |
| Communicating | | 0.60 | |
| Winning | | 0.53 | |
| Voting | | 0.43 | |
| Losing | – | – | – |
| Cronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha α (per factor)* values when excluding negative loading scoresCronbach Alpha(per factor) | 0.86 | 0.76 | 0.73 |

The same EFA technique was applied to the game mechanic questionnaire. The Bartlett's test was significant, $p < .001$. and the KMO statistic, 0.85 presented as good. Table 5 displays the items and component loadings for the rotated components, with loadings less than 0.30 omitted to improve clarity.

Cronbach's α has been calculated for each of the factors, and is presented in Table 5. Similarly to Survey 2, the alphas presented with high alphas (i.e. above 0.6), thus proving a consistent reliability for the factors.

The game mechanic factors in Survey 3 gave quite different results in comparison to Survey 2. GM-1 and GM-2 stayed consistent while GM-M3 featured only one correlating game mechanic – *Collecting*. As a result, the third factor EFA produced in Survey 3 was titled GM-M4.

- **GM-M1** and **GM-M2** stayed like Survey 2, therefore, their descriptions do not vary.
- **GM-M4** *(organizational)*: featured game mechanics that demonstrated a more *organizational* approach to gaming. For example, *Sorting, Collecting,* and *Scheduling,* all represent mechanics that encourage a player to calculate their gameplay movements.

### 3.5. GEM Framework

Below is the final iteration of the GEM Framework for both the GE-M and GM-Ms. Below in Table 6, the GEMs are colored depending on their level of consistency among surveys. The mean (represented as "$x$" in Tables 6 and 7) for each of the GEMs. Lastly, standard deviations (*SD*) were calculated for primary and secondary GEMs in their respective factors. The final iteration of the GEM Framework consists of three GE-Ms (Table 6) and four GM-Ms (Table 7).

#### 3.5.1. Game element model

After the results of the EFA, the following tables indicate the final GEM factors and in turn GEM models.

**Table 6**
GEM Framework: game element model.

| GE-M1 | x | SD | GE-M2 | x | SD | GE-M3 | x | SD |
|---|---|---|---|---|---|---|---|---|
| Story | 0.79 | *0.15* | Badge | 0.86 | *0.02* | Status | 0.68 | *0.29* |
| Quest | 0.79 | *0.10* | Achievement | 0.84 | *0.07* | Permadeath | 0.60 | *0.18* |
| Avatar | 0.56 | *0.15* | Leaderboard | 0.69 | *0.13* | Timer | 0.58 | *0.14* |
| Item | 0.49 | *0.12* | Points | 0.44 | *0.06* | Combo | 0.56 | *0.06* |
| Difficulty | 0.44 | *0.06* | Collectable | 0.38 | *0.13* | Leaderboard | 0.70 | *0.04* |
| Unlockables | 0.38 | *0.03* | Status | 0.59 | *0.33* | Chance | 0.55 | *0.03* |
| Leaderboard | −0.53 | *0.14* | Rewards | 0.56 | *0.01* | Bonus | 0.49 | *0.06* |
| Rewards | 0.51 | *0.15* | Bar | 0.47 | *0.24* | Achievement | −0.31 | – |
| Level | 0.48 | *0.04* | Permadeath | −0.33 | *0.03* | Story | −0.42 | – |
| Currency | 0.43 | *0.13* | Level | 0.49 | – | | | |
| Chance | 0.34 | *0.02* | Bonus | 0.44 | – | | | |
| Status | −0.54 | *0.01* | Currency | 0.36 | – | | | |
| Points | 0.41 | – | Combo | 0.32 | – | | | |
| Bonus | 0.37 | – | Story | −0.50 | – | | | |
| Bar | 0.34 | – | | | | | | |

- **GE-M1** (*adventure*): presents elements that focus on exploration and narrative. These are least likely to be found in games that are highly focused on competitiveness. Instead, *Status* and *Leaderboard* are both negatively related to the GE-M1 model and should be avoided when creating game experiences that have more of the other GE-M1 elements. It is also evident that there are three different "layers" of the model. These are indicated in the table by varying shades of grey. The top-level are primary elements to this model. Therefore, these are what players prefer (or not) the most out of all the elements here. This is followed by the secondary and tertiary game elements.
- **GE-M2** (*quantifiable*): presents elements that focus more on achievement and validation. It is clear that both *Permadeath* and *Story* are negatively correlated with this model. It is likely that players who prefer their actions during gameplay validated by elements such as *Badges*, *Achievements*, *Points*, and *Collectables*, do not prefer a severe consequence like *Permadeath*. In the same line of thought, *Story* could offer meaning in a gaming experience, but not in the same way that GE-M1 does.
- **GE-M3** (*dexterity/skill*): presents elements that afford risk and chance. This is most prevalent with the game elements *Permadeath*, *Timer*, and *Combo*. In these instances, players can project their success by ranking up with their *Status*. In a game that has these kind of elements, it is likely that a player enjoys the benefits of pushing his or her own limits and then project that out in a more social setting, via *Leaderboards*. *Achievement* is a negatively correlated suggesting that it is not so much the award that a player is drawn to but the challenge that is involved leading up to it. This is also clear when it comes to *Story*. While it affords opportunities for risk and challenge, it does not offer much in terms of *dexterity/skill* as the other game elements of this model.

### 3.5.2. Game mechanic model

- **GM-M1** (*efficacy):* suggests a focus on players interacting with players (including NPC's) and the game world. This relates to players having to seek out items and people to communicate with. It requires that the player also engages with various items within the environment.
- **GM-M2** (*activism*): suggests a focus on gaining an advantage. This is clear with game mechanics like *Shooting*, *Punishing*, *Disabling*, and *Voting*. While in some cases *Voting* can seem democratic, in instances such as online games where players must vote on a map to play in, it is possible to sway it towards one that is in favor of another to have an advantage.
- **GM-M3** (*social*): suggest two things to keep in mind when it comes to the last two models (GM-M3 and GM-M4). The first being that both share only one common mechanic: *Collecting*. The second being

**Table 7**
GEM Framework: game mechanic model.

| GM-M1 | x | SD | GM-M2 | x | SD | GM-M3 | x | SD | GM-M4 | x | SD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Making | 0.90 | *0.18* | Shooting | 0.76 | *0.16* | Collecting | 0.03 | *0.52* | Collecting | 0.03 | *0.52* |
| Creating | 0.86 | *0.11* | Punishing | 0.74 | *0.08* | Communicating | 0.77 | - | Celebrating | 0.77 | - |
| Building | 0.79 | *0.14* | Targeting | 0.71 | *0* | Collaborating | 0.71 | - | Scheduling | 0.77 | - |
| Obtaining | 0.69 | *0.04* | Disabling | 0.62 | *0.01* | Trading | 0.55 | - | Customising | 0.76 | - |
| Finding | 0.65 | *0.11* | Winning | 0.51 | *0.03* | Sending | 0.45 | - | Enabling | 0.63 | - |
| Using | 0.64 | *0.10* | Voting | 0.47 | *0.05* | Making | 0.33 | - | Repairing | 0.51 | - |
| Keeping | 0.63 | *0.04* | Collaboration | 1.03 | - | Building | 0.30 | - | Sorting | 0.49 | - |
| Collecting | 0.50 | *0.16* | Communicating | 0.60 | - | | | | Revealing | 0.41 | - |
| Sending | 0.47 | *0.11* | Enabling | 0.59 | - | | | | Disabling | 0.30 | - |
| Sorting | 0.50 | - | Revealing | 0.52 | - | | | | | | |
| Repairing | 0.43 | - | Customising | 0.42 | - | | | | | | |
| Trading | 0.36 | - | Celebrating | 0.40 | - | | | | | | |
| Collaboration | 0.33 | - | | | | | | | | | |

that they only produced themselves once in the two surveys that they were measured in.[3]
- **GM-M4** (*organizational):* consists of mechanics that would suggest players prefer games that focus on a more systematic and experimental approach to gameplay.

*3.5.2.1. Visualizing the GEM Framework.* Once the establishment of the GEM Framework, it was then visualized to provide a more direct and clear way of displaying its models and loading values. This is presented below in Fig. 1.

As the figure demonstrates, each GEM model varies in both color and hue. While the general colors (pink/blue) are not important and are only used to display variation between GEMs, the use of black signifies a negatively correlated game element and/or mechanic within its respective model. In addition, the primary, secondary, and tertiary elements and mechanics are displayed by variation of the color (e.g. grading hue) and position. GEMs at the top row represent primary GEMs and those on the bottom (third two) represent tertiary GEMs. A clearer version of this can be seen below in Fig. 2.

As presented in Figs. 1 and 2, the GEMs name, position within their respective model and their mean loading score are represented within the graphical version of the GEM Framework, as presented below in Fig. 3.

### 3.6. Applying the GEM Framework to Gamicards

To validate the use of the GEM Framework during the game design process, the design of the Game Element and Game Mechanic Cards (in Gamicards) was iterated. In these iterations, the cards included icons that represented its corresponding GEM model that it belonged to. A brief example of this is showed below in Fig. 4. If the GEM cross loaded into another factor, it was also included. This was done so that participants could quickly find the corresponding model easily by matching the icon with those in the overview of the framework. Lastly, participants were provided with the entire GEM Framework via a projection on a wall throughout the workshop.

### 3.7. Workshop

The aim of the workshop was to identify if the cards (a) provided a useful resource for the design of games for designers from a range of different context and game design experience levels and (b) evaluate the effectiveness within the GEM Framework during the design stage.

#### 3.7.1. Observations

Participants were observed [47] throughout the entire workshop on how they used the cards during the game design process. Observations were made by walking around the workshop space and noting (on paper) the way that participants were engaging with Gamicards. During the first hour, an important observation was noted that as a participant's ideas began to develop so too did their rationale (among their group) for implementing different GEMs. These rationales and methods of implementation were explored via semi-structured interviews and described below.

#### 3.7.2. Semi-structured interviews

As participants began to develop their idea, many groups began to choose cards because they added a “fun” element such as badges. At around thirty minutes into the workshop, participants were asked about their experience with the cards and the design of their game. Upon questioning their rationale (at 30, 60 and 90 min) and how it related to other elements that were already part of the design, some participants said that they included it because they considered it as an “enjoyable” element but later realized that it was not needed. In some cases, participants revealed that implementing some elements inhibited the overall aim of the game. In addition, participants also reflected on how the cards provided them with a useful visual tool for seeing their game's structure. As participants began to work through their ideas, they began to become more refined. Participants were then asked again, thirty minutes before the workshop finished, about their experience with the cards and the GEM Framework and how both affected the design and development of their game. At the end, participants presented their game and a final series of informal questioning was also conducted relating to each group's game and their experience with the cards.

Overall, participants commented that they found the factors more appropriate than choosing GEMs based on existing or posteriori knowledge. In addition, participants often reflected on the outcomes of the games that they were trying to create in the sense that they felt their games were “complete”. It is also interesting to note that during the design process, once a group had a general structure of their game, they used the GEM model cards to refine, add, or remove elements. In this way, the GEM model combinations served as a method of refinement in contrast to a guide for player's preference for GEMs. Participants commented that it gave more support to the overall design, as many participants remarked that once the ideas began, the concept grew, and felt as though it became a bit overwhelming in terms of how many GEMs had been incorporated. In fact, many participants commented about the way that the cards were laid out on the table and that the simple visualization of the game's design though the cards made them realize that they had incorporated too many game elements and/or mechanics. In some instances, participants were not sure how each added element would then affect other parts to the design because there simply were too many to consider. However, in these instances, participants felt that the GEM Framework made the decisions easier about what elements and mechanics were worth keeping and which ones were not.

Lastly, given the various backgrounds, demographics, and contexts of participants, Gamicards (and the GEM Framework) offered a common vocabulary to discuss the elements among each other. It helped to improve the overall understanding about the concepts throughout the game design process. For example, many participants remarked that the cards also provided them with “names of other elements” that they had not thought about without being prompted by the cards. One participant explained the following after being asked the question “Based on your game-design experience, what do you think about Gamicards?”

> *“Based on my design experience, Gamicards enlightened me by offering a new lens to look at the design. Instead of having a top-down approach, as many game design resources has, Gamicards dug deep into the atoms of game design by looking at its primary components - Game elements and mechanics. The hexagonal shape of the cards makes them perfect to combine them together and make you think about your design in a completely different way. In my opinion, the perspective and the different models that this tool offers are great insights on how the “design melody” should be composed, and Gamicards are the rhythm that harmonises all your ideas in a meaningful way.”*

Male participant, 28 years

Overall, the workshop gave a great deal of insight into the effectiveness of not only the cards but also the GEM Framework and its models. Participant feedback was about the structure that the cards offered in terms of designing and defining the game idea and experience. Many felt that the cards gave a structure and guide that helped them when the game idea became convoluted, or they felt lost. Many participants commented about how the cards either provided them with game elements that they were not aware about or may not have necessarily used. This was most clear when groups began to “substitute”

[3] Unlike game elements, game mechanics were only tested in 2/3 surveys carried out as part of the research. Nevertheless, we can look at these models and draw some general conclusions. Such as, GM-M3 appears to focus on a more communal way of creating and interacting with other players (whether real or NPC)).

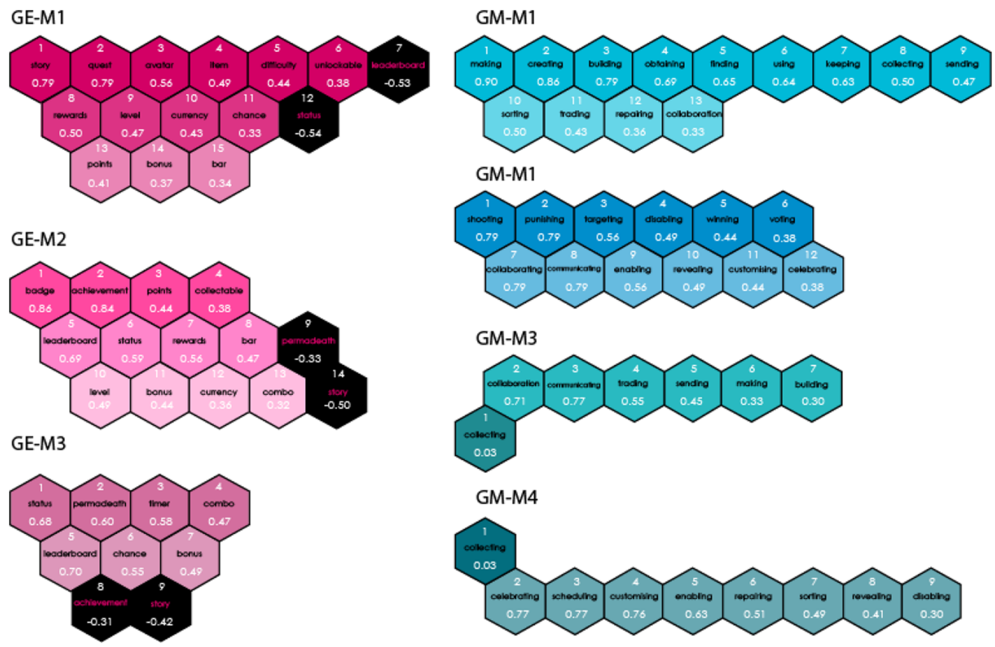



**Fig. 1.** An overview of the visual representation of the GEM Framework and its models (*from left to right:* Game Element Models, Game Mechanic Models).

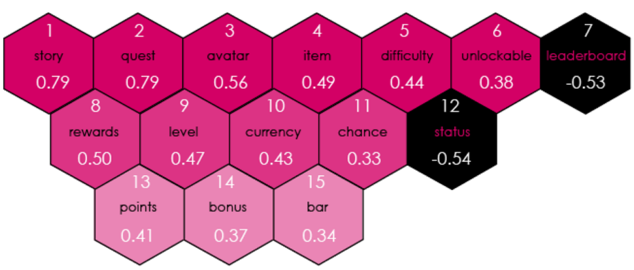
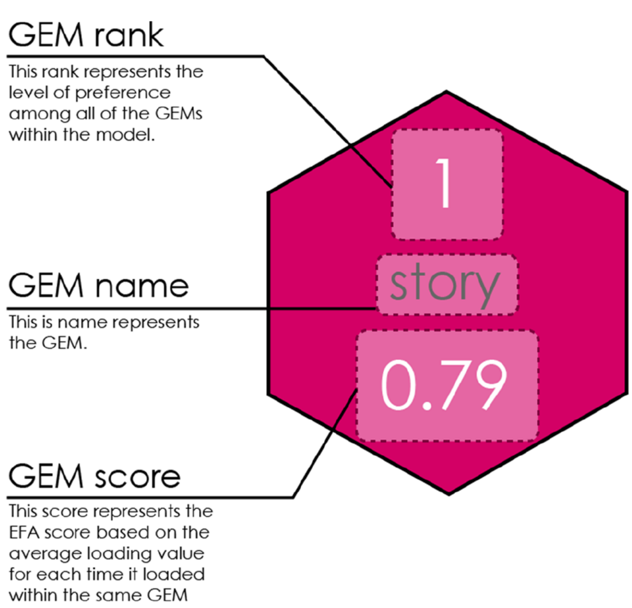



**Fig. 2.** An overview of the visual representation of the GEM Framework and its models. The model represented here is GE-M1.




$$\bar{x} = \frac{1}{N}\sum_{i=1}^{N} x_i$$

**Fig. 3.** The design of a GEM within the visual version of the GEM Framework.

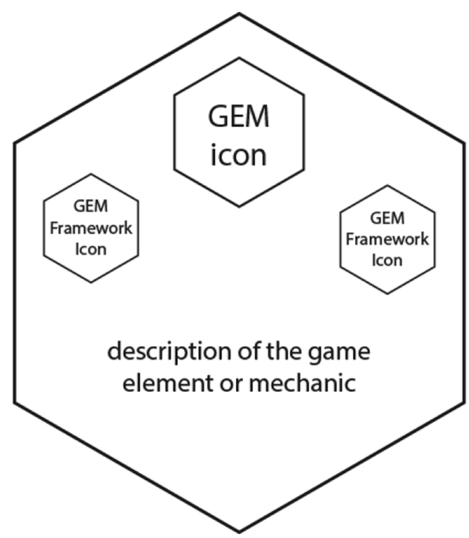



**Fig. 4.** How Gamicards was modified to accommodate the GEM Framework. As presented in Fig. 1, GEM Framework Icons (left and right) were added to identify which part of the GEM Framework the GEM belonged to.

cards. In addition, participants felt that their designs also benefited from using the cards with the GEM Framework as it helped them to find complementary elements, which they agreed felt more suited than other elements. In this way, it was right to say that Gamicards did offer an overall structure (based upon the GEM Framework), a common vocabulary, explanation, and concentrated structure towards the design of games/gamified experiences, for both experienced and inexperienced game designers. Lastly, and worth noting, participants also commented on the hexagonal shape of the cards as being quite useful and practical for creating and finding relationships between elements and mechanics.

### 3.7.3. Thematic analysis

Based on observations and discussions with workshop participants, it appears groups did one of three things when using Gamicards with the GEM Framework:

1. **Substitutions:** involved participants placing another game element

or mechanic card over the top of the existing one to see how it affects the overall flow of the game. In some cases, participants completely swapped out existing cards with new ones, thus not necessarily "exploring other opportunities";
2. **Guidance:** invovled participants referencing the GEM models on the cards (and via wall projection) to make decisions about what game elements or mechanics to use next. In this way, the GEM models offered a type of benchmark to test their own implementations against. Then, if something was not working (e.g. the player was needed to perform too many actions, or they were over-compensated), then the GEM model offered a reference point.
3. **Refinement:** involved participants using the GEM Framework to refine their ideas. If at certain stages during the game development process they felt that a game element or mechanic did not feel right or was not working, they referred to its respective GEM model and made decisions accordingly. This step differed from *Substitution* because it often took place at later stages during the iterative phase of game development. In saying this, both Gamicards and the GEM Framework offered a more concentrated iterative loop. For example, when adding more elements and mechanics participants were encouraged to reflect on how the addition of these components would affect the aim and overall objectives of their game.

It was clear that Gamicards *in conjunction* with the GEM Framework offered a tangible game design resource that offered several things to both participants and the way that they carried out the design of their games during the workshop. First, the cards provided participants with a common lexicon via the GEM lists (and cards). Secondly, Gamicards and the GEM Framework offered a more focused iterative process of development during the game design stage. Lastly, the GEM Framework gave participants a guide to make better informed choices about the removal, addition, and/or substitution of GEMs during the game design process. In this way, it is right to say that the workshop confirms the use of Gamicards *with* the GEM Framework as a game design tool and resource.

## 4. Discussion

The development of the GEM (Game Element and Mechanic) lists was one of several key outcomes of the research studies. The development of the GEM lists provided an initial and common lexicon for the research. While many game component lists exist (e.g. Grow-a-Game, Deck of Lenses), none dichotomize or focus specifically on GEMs. Therefore, this research offers a foundation that combines the two, which existing typologies could incorporate/extend upon (e.g. [19,88]). To this end, developing their own typological structures so that they may align with GEMs and the models within the framework as also described in [29].

This research presented seven GEM models (based on EFA factors), most of which were consistent throughout all studies. The importance of finding such as the factors shows that players prefer GEMs in combinations. To this end, it reinforces earlier work carried out by Malone [33], which suggested that games are enjoyed by the combination of their parts and that removing as little as one core component can significantly decrease a player's engagement. In this way, this research further confirms Malone's study, despite the first study being carried out over 30 years ago. Thus, promoting that his direction is still relevant with the potential for widespread use in contempoary and future research.

While some GEs fluctuated among factors throughout the three surveys, there were core GEs within the three factors that stayed consistent. The core or primary GEs within each factor provide academics and designers with suggestions about what are core elements to their respective model. For example, one could deduct that if core GEs from a factor are not present in Game 1 but are in Game 2, of which is more favorable to the player, it could be an indicator that a player favors the game closer to that factor – that being Game 2. Of course, this research did not examine the GE factors to this extent, but it is an exciting possibility for future research.

Unlike the GE factors, the results of the GM factors were not as consistent. Only two of the three (in both Surveys 2 and 3) were constant. Unlike GE factors, this lack of consistency may suggest that GM factors are not as significant nor consistently present in games to the extent that they will influence a player to choose one gaming experience over another because of them. It is possible that the GMs present in Factor 3, in survey 2 (GM-M3 and GM-M4), are not important enough to affect a player's preference. The lack of consistency in comparison to the GE factors, may also result from the chosen mechanics. Therefore, the GM lists also need further research and iterations with a focus on unique or the unusual use of mechanics within games.

However, given that there are two consistent factors, it does suggest that there is a preference for GMs within combinations to some end that may have an impact on a player's preferences towards gaming experiences. Whether it affects their choice for them (and to what extent), as discussed before, or if it affects another aspect does require further research. It is likely that one can also approach the development of a GM list by following in the footsteps of Cattell [89], and Allport and Oddbert [90], where one could name every verb within an (English) dictionary and then proceed to carry out data collection and analysis. In this way, it is then more likely to cover all actions that players can perform in every game; rather than those played as part of the research project and within the context of the English language. In other words, identifying GEMs in other languages may also reveal additional insights that future iterations of the GEM Framework can incorporate.

The creation of the GEM Framework presented the GEM factors in a way for game designers and scholars to use during the game design/development stage, and furthering research. The GEM Framework is the first of its kind that presents GEMs based on their relationship with one another. The framework provides designers with a guide to use during the development process in a way to make better informed choices of other GEMs. In addition, it also offers game academics with a way to explore the design of games and a lens to filter a player's engagement (i.e. choice to play). In addition, this framework aims to fill a gap among these that steps into the "atomic" level of game development focusing on the relationships between what players do and what they get in return – the cause and effect of gameplay and how GEMs catalyze gaming experiences. Moreover, it also demonstrates (thematically) consistent components that many other frameworks also contain. For example, if we consider GE-M1 and GE-M2 in comparison to Chou's Octalysis Framework, we can see that the game elements, which a present, align well with the drive of *Accomplishment* and towards both the drives of *Ownership* and *Meaning*.

Nevertheless, questions have been raised as to the need for frameworks that focus on playing or whether game studies should adopt existing frameworks from the larger context of psychology [22, p. 45]. However, as many of the typologies that have been discussed within the paper lack a focus on the components of games themselves (as opposed to player's behavior), the GEM Framework offers an innovative foundation for future player centered research. Therefore, offering something that further studies in areas like psychology could build upon.

Within the context of existing research, the GEM Framework, the models themselves present similarities to existing research such as Yee's [26,91–93], Chou's [36], and Malone's [33]. This is in the context of similar themes and approaches. For example, based on player's motivations [94], GE-M1 (*Adventure*) could align with Yee's *Immersion.* Mainly because these models share common characteristics of games that could facilitate such a desire to incorporate oneself within the game's environment. Others such as GE-M2 (*Quantifiable*) could align with *Achievement* given the nature that elements such as *Status* and *Leaderboard* facilitate. In addition, GE-M1 also shares similarities with Chou's Octalysis Drive of *Accomplishment* suggesting that there is a desire for players to feel accomplished whether that is on their own or against others. Moreover, GE-M3 (*Dexterity/Skill*) appears as though it could with Yee's *Mastery* with the player would has to show agility to avoid elements such as *Permadeath.* In relation to game mechanic models, GM-M1 (*Efficacy*) appears that it could align with *Creativity*, GM-M2 (*Activism*) with *Purpose*, GM-M3 (*Social*) with *Social*, and GM-M4 (O*rganizational*) with *Strategy/Completion.* Beyond Yee's, there are also thematic similarities with many of the existing player types and taxonomies such as Bartle, Marczewski, Kallio, and Fullerton. In particular, Tondello et al. [28] has also presented with both a similar approach and results to what has been reported here in this article with regards to the results of game elements. Therefore, a common theme is again present among all of them.

Lastly, the workshop demonstrated that Gamicards offers a tangible version of the GEMs and in turn GEM Framework for game designers to use during the game design and development process. Although recent frameworks have emerged, namely that of [30] (in the context of gamification), it does not actually provide designers with a way to use it beyond considerations. Supporters of their framework are right to argue that it does offer a new way to consider the value of game design elements. But they are exaggerating when they claim that it "will enable researchers and practitioners to design better tailored gameful systems in the future" without a more structured way to use it. Therefore, Gamicards matters because it provides a tangible way to observe, develop, and even reconstruct the use of the GEM Framework in such a way that game designers are actively engaging with the games design. Therefore, by using the GEM Framework with Gamicards, game designers can directly explore the cause and effect of gameplay. This is something that does not exist and helps to keep the focus on the relationship between GEMs and in turn the overall gameplay experience.

## 5. Limitations and future work

The follow sections describes the limitations of this research and future work that can extend upon the results presented here and are described in their relevant sections below.

### 5.1. GEM lists and framework

Despite finding seven factors, a limitation would be the level of generalness of the GEMs. For example, incorporating more specific elements and mechanics (e.g. progress bar for tasks, progress bar for overall achievement) could offer more insights. In saying this, such lists are expected to be quite large and thus, would need commitment from the participants of surveys, especially given the increased length of time needed to complete the survey. Moreover, a larger number of participants would produce more accurate results. In addition, a more in-depth approach could also be through isolating verbs (i.e. combing dictionaries for verbs) and generating a more specific list for GMs. Moreover, given the emergence of Virtual Reality and even Augmented Reality into mainstream gaming (i.e. in addition to console gaming in a player's home, educational institutions, and workplaces), the list of GEMs will likely need to be iterated so that they consider the real world (e.g. virtual and real currencies, virtual and real trading (and other actions)).

Overall, the GEM framework requires more iterations and testing, which can only come from continuing the development of the GEM lists and factors through additional analysis. In addition, the real test of the GEM Framework will be when game designers use it from the beginning of the game development process to the end and *how* they use it as part of their design process. In this way, one would need to assess the level of impact that the GEM Framework has on a game's success with regards to a player's preferences. This would need careful planning and development to ensure an accurate assessment of the GEM Framework, ideally with existing benchmarks to provide comparative data.

### 5.2. Gamicards

Gamicards is still developing prototyping tool and thus is likely to be modified as new research is undertaken and iterations are made to the GEM lists, factors and ultimately the GEM Framework. Therefore, the results and use of the GEM Framework with Gamicards may only be applicable within the context of this research and its potential as a resource during the game design process.

### 5.3. Limitations of the surveys

One of the main limitations for the first survey was that it did not have any pre-existing research to compare the data against. Furthermore, responses for the surveys were difficult to obtain, due to the length of the survey (around 10–15 min to complete). Therefore, requiring more commitment from participants. Moreover, the self-reporting nature of the surveys presented another limitation. It is possible, like many other self-reporting questionnaires that participant biases affected the results, such as social desirability or to respond in a way given the context. However, this can only be speculated as results were not provided to the participants after completing the survey.

### 5.4. Limitations of the workshop

The main limitation of the workshop was the amount of times that it was conducted (only once) and the type of participants that were involved. For example, while the workshop itself offered a general idea about the usefulness of the GEM Framework with Gamicards, it could not offer any specific insight beyond the prototyping stage. Therefore, subsequent workshops could improve the framework by testing with specific target groups.

## 6. Conclusions

Over the last decade and with the ubiquity of technology we have seen a surge in the emergence and development of gaming experiences, as well as their application to a variety of contexts. Consequently, research has revealed that many game scholars have shared an interest in observing and categorizing player's behavior to explain how and why they are engaged with various gaming experiences. However, these typologies are often situated within a specific domain/context (e.g., gamification, general gaming, and personality, behavior, motivation, learning theories) and lack general application as they are. This is the first study that identifies GEMs and then explored how they can align with player's preferences in a context free perspective (e.g. not solely in a game or gamification context). Thus, this investigation has resulted in a validated (via exploratory factor analysis) game design framework known as the GEM Framework, which has seven GEM models (three game elements and four game mechanics). These seven models present combinations of GEMs based on a player's preference questionnaire, thus, proving that players do indeed prefer them in certain combinations. This has the potential to enable game designers to make more informed decisions about the use of GEMs in all stages of a game design process. Moreover, to test the usefulness of the GEM Framework, Gamicards were used by participants in a game design workshop. Through observations, semi-structured interviews, and thematic analysis, the use of Gamicards with the GEM Framework proved to be effective during the game design process. As a result, this encourages further study to observe the use of the GEM Framework throughout the entire process with the framework being evaluated after a game's completion to thoroughly evaluate its effectiveness as a design resource. In this way, the GEM lists (and questionnaire) and GEM Framework are significant contributions to the areas of game design and HCI because they allow game designers and game scholars to consider and implement GEMs according to a player's preferences.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix

See Tables 8 and 9.

**Table 8**
Game element table.

| Rewards | Rewards |
|---|---|
| **Avatar** | Representation of the player. This can be virtual, physical, or even the player herself. Examples of virtual avatars can be an image in the player's UI or HUD, or their actual playable character. |
| **Achievements** | Virtual (digital) or physical items that represent some type of accomplishment. The process of obtaining achievements may be through varying challenges of varying levels of difficulty, exploration – as with the case of hidden achievements, or locked achievements that require you to have obtained something prior to unlock the achievement. Achievements can be considered outcomes that are built around different behaviors. For example, a player may be asked to check-in with the application five times consecutively. |
| **Badges** | Visual representations or icons that a player can obtain for doing an action(s) and/or completing objectives. Examples include Steam holiday badges. |
| **Bars** | Indicators for various factors such as health, mana and experience levels. |
| **Bonuses** | Like achievements, but generally not with the objective focus that achievements possess. Bonuses act as an "extra" to contribute towards other rewards. They may come in the form of additional items, more experience, aid in completing an achievement (e.g. extra coins) |
| **Chance** | The supposed luck for the player. Examples would include the likelihood that a rare item is dropped after killing a boss enemy or obtaining a certain amount of gold after opening a chest. |
| **Collectables** | Items that you can collect but not necessarily use. |
| **Combo** | Grouping items together to perform certain behaviors or obtain items. |
| **Timer** | A way of limiting how long it takes a player to complete an objective. They usually push a player to improve so that the time they take to complete an objective becomes more efficient. A time restriction in which the user must perform a/or set of objectives. |
| **Currency** | Virtual or real currency that can be used to obtain items (in the real and virtual world). |
| **Difficulty** | Allowing the user to select a level of difficulty before they engage with an experience. Common levels include easy, medium, and hard. |
| **Points** | Points are a numerical value, whether numerical in the sense of our own systems or of that within the game world. |
| **Feedback** | Providing information about the user's interaction. This can be after an action, duration or series of actions and behaviors. |
| **Items** | Useful objects that you receive (physical and/or digital) for performing an action or through exploration. |
| **Leaderboard** | Your rank among other users based on a parameter(s) such as points. |
| **Levels** | A way of providing a sense of progress to a player. They can be in the form of varying levels of difficulty, locations that reveal more aspects of the games narrative and so forth. |
| **Permadeath** | The death of the user in the experience is permanent. If the use wants to continue, they must start from the beginning. |
| **Quests** | A part of a player's journey that may include various obstacles and challenges that they are required to overcome. |
| **Rewards** | An item that the player obtains after completing something that they are supposed to do, or by assisting another player. |
| **Status** | Defines a player's hierarchal status within a world. It is usually a good indicator to represent how much time they have committed to the game (e.g., they are a high-level warrior). Status can also be important in allowing players to enter various parts of a level or engage in certain challenges. This is seen to be the case with many online massively multiplayer games (MMO's). |
| **Story** | The narrative that accompanies the design of an experience. It can provide the context and meaning for actions, quests and objectives. |
| **Unlockable** | Items, levels and other aspects that are not available until they are "unlocked". Often requiring completion of objectives. |

**Table 9**
Game mechanics table.

| Element | Description |
|---|---|
| **Aiming** | Having to direct an object to interact with another. |
| **Build** | Having the user construct parts of the interactive experience. |
| **Celebrate** | Celebrating the completion of an outcome. |
| **Collaboration** | Communicating with other users of the interactive experience to achieve an objective. |
| **Collect** | Being able to collect items for use later. Collecting items may be seasonal (e.g. Christmas) and have expirations (e.g. can only collect items for one week). |
| **Create** | Allowing users to create their own content. This may be within defined parameters or unrestricted. |
| **Customize** | Allowing the user to customize elements of their experience. Customization may be simple (e.g. name change) or extensive (e.g. name, aesthetics, features, etc.). |
| **Disable** | Being able to disable features in an interactive experience (e.g. location settings, profile privacy). |
| **Enable** | Being able to enable features in an interactive experience (e.g. location settings, profile privacy). |
| **Find** | Encouraging the user to locate items to further the interactive experience. |
| **Gift** | Giving another user an item in the form of a gift. |
| **Keep** | Having the user construct parts of the interactive experience. |
| **Lose** | A losing condition for the user to experience. |
| **Make** | Allowing the user to make items. For example, providing the user with parts of an item incrementally to make a whole item. |
| **Obtain** | Obtaining items during the interactive experience from other users, during events, through performing behaviors, etc. |
| **Organize** | Organizing items in an order (e.g. color, shape, size, weight, etc.). |
| **Punish** | Punishment for failing to complete an action correctly. Being able to receive, give (to others) punishment. |
| **Repair** | Repairing items for use at a later stage during an interactive experience. |
| **Reveal** | Elements of the experience are revealed or can be revealed if conditions are met. For example, a user will reveal the next level only once they have finished the current one. |
| **Send** | Allowing the user to send (e.g. items, messages, etc.). |
| **Shooting** | Hitting another object with a projectile. |
| **Sort** | Sorting items in order based on a certain parameter (e.g. size, color, weight, shape etc.). |
| **Trade** | Trading items between individuals or groups. |
| **Use** | Allowing the user to use a feature(s). |
| **Vote** | Being able to have a say that directs future experiences/interactions with the process of voting. Voting may influence the experience of a single user or all users. |
| **Win** | A winning condition for the user to experience. |

## Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.entcom.2020.100375.

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