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Re-framing engagement for applied games: A conceptual framework

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ABSTRACT

Although games are frequently described as 'engaging', what this means exactly continues to be subject of debate in game literature. Engagement is often defined through related concepts like immersion and positive emotions. However, this neglects the fact that applied games aim to provide more than an entertaining experience, and that engagement with the applied purpose can exist separately from engagement with the game's systems. To make this differentiation more apparent, this article introduces the Applied Games Engagement Model (AGEM), a theoretical model that distinguishes between an applied game's systems and its non-entertainment purpose. It poses that game systems and purpose can overlap in varying amounts, both from game to game, and from moment to moment within a single game. The value of the model is in the explicit acknowledgement that the attention necessary for engaging with content is a limited resource, and that measures for engagement in applied games need to consider that not all engagement is purposeful. The article lays the conceptual foundation for the study of engagement in applied games, and provides a framework for how to design for an applied purpose. It illustrates its use in analysing applied games and their designs through three case studies.

1. Introduction

It is a truth universally acknowledged that games are 'engaging'. *Applied* or *serious games*, two terms used interchangeably in this text, are used across various sectors and for many applications [1]. Whether they are implementations of gameful elements in a non-gaming environment or full-fledged (video) games [2], their ability to engage audiences has been the cause for much enthusiasm on the many non-entertainment purposes they might fulfil. The assumption about these games is that they can better involve a person in a particular task, e.g., training or learning, than if they were to partake in said task without a game as the mediator.

Despite games' reputation as 'engaging', the answer to what engagement exactly entails is far from uniform and definitive. Within the study of applied games, authors tend to primarily focus on the subjective game experience [3], i.e., the *emotional and behavioural constructs* that result from *interaction with the game* (e.g., positive/negative emotions, immersion, presence, flow). In purely entertainment games, this focus is understandable and comprehensive. However, applied games cannot primarily be judged by their entertainment value or how well they induce these types of constructs in players. Instead, an applied game should be assessed not only by *how well it engages a player*, but whether that engagement is *servicing its intended purpose*. In other words, it is essential to know *how engagement functions*, rather than only measuring the expression of it. How it functions, however, is far from clear. Two literature reviews looking into engagement, several years apart with one as recent as 2019, share very similar conclusions — namely, that engagement is a complex construct that is often confused and conflated with other terms, and that more clarity is required [4,5].

This article aims to provide that clarity. It does so by presenting the *Applied Games Engagement Model* (AGEM). This model is grounded in theory from game studies and other relevant fields. Its purpose is to re-frame the discussion on engagement from a primary focus on the subjective game experience. Instead, it brings engagement back to the root definition of 'focusing purposeful attention on a task'. Extending upon a term from game studies, the model introduces the distinction between an applied game's *diegetic systems* (i.e., collections of game mechanics, game narrative, and related elements) and its 'applied' extra-diegetic purpose (i.e., everything in the game that is meant to fulfil an intentional, applied purpose). *Attention* is considered a *limited resource* that can be *purposefully directed* between these aspects through design. This novel approach allows developers and researchers to determine how much and when these aspects should overlap, how their design decisions affect a player's moment-to-moment attention, and evaluate whether

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their designs are performing as desired. The presented model can be used in tandem with existing frameworks that aim to explain the subjective game experience and provides a more fundamental understanding of how players interact with an applied game, its systems and its purpose.

This article primarily focuses on the theoretical foundation of the model, explaining the model itself, and illustrating how it can aid in the analysis of applied games through three case studies. The model's use in the design, development, and evaluation process is briefly discussed, although outside the scope of this article to cover extensively. Ultimately, this article aims to form a foundation for further discussion on engagement in applied games so that disparate case studies may be analysed using common terminology and new applied games can be designed mindful of the player's attention and how it engages with such designs.

2. An Overview of Engagement

Although 'engagement' is a common reason for people to consider games beneficial for non-entertainment purposes [6], few authors define their use of the term, and it often gets conflated with others [5]. Perhaps this is because it is a phrase that most people understand implicitly. However, while it is a term that is easily understood, this does not make it easy to define [7,6].

The concept of engagement is far from unique to (applied) games. In colloquial use, it refers to a state of involvement or participation. Its original meaning related to pledging oneself to something, usually a moral and often legal obligation [8]. Over time, the meaning of the word changed and became more akin to *occupying the attention of*. When people are *engaged*, it means they are 'present' with their thoughts in an activity, instead of somewhere else.

A seminal text associated with engagement is that of Csikszentmihályi on flow theory [9]. To experience flow means being hyper-focused on a task or *in the zone*. To achieve such a state, a person needs to focus attention on a task or activity (i.e., engage with it) with purposeful intention. Attention is considered to be a limited resource that a person can actively direct. The effect of flow is generally considered to be a pleasant experience, characterised by positive affect, loss of sense of time and surroundings, and a feeling that activities happen automatically. Witmer and Singer [10] provide a similar definition, describing a "psychological state experienced as a consequence of focusing one's energy and attention on a coherent set of stimuli or meaningfully related activities and events".

Engagement is a topic of study within a wide variety of applications, e.g., media studies [11], customer-brand relationships [12,13], therapy [14], and group-work [15]. Although the general understanding of engagement tends to stay the same, some expand upon it depending on the particular context. In *employee* and *student engagement*, for example, engagement refers to intellectual absorption with the tasks in performing one's job [16] or how involved students are in their learning processes [8].

Additionally, engagement can relate to a feeling of social connection to direct colleagues, a company or institution. *Job engagement* (i.e., involvement in performing one's work role) and *organisational engagement* (i.e., performing a role as a member of the organisation) are considered to be distinct conceptual experiences [17]. Similarly, student engagement includes involvement in both academic aspects (e.g., tasks surrounding studying) and non-academic aspects of the learning experience (e.g., feeling supported by the learning environment) [18]. This differentiation between *task engagement* and *context engagement* exists in other fields as well, e.g., *customer engagement* [13], *public* [19], and *civic engagement* [20].

Generally, *civic engagement* describes how an active citizen participates in the life of a community in order to improve conditions for others or to help shape the community's future [20]. There are various actions associated with this kind of engagement, such as performing community service, organising collective action, being politically involved, or enacting social change. There is an overlap between engagement with these kinds of tasks and those in a corporate or school environment. The difference lies in the specific tasks in which one engages and the broader context that such activities serve.

These fields have certain things in common, as well as aspects that are valuable in understanding engagement. A common thread is a separation between *task engagement* and *context engagement*. In the first, engagement is a state of focusing attention on a task. The second interpretation relates to a sense of involvement with the context that those tasks or activities serve. The notion of information flow furthermore presents the idea of *tools and mechanisms* that facilitate task engagement, which in turn fosters context engagement.

This distinction clarifies the general understanding of engagement, but it does not yet explain a pivotal point. Namely, *how* does a person become engaged in a task? According to Csikszentmihályi, any task can be engaging as long as one intentionally focuses their attention on it [21]. He identifies eight elements to achieve flow. These include a balance between challenge and skill, clear goals, and immediate feedback. It follows that some tasks will be easier to engage with than others. Games, for example, with their short term goals and feedback loops, are particularly suitable [22]. Other flow elements are less related to an activity and more to the experience of the person performing it. Flow elements include a merging of action and awareness, a loss of self-consciousness, and time distortion. In the previously discussed fields, flow is considered the 'optimal experience' or the end-goal of engagement. This sentiment, as is discussed in-depth in the next section, is prevalent in the study of games as well [3,5].

Another field to consider is that of narratology, the study of structure and function of narrative and its themes, conventions, and symbols. Narratology has had a notable influence in the study of games. Early game scholars considered games as a new form of 'text' that they could interpret through a narratology lens [23]. While other theories emerged over time, e.g., those more focused on understanding games as interactive systems, many games feature some form of narrative [24]. Therefore, understanding how stories engage readers is valuable in understanding how games engage players.

Readers form mental models as they progress through a narrative [25]. These models are continuously updated as a reader receives new information. If new information fits within the existing mental model, the reader incorporates it without question and maintains suspension of disbelief. However, if new information is ill-conceived (e.g., actions taken by a character are inconsistent with the reader's image of them) the reading experience can be disrupted. Generally, authors will aim to write in a way that readers can enter an 'effortless' state [26] in which suspension of disbelief is maintained and they become absorbed in the text. This definition of engagement aligns closely with that of other task-related views on engagement previously discussed. However, authors can also purposefully encourage readers to assume an *extra-textual perspective* on the text by disrupting their focus. In this case, the text challenges 'engaged' readers through contradictory elements [27] that clash with their mental model. Engagement is then not solely about becoming absorbed in the story, but rather refers to *mental involvement in reflecting on and processing the text*.

2.1. Engagement in (Applied) Games

Similar to the fields discussed previously, Csikszentmihályi's work is prominent in the discussion on game engagement. It is not uncommon to see the term used interchangeably with a variety of emotional states and other related aspects as well [4,3,5]. Some authors equate engagement with time spent on a task [28] or some other outcome that can be measured (e.g., the number of visitors or amount of replays) [29–31]. Others consider engagement a precursor to or 'initial stage' of immersion, while immersion, in turn, becomes conflated with aspects of presence (i.e., a sense of 'being' in the virtual environment) and

absorption (i.e., loss of time and space) [4]. Engagement is furthermore associated with other behavioural states. Flow, in particular, is framed as a state of complete absorption or engagement that provides a sense of deep enjoyment [32–34], and the ultimate experience that games can offer.

Authors frequently define engagement as comprising affect or emotion [5]. The term describes an emotional state that is the result of playing games as well as a reason for playing them. Positive emotional states associated with engagement, e.g., enjoyment and flow, receive particular attention. These states are considered essential, as 'enjoyable feelings experienced while playing games lead to positive attitudes and expectations of games, which provide more enduring reasons or motives for playing' [4]. Negative emotions (e.g., frustration) are unwanted or considered the result of 'too much engagement.' Engagement, therefore, can be considered a bad thing when people play 'for the wrong reasons,' such as 'escapism, avoiding boredom and depression,' as it leads to poor self-regulation [4].

The heavy focus on and perceived importance of positive emotional experiences have caused friction in the discussion of applied games. Michael and Chen [35] question the need for fun in serious games. Instead, fun might need to take a backseat to the accuracy of the underlying simulation or subject matter of the game. Similar sentiments are repeated in other publications, that debate whether applied games can be both fun and serious [36] or where the 'game' and the 'serious' get posited against each other [37]. Mildner et al. [38] state that serious games have 'fun parts and serious parts' that need to be balanced.

In a recent literature review comprised of 107 papers discussing engagement in the context of serious games, only 26 defined their use of the concept [5]. Notably, in 31 studies, engagement was conflated with, replaced by, or defined as components of immersion, flow, or presence. Hookham and Nesbitt [5] found three primary uses of engagement: referring to *use*, i.e., the player is 'engaging' with the game; referring to a player's *state*, i.e., being 'engaged'; and referring to the *property of a game* to be 'engaging'. These themes are accompanied by factors that influence engagement, e.g., usability and demographics. They observe that "engagement is a meta-construct with behavioural, affective, and cognitive components that vary both situationally and dispositionally. Effort and task persistence constitute some of the behavioural components of engagement, while the affective components include valence, arousal, and discrete emotions. The cognitive components of engagement include attention, concentration, and the use of learning strategies" [5]. Hookham and Nesbitt also state that the intensity and emotional quality of a user's involvement vary over time and that "engaged users show sustained behavioural and cognitive involvement in activities, accompanied by a positive emotional tone" [5]. These findings are also largely in line with those on engagement in the other fields described in the previous section [18,16].

2.2. Models of Engagement

The above overview illustrates that the experience of playing a game is subjective, and that it is both many-faceted and complex. As a result, clear definitions that separate related concepts are challenging to establish [3]. However, it is not the case that none have attempted to define or create models of engagement before. For example, multiple models exist that define engagement as a progressive experience with varying levels of intensity. The foundation for this view was established by Brown and Cairns [39]. They identified engagement as part of three increasing levels of 'immersion', a theory that was further expanded upon in efforts to measure such levels through surveys and observation [40].

Though these earlier models were inconsistent with previous findings [3], Procci et al. [3] build upon this work and present *game engagement* as an all-encompassing term for the subjective game experience comprised of the related constructs of immersion, presence, and flow. They review each of the involved concepts and combined the previous models into the Revised-Game Engagement Model (R-GEM), in an attempt to comprehensively capture the subjective gameplay experience. Similar to their predecessors, they consider *game engagement* as a progressive state and attention a precursor to achieving such states. In their model, low-level engagement consists of immersion (the subjective feeling of being enveloped by the game's stimuli and experiences) and involvement (related to motivation to play). These two concepts exist in a reciprocal relationship and may lead to high-level game engagement. High-level game engagement, in turn, consists of presence (i.e., a player feeling a physically existing within and interacting with the game) and flow (the optimal experience of intrinsically motivated enjoyment).

The Engagement as Process model [41] illustrates the sequence of events in engaging with an interactive system. The authors performed a qualitative study, in which they asked users about their experience with a range of interactive systems, including video games. They present engagement as a *process*. It begins with a *point of engagement*, followed by the *process* of being engaged, and eventually a *point of disengagement*. At some point in time after disengagement, the player may decide to *reengage* with the system. Each of these 'stages' has attributes associated with them, either related to the user or to the system itself. Such attributes can, for example, be emotional states (e.g., negative affect leading to disengagement or positive affect lengthening the engagement process), but also aspects of the user interface or feedback provided by the system. A system, therefore, has qualities that can make it *engaging* and attributes that influence engagement are distinguished for users. Although it could be beneficial to separate these attributes more clearly, the model provides a comprehensive overview of various components involved with engagement without treating them as the same. However, creating a model of engagement for any interactive system, rather than games specifically, may cause some specifics to be lost.

In their literature review, Hookham and Nesbitt [5] conclude that further work on defining engagement is required and state engagement to be a complex construct comprised of many others. They summarise their findings by connecting the individual constructs and their connection to engagement in a visual model. In this model, immersion and presence are an indication of affect and experienced as part of flow. Flow, in turn, is a cognitive state that manifests in observable behaviour. Each of the three dimensions (behavioural, cognitive, and affect) provides a different insight into engagement with a game.

The previous models primarily focus on subjective experiences that manifest during gameplay. While researchers explore certain factors (e.g., usability and graphical fidelity) for how they predict or influence the various constructs (e.g., [3]), the models do not incorporate a way of discussing the game itself and in what ways it may be engaging players. The Player Involvement Model [42] takes a different approach and provides a conceptual framework for understanding player experience as it relates to the design of the game. Although the model has limited empirical validation, it provides one of the more comprehensive theories on how games engage players.

According to the Player Involvement Model, for a player to be engaged requires that they focus their attention on the various areas of a game's design. There are six areas of involvement: *spatial*, *kinaesthetic*, *narrative*, *affective*, *ludic*, and *shared involvement*.

Similar to flow theory, Calleja [42] considers attention as a limited resource that fluctuates during play between these different types of involvement. For example, a game that prioritises precise executions of running or jumping mechanics has players more involved with the kinaesthetic experience of the game. It is also possible that when a player starts playing, they might be more involved in this area as they are learning the controls. Once they have learned to work the controls and the required attention for this area decreases, they can instead become involved with other areas of the game, such as appreciating beautiful environments (affective involvement), playing with others (shared involvement), or navigating a level's design (spatial involvement). The act of being involved with a game can lead to 'incorporation,' a game-specific concept that incorporates aspects of presence,

immersion, and flow.

What the Player Involvement Model also provides, is a way of considering engagement *beyond direct interaction with the game itself*. In other words, it does not only account for the direct 'task' of playing, but engagement with the broader context as well. The author distinguishes micro-involvement (i.e., in the moment involvement during play) and macro-involvement (i.e., involvement outside of playing). Each area of involvement has its own interpretation of macro-involvement. While it is not the primary focus of the model, it is a valuable contribution to acknowledge such involvement, considering how rarely it features in discussions on engagement. Even in the entertainment sphere, engagement with a game rarely ends with playing. Often, players engage in fan forums, produce derivative content, create mods, or are otherwise occupied with the games they enjoy outside of direct interaction.

3. The Applied Games Engagement Model

The previous section shows that, within the study of games, engagement is primarily focused on the behavioural and cognitive states that may arise from it. Additionally, it only regards the direct interaction with the game, and applied games are often evaluated similarly to entertainment games. In other fields, however, both the task and the circumstances surrounding that task are considered part of engagement. This article does not argue against the importance of understanding game experience. Rather, it takes the stance that a singular focus on the game experience of applied games is not enough to fully comprehend how or indeed whether they fulfil their purpose, and how to purposefully design them. Differentiating individual applied games by their entertainment value does not help to generalise findings across studies and move the field forward, especially if entertainment is not their only purpose.

This article proposes a new approach to understanding engagement with the *Applied Games Engagement Model* (AGEM). It makes a distinction between the 'game' and the 'applied' aspects of applied games. However, unlike some approaches discussed previously, these are not considered to be diametrically opposed. Rather, applied games, by nature, have both as part of their design and development process, and players engage with both in various amounts as they interact with the game. 'Applied' and 'game' can strongly overlap, in which case engagement with either is essentially indistinguishable from one another. They can also be so separate as to appear almost unrelated. More commonly, however, **'applied' engagement and 'game' engagement partially overlap to varying degrees over a play session.**

3.1. Terminology

A distinction is made between the two aspects by re-purposing a term from narratology, cinema, and game studies: diegesis. Diegesis is used to distinguish between elements that are part of the narrative world of a piece of fiction and those outside of it. For example, characters and objects in a video game tend to be intra-diegetic (i.e., part of the game world), while aspects of the user interface, menus, and loading screens are extra-diegetic (i.e., outside of the game world) [43]. In the context of AGEM, the term is used to distinguish between *the game as an observable object*, and *everything in the game that is meant to fulfil an intentional, non-entertainment (applied) purpose*. As such, the 'game' part of the applied game is referred to as the *diegetic systems*, with systems being collections of mechanics and elements (e.g., objects, environments, characters) [44]. Sicart [44] defines mechanics as 'actions that can be taken by the player', with a system containing of particular mechanics and the elements that enable those mechanics. For example, a 'cover system' in a shooting game contains anything related to a player or non-player character taking cover behind specific objects. In entertainment, this collection of systems would be considered the entirety of the game. For applied games, the AGEM introduces the addition of an *extra-diegetic purpose*. This extra-diegetic purpose includes other elements (e.g., actors, additional media, physical environment) that the player can engage with as well. In AGEM, 'game' refers to the entire experience, including both diegetic systems and extra-diegetic purpose. For a non-exhaustive overview of elements in each area, see Table 1.

AGEM proposes that extra-diegetic purpose and diegetic systems can have varying amounts of *synergetic overlap*, as illustrated in Fig. 1. It is possible for both circles to fully overlap. In this case, the player engages with the diegetic systems and, through them, also fully engages with the extra-diegetic purpose. It is even possible for players to be unaware of the extra-diegetic purpose during play, e.g., when playing a game for data collection in research projects or training games. Hence, diegetic systems and extra-diegetic purpose are usually not completely or clearly distinguishable from each other. It depends on the design of any particular applied game how much the two aspects overlap. A diagram (such as shown in Fig. 1) can be drawn for the game as a whole, or for different sections of the game (e.g., tutorial, main gameplay loop, menu interaction). It is not necessarily (and likely rarely) the case that the circles overlap equally throughout the entire game experience.

3.2. Focus of Engagement

While it may seem like the 'ideal' situation is for the circles to overlap

Table 1
A non-exhaustive overview of elements making up the extra-diegetic purpose and diegetic systems, and their hypothesised impact on engagement. The importance of individual elements is expected to vary between projects.

Extra-diegetic	Impact on Engagement
Facilitator	Mediates the player's experience. Can serve as a 'background' guide in service of interaction with the diegetic systems, or take a more active role integrated with the game experience.
Observer	Common in research projects. Generally meant to not impact engagement as a 'background' presence, but possibly sensitive to influencing engagement depending on experiment setup.
Actors	Other people influencing the player's experience, either by proximity (e.g., playing in a public space) or intentionally (additional players, active audience). Divert attention from game systems, unless meaningfully integrated.
Physical space	The area in which the game takes place. Can be shaped to aid in focusing attention on diegetic systems, or integrated into the game experience. Prone to divert attention.
Additional media	Catches a player's initial intention (e.g., marketing material/ trailer). Can further explore and emphasise the extra-diegetic purpose, though challenging to integrate with diegetic systems.
Diegetic	**Impact on Engagement**
Mechanics	Define interaction possibilities in the game that (ideally) align with extra-diegetic purpose. Clarity and usability are important to sustaining engagement. Can capture initial attention and maintain engagement (e.g., through rapid feedback).
Environments	Representation of game spaces, often visual. Can catch attention and maintain it through offering exploration, vistas, and places of interest.
Controls	Essential in certain projects to serve the extra-diegetic purpose (e.g., physical rehabilitation games). In other cases, important to test and develop for usability, as poor controls take up unwanted attention or may lead to unintentional disengagement.
Characters	Non-player entities, or other players with visual representation in the diegetic systems. Draw attention well, although challenging to develop for maintained engagement (e.g., writing an interesting, well-rounded character, and getting to know a character is time-intensive). Other players can help engagement, but are unpredictable.
Narrative	Narratives easily catch attention, and can be a strong motivator to maintain engagement. However, similar to characters, 'good' narratives are challenging to create. Suitable for integration with many extra-diegetic purposes.
Visuals/Music/ SFX	The audio-visual presentation of the game forms a major factor in engagement of entertainment games. Often less considered in applied games (e.g., due to budget and time restrictions), but important in enforcing the extra-diegetic purpose, especially when aiming to influence the player emotionally.

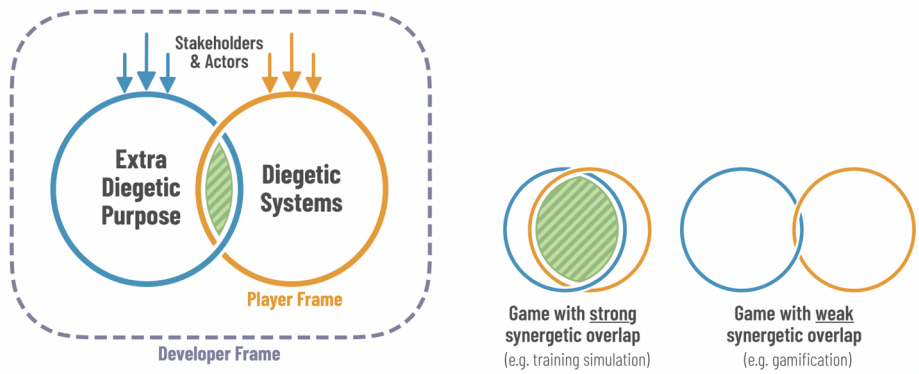

Fig. 1. Schematic visualisation of the locus of attention during player engagement.

completely, this is not the case. Often there are elements to the extra-diegetic purpose that are external to the game (e.g., the involvement of an expert or facilitator, the physical environment, or other forms of media). For example, educational games used in the classroom, ideally, do not exclude the teacher or even peers from the game experience. Such factors should also be considered in the development and evaluation of the game and how players are engaged during the entire experience.

Although synergetic overlap between diegetic systems and extra-diegetic purpose varies per game, the AGEM proposes that some overlap is necessary when viewing the game as a whole. If engagement with the diegetic systems of the game and its extra-diegetic purpose never meet, the particular applied game project has failed in the view of the model. In such a situation there is no connection between the two aspects, meaning that extra-diegetic purpose is communicated entirely outside of the diegetic systems, and that the diegetic systems are essentially an entertainment game (or worse: a game devoid of both purpose and entertainment). Note, however, that the connection can be fairly small and still be considered successful. A game primarily meant for entertainment created for marketing purposes (e.g., by including branding) still has an extra-diegetic purpose, even if it is only very loosely integrated with the diegetic systems.

The AGEM poses the diegetic systems as a mediating tool between the player and extra-diegetic purpose. Certain types of games, where the extra-diegetic purpose can be integrated primarily through the diegetic system, lend themselves to closely or fully overlapping circles. Examples of such games are those providing training or those used for data collection (e.g., *Foldit* [45]). Redirection of attention may be desired (e.g., towards additional information), but attention generally stays within the area of overlap. Games in which the diegetic systems facilitate active participation with external factors (e.g., those used in a classroom or encouraging neighbourhood participation) are more likely to map to a diagram with only partially overlapping circles. Projects such as these require interaction between the player and the extra-diegetic purpose, rather than the player only receiving information or providing input to be recorded. The extra-diegetic purpose may involve additional actors (e.g., a trainer, teacher, or therapist) or the physical environment. Mediation of interaction between the player and the extra-diegetic purpose, in this case, quickly becomes more complex and attention may, at times, need to be focused away from the diegetic systems altogether.

3.3. Stakeholder Frame

Fig. 1 shows a distinction between the *developer frame* and the *player frame*. In general, the player interacts with the diegetic systems and, through them, with the extra-diegetic purpose. Although attention can be directed towards the extra-diegetic purpose completely (explained further in the following section), the core of the player's experience revolves around interacting with the diegetic systems — hence, a project with no overlap is considered unsuccessful. From the developer's point of view, however, the entire game — diegetic systems and all elements of the extra-diegetic purpose — need to be considered. Though it may be possible for the two to be inextricably intertwined, there are many cases in which external factors (e.g., other actors, physical environment, limitations) need to be considered. If not enough attention is given to these factors during development, developers run the risk of creating games that do not mediate the interaction between player and extra-diegetic purpose to the best of their ability. It should also be noted that each element of the extra-diegetic purpose, and the player as well, are defined by attributes that may influence engagement [41], e.g., age, socioeconomic background, technical literacy, motivations, and preferences.

Various stakeholders are involved in the development of an applied game. Similarly, as mentioned above, additional actors beyond the player may be part of the game experience in the final product. It is important to be mindful of the involvement of stakeholders throughout the development process, and in which aspect of the applied game they are involved. The fundamental knowledge for the extra-diegetic purpose is often the work of experts, while developers are consulted to shape the diegetic systems and translate that knowledge into game mechanics. The AGEM does not argue for a specific involvement of stakeholders or inclusion of actors, but suggests that it is beneficial for all stakeholders to be aware in which areas of the game their respective expertise overlaps and discuss how to best integrate them during development, keeping in mind that the player's attention is a limited resource.

3.4. Process of Engagement

As shown in Fig. 1 and described above, the overlap between diegetic systems and extra-diegetic purpose can vary between different parts of the game. The overlap in a simulation-style training game will be different between a tutorial explaining keyboard controls to new players and the core gameplay loop. When developers design the various aspects of the game, this overlap should be kept in mind — it depends on the focus of that particular part how much overlap is desired. Designers should always consider that attention is limited and that attention focused on one thing takes away attention from something else.

The Process Model of Engagement [41] illustrates how players start engaging with a game, and how they eventually disengage with it. As engagement takes place, attributes of both the player and the game may influence engagement positively or negatively. However, the model does not help to understand how attention shifts between different aspects of the game as long as engagement takes place. The Player Involvement Model [42] does acknowledge this, at least for entertainment games. It identifies several types of engagement, as discussed in Section 2.2. The different dimensions provide a vocabulary for describing how attention shifts between aspects of the game's systems, and thus provide a solid starting point for understanding engagement

with the diegetic systems of an applied game. The AGEM adds the dimension of extra-diegetic purpose (see Fig. 2).

The AGEM poses that when players engage with an applied game, their *locus of attention* shifts between the diegetic systems and the extra-diegetic purpose in varying amounts. A generic example of this is shown in Fig. 3 — how exactly the diagram looks depends on the applied game and which part of its design is illustrated (for practical examples, see Section 4). The horizontal axis represents the progression of time in playing a particular part of the game, while the vertical axis represents the player's full attention. Attention is completely focused on the game and, thus, the player is engaged. Where exactly attention goes within the designed boundaries of the game varies. It should be noted that this represents an ideal situation in which the player does not experience any distractions and is entirely focused on interacting with the game. Naturally, this is not always the case in reality.

At times, either the diegetic systems or the extra-diegetic purpose inevitably require more of the player's attention. In Fig. 3, the example is used of a tutorial. While it is possible to integrate extra-diegetic purpose within a tutorial, it is likely that at the time of learning how to control a game, a significant portion of attention is taken up by this learning process. Therefore, it is unreasonable to expect that players will be able to focus much of their attention on the extra-diegetic purpose as well. Similarly, a facilitator may be required to perform certain actions with the player during the gameplay session (e.g., a teacher or researcher asking questions). The model does not state either situation as problematic, but rather identifies them as natural aspects of the applied game experience that designers should be aware of. However, explicitly illustrating the locus of attention can show whether enough time of a game fulfils its extra-diegetic purpose. A lengthy control tutorial for a short game likely does not make sense if the tutorial itself is fully unrelated to that purpose. In this case, designing simpler controls might be preferable.

In some cases, it can be beneficial to direct attention away from the diegetic systems and towards the extra-diegetic purpose by design. The AGEM calls this *the purposeful redirection of attention*. In extreme cases, the player's attention can be redirected away from the diegetic system completely to engage more fully with the extra-diegetic purpose and its elements. For example, designers of educational games may want to encourage reflection on the presented educational content. Since attention is a limited resource, it should not be spent on game mechanics or other elements in such moments. In less extreme cases, the player's attention may be directed to elements that are still part of the diegetic systems, but are shaped by the extra-diegetic purpose (e.g., information screens or integrated videos). Depending on the use case, this may be more beneficial than trying to fully remain 'in the game', or attempting to gamify every possible activity — the AGEM provides the flexibility to integrate other types of materials and interactions within the entire applied game experience when appropriate.

3.5. Use of the model

The Applied Games Engagement Model aims to provide a vocabulary for discussion and an understanding of engagement in applied games based on a player's attention. In the following section (Section 4) three case studies illustrate how to apply the model retroactively to an applied game, and how this can help in discussing and comparing design decisions.

In addition to this application, the AGEM can be applied during the design and development process as well (Fig. 4). However, at this point, the model has not been applied during the development phase of game. Further work is needed to establish how the AGEM relates to existing game design approaches, or how specific mechanics and other design decisions influence, or may purposefully direct, attention. In the future, the AGEM should be implemented in development processes and assessed in this environment for its value. The following section briefly describes how the AGEM could be used as a guide during the development process of an applied game, while keeping in mind that these suggestions remain theoretical at this point. (See Fig. 5).

1. Identifying required elements to convey the extra-diegetic purpose Before designing the diegetic systems, first all intended elements of the extra-diegetic purpose need to be described. As mentioned before, these can be actors in addition to the player (who, to varying extents, might be players themselves) but also, for example, the physical environment, additional media, and other materials that need to be mediated to players. Each of these is defined by certain attributes such as demographics, motivations, preferences, etc. A mapping of all elements involved, whether they can be integrated with the diegetic systems, whether they exclude the use of certain mechanics or elements, and what function they serve in the game experience is an essential step in early design.

2. Determining the intended synergetic overlap The model posits diegetic systems as the mediator between the player and the extra-diegetic purpose. Whenever players' engagement with the diegetic systems simultaneously results in engagement with the extra-diegetic purpose, there is synergetic overlap. As mentioned before, a game does not need to strive for constant synergetic overlap to successfully fulfil its purpose. It should also not be assumed to occur when a given part of the game is unlikely to support it. Instead, a realistic overlap should be mapped for the game as a whole, as well as individual game segments. These segments can be delineated by changes in the involved diegetic systems (e.g. a puzzle section followed by reflex-based gameplay), moments of providing instructions, conveying narrative, providing performance feedback, etc.

3. Designing diegetic systems that mediate interaction With the extra-diegetic elements and potential for overlap determined, developers can design the diegetic systems. Circle diagrams can be drawn for different gameplay sections to establish the intended synergetic overlap in more detail. These can then form the basis for more detailed mappings of the locus of attention in these gameplay sections. In this stage, developers and other stakeholders should continuously be aware

Fig. 2. A straightforward process of engagement. A player's attention is captured via the game systems and/or related aspects (e.g., surrounding material, presentation) and engagement initiates. Attributes of engagement [41] come into play determining how well the game captures a particular player's attention, and continue to influence the experience. The player engages with the game for a certain duration, experiencing both applied and game engagement. Eventually, either by design or other factors, the player will disengage and their attention shifts elsewhere.

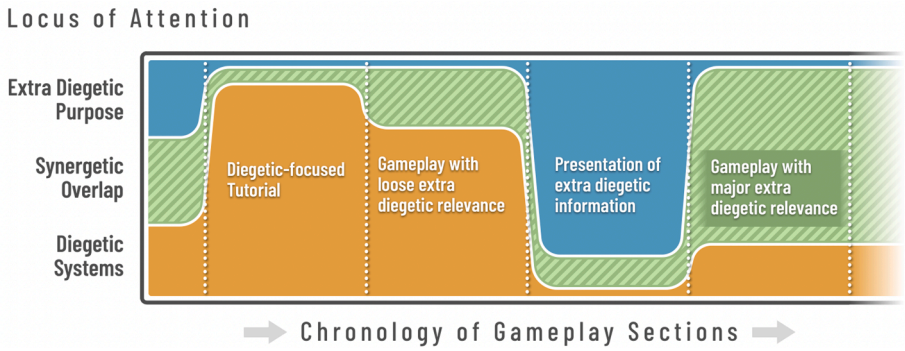

Fig. 3. Locus of attention visualised across different gameplay sections (example depicting a hypothetical game).

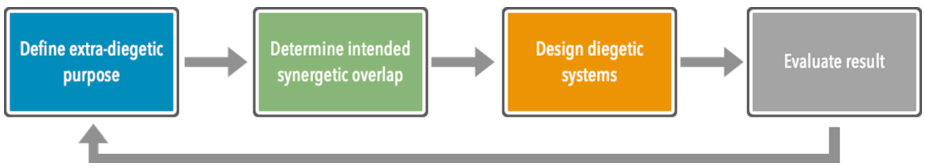

Fig. 4. The steps of applying the model, incorporated into an iterative development cycle. This is not a rigid process; there may be overlap between the phases as different parts of the game get designed and developed simultaneously, or there may be moving back and forth between phases over the course of design discussions (e.g., discussion of possible game mechanics in conjunction with discussion of the intended purpose). However, the definition of the extra-diegetic purpose should inform the intended synergetic overlap, which in turn should inform the diegetic systems. Results should be evaluated appropriately to assess whether the design meets the intentions set out initially.

Fig. 5. Screenshots taken from the *EndeavorRx* trailer on YouTube[55]. L: The player's spaceship on the track with obstacles. R: Costumes that can be unlocked through repeated play. Copyright Akili Interactive.

of how the player's attention is used efficiently — where to focus on the diegetic systems alone, where to disconnect from them to focus on the extra-diegetic purpose, and where the two can be presented in tandem.

Once the intended locus of attention is established for each section, designers can consider which mechanics and elements to use to facilitate that distribution of attention. At this stage, it is likely some concept of the game has already been established. This is the stage in which that concept is further detailed and connections are made between individual decisions in the diegetic system and the established elements of the extra-diegetic purpose.

The design of the diegetic systems is influenced by the extra-diegetic purpose, its elements, and their attributes. For example, games used for medical treatment targeting children will use different mechanics and elements than those meant for elders. There are many studies into how to design for specific extra-diegetic purposes and target audiences (e.g., the elderly [46,47], people with physical disabilities [48,49], classroom use [50]) and careful consideration is required to ensure design decisions meet these requirements.

4. Evaluate the resulting synergetic overlap This final step should be an integrated part of the design process [51]. At various stages in the development, it is important to test a player's engagement against the intended locus of attention. It may, for example, be the case that players become distracted with unexpected elements of the diegetic system, that an extra-diegetic message is ignored, or that controls require more focus to master.

There are various ways of measuring attention. Within game user research, this has been done quantitatively by recording game metric data (i.e., in-game behaviour of the player) and biometric data (e.g., eye tracking). Additionally, qualitative measure such as observation, interviews, and focus groups can provide insight into the player's experience. It is recommended to pay attention to the specific gameplay sections defined when mapping out the locus of attention, as even small moments and decisions may impact where attention is focused. While the model focuses on how attention shifts while the player is fully engaged with the game, observation of elements that disrupt this engagement are equally important.

4. The Model in Analysis

The following section describes case studies illustrating how the AGEM can help to understand and discuss engagement in applied games. Three games were chosen for this analysis. Each game was developed in recent years and is representative of different types of games with varying designs and applications. The model was applied retroactively to these three games, either based on the authors of this article having played them or by reviewing online materials or publications about them in case the game itself was not available.

4.1. EndeavorRx

EndeavorRx [52] was the first video game approved by the US Food and Drug Administration [53]. The game has been tested in multiple clinical trials that show it could be beneficial for improving attention in children with ADHD aged 8–12 [54].

In *EndeavorRx*, players guide a spaceship in a 3D environment that automatically moves forward along a track at high speed. The game is played on mobile devices that players tilt to steer their spaceship and avoid obstacles. An inhibition training, or 'go/no-go', task is incorporated in the form of pickups. Along the way, players tap the screen to pick up certain objects while ignoring others. As such, the game challenges players' attention by having them focus on multiple tasks at once. A treatment cycle consists of a child playing the game for 25–30 min per day, five days per week, for a month. In addition to unlocking new 'worlds', players can customise their character by unlocking costumes. Players can never 'complete' the game, as its goal is to progressively continue to challenge them. A player completes five missions per day to reach the needed playtime. Once they complete five missions, the game can no longer be played and locks until the next day. There is also a companion application for the child's caregiver to monitor their progress and involve themselves in the treatment.

4.1.1. Elements of Extra-Diegetic Purpose

EndeavorRx's purpose is to engage players with ADHD in a beneficial task. Elements to the extra-diegetic purpose are limited and the game is primarily presented as a stand-alone experience. Interestingly, however, communication of the purpose targets the players' caregivers rather than the players themselves, and this communication takes place through accompanying documentation (e.g., the game's manual). Caregivers act as facilitators who monitor and motivate their child's use of the game without interacting with the game directly. They are essential in the functioning of the game – without them presenting it to the player, it would likely not be played. There is little mention of the game's benefits towards the players themselves apart from what the developers suggest caregivers should tell them. While the game mediates communication to the players through its design, the intention is for players to have limited awareness of the fact that they are playing a game for treatment.

4.1.2. Directing Attention through Design

EndeavorRx's design incorporates common features from commercial mobile games; a simple game loop, progressive difficulty without a definitive end, easy to pick-up-and-play controls, unlock-able content (e.g., stages, missions or worlds) and cosmetic customisation options. Extra-diegetic purpose and diegetic systems are tightly integrated — the tasks that are beneficial for the player to engage in are closely linked to the game's mechanics. In this case, a Go/No-Go task used for inhibition training is translated to a game mechanic of collecting certain in-game items while avoiding others. Customisation of the player's avatar is not a part of these tasks, but functions as a motivational aspect to play on a regular basis (e.g., desire to unlocking favourites or 'collect them all'). Presumably, players are fully involved with the game mechanics without being aware of the extra-diegetic purpose during play.

Players engage with *EndeavorRx* for the intended duration. At the end of the session, they disengage from the game and their attention goes elsewhere. However, it is not the players themselves who decide when the session ends. Since the game is used for treatment — as opposed similarly designed mobile games that aims to turn a profit through 'pay-to-play' mechanics or advertising — it puts a stop on playtime after the necessary amount of missions has been completed. As such, attention is purposely directed away from the diegetic systems. It may turn to the extra-diegetic purpose, e.g., discussion or debriefing with the caregiver. Inevitably, however, it results in complete disengagement for the time being. While *EndeavorRx* uses many mechanics designed to keep players engaged, its designers made the purposeful decision to stop players from playing too much.

Fig. 6 shows a plausible process of engagement for a player interacting with *EndeavorRx*. Players begin playing and continue to do so for the duration of a treatment session. In this time, the act of interacting with the diegetic systems is serving the extra-diegetic purpose of the game, even if players are not aware of it. Additional elements (e.g., customisation options) can direct the player's attention away from the extra-diegetic purpose and solely on the diegetic systems, which motivate them to come back to the game over multiple sessions. Once enough sessions have been completed, the game blocks the player from playing more levels. They may interact with the purely diegetic systems some more, or discuss their treatment with the caregiver. (See Fig. 7).

4.2. Never Alone

Never Alone (Kisima Innitchuna) [56] blends traditional Alaskan storytelling with gameplay, and incorporates short, documentary-style videos that teach players about the Iñupiat, a group of Alaskan natives. It received positive responses upon launch from applied game proponents (e.g., receiving the award for 'Most Significant Impact' from the Games for Change Organization [57]). On the other hand, user reviews were mixed. On Metacritic, a website that aggregates reviews from various sources, the game received an average score of around 6.5 out of 10 [58], with users lamenting its weak platforming gameplay and clumsy controls, while praising its art style.

Never Alone is a side-scrolling platformer puzzle game. Players take turns controlling either the Iñupiat girl Nuna or her Arctic fox. Each have their own abilities to solve the various environmental puzzles that they are presented with. The game's story is based on traditional tribal tales. During play, players are rewarded with short video vignettes. These are usually interviews with members of the Iñupiat community members sharing their stories, and they provide additional information on some of the objects, situations, characters, and environments encountered in the game.

4.2.1. Elements of Extra-Diegetic Purpose

Never Alone was developed as a commercial game, available for purchase on various gaming platforms. Players engage with it through their own volition from their home environment. Similar to *EndeavorRx*, *Never Alone* provides a self-standing game experience. Information flow is one-directional and is again one of *communication*; the game mediates the information set out by its developers and experts (e.g., the Cook Inlet Tribal Council). However, while communication in *EndeavorRx* partly occurs outside of the game and targets the players' caregivers, communication in *Never Alone* is with the player and through the game itself. Beyond the educational purpose of the game, the extra-diegetic purpose is very limited. At most, additional materials (e.g., the game's website providing further information) could be considered, but these have no direct connection to the game.

4.2.2. Directing Attention through Design

In *Never Alone*, players move Nuna and her fox through linear levels, navigating obstacles, solving puzzles, and avoiding or tricking adversaries. Where it differs from other games, is that every aspect of its design (e.g., the narrator speaking in his native language, the art-style, the environments, obstacles, and characters) are based on Iñupiat traditions and culture.

The game's design combines its extra-diegetic purpose with its diegetic systems. Yet, in contrast to *EndeavorRx*, it is not the mechanics that accomplish this. Players are unlikely to learn about the life of the Iñupiat people by solving puzzles or completing jumping challenges. Instead, *Never Alone* imparts this knowledge through its characters, storytelling, atmosphere and audiovisual elements. According to the Player Involvement Model [42], players might experience kinaesthetic involvement in *Never Alone* due to its focus on jumping and running, or spatial involvement when solving environmental puzzles. Its context,

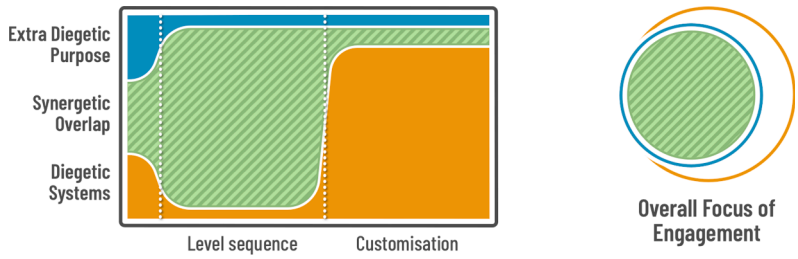

Fig. 6. Engagement graphs for the game *EndeavorRx*.

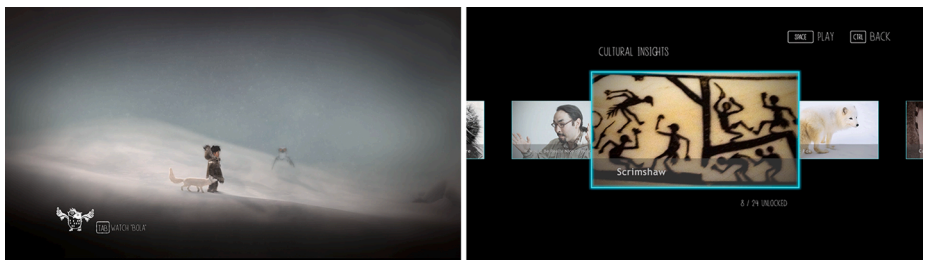

Fig. 7. Screenshots taken from *Never Alone*. L: the player characters, Nuna and Fox. In the bottom left, the player is alerted to a new video being unlocked. R: The menu screen from which videos can be selected and viewed. Copyright Upper One Games.

however, is communicated through a largely non-interactive narrative and affective elements. Players' attention, therefore, fluctuates between diegetic systems and extra-diegetic purpose and the two aspects do not enforce each other in quite the same way as they did in *EndeavorRx*.

The inclusion of video vignettes serves as an additional way to impart information on the player. They are also a reward for progressing through the game (e.g., a video about Arctic foxes is unlocked when Nuna first meets the fox). *Never Alone* reminds players of unseen vignettes in the game's loading screens, as well as whenever a new one is unlocked via an onscreen message. In doing so, the game purposefully draws the attention of the player, as the message and subsequent viewing of the vignettes takes them out of the game's interactive experience. Providing additional information outside of the game's mechanics is a common way of integrating educational content in games. In *Never Alone*, this inclusion is subtle. The message in the bottom left corner of the screen is easily ignored and therefore unlikely to frustrate players. This, however, also increases the chance that players are not aware of, or forget to engage with the videos. Additionally, rather than learning as they play, players need to pause their interaction with the diegetic systems to learn.

Fig. 8 shows a potential process of engagement for *Never Alone*. Although it may look similar on the surface, it includes a different use of redirecting attention. Some engagement with the extra-diegetic purpose can occur during interaction with the game, as players experience the story and the game's audiovisual elements. However, engagement with the extra-diegetic purpose happens primarily by diverting the player's attention away from the diegetic systems and towards the video vignettes. Gameplay can be resumed when a vignette is watched, at which point engagement with the diegetic systems is dominant once more. While the video vignettes are still integrated into the game itself, they direct attention towards the real-life situations of the Iñupiat and are presented quite separate from the side-scrolling gameplay. (See Fig. 9).

4.3. CURIO

CURIO is a multiplayer game aimed at encouraging inquisitive mindsets [59] that primary school teachers can use within their classrooms. It is a tool for teachers to assess existing knowledge and facilitate discussion on new topics, as well as an exercise for students that stimulates them to explore those topics in a playful manner.

CURIO is intended to be used when teachers introduce a new topic to students. The teacher creates a scenario, which involves thinking of a particular topic and various sub-topics. The students then play through that scenario in a session that is mediated by the teacher. Students need to liberate a fictional galaxy from the 'Haze of Confusion', an entity that has taken away the curiosity of the galaxy's inhabitants. The players visit planets (i.e., sub-topics set by the teacher) and ask the inhabitants questions about each sub-topic to spark their curiosity. After each round, the teacher can pause the game and discuss the questions that were submitted. The game ends in a confrontation with the Haze, where players answer multiple-choice questions on the sub-topics they visited. Finally, players can decorate their spaceship using the points they earned in the session by asking questions to buy a variety of stickers.

4.3.1. Elements of Extra-Diegetic Purpose

Unlike the previous two examples,*CURIO* involves a facilitator (i.e., the teacher) who is also an active participant. Additional components of the extra-diegetic purpose are the school environment and the

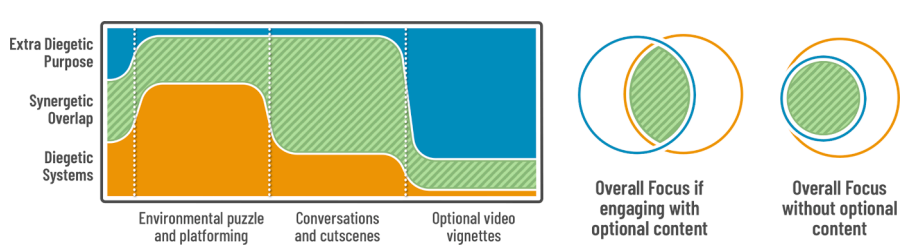

Fig. 8. Engagement graphs for the game *Never Alone*.

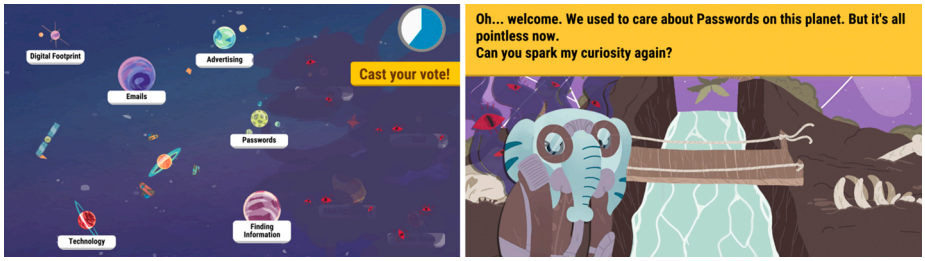

Fig. 9. Screenshots taken from *CURIO*. L: The overview screen where students vote for a planet to visit. R: A planet inhabitant prompting players to ask questions.

involvement of a class of students rather than one individual player. Information flow is *bi-directional*. The facilitator communicates through the game with the players (through presenting them with the topic and sub-topics). At the same time, the questions asked by players are sent back to the teacher to evaluate. Additionally, the game is used to mediate direct interaction between the facilitator and the players. Therefore, *CURIO* is an example of a *participation* information flow.

4.3.2. Directing Attention through Design

CURIO aims to encourage players to think about a topic, inquire about what they do not yet know, and facilitate discussion between students and teachers [59]. The core game mechanic of asking questions about a topic is integrated with this goal — players need to think about the topic to formulate questions and are motivated to help the planet's inhabitant in doing so. Choosing the next target planet is also based on which sub-topic interests the players most. Finally, answering the multiple-choice questions in the end is tied to defeating the adversary and completing the game's narrative. Engagement with the diegetic systems and the extra-diegetic purpose are thus designed to occur simultaneously. Attention may shift between the two depending on the phase of the game, but the two are closely linked much of the time.

The teacher has access to an application that controls the flow of the game. This interface gives them the option to pause the game at any point, for example to start a class discussion about previously asked player questions. This is an example of purposeful redirection of attention, taking attention away from the diegetic systems to focus on the extra-diegetic purpose completely. The engagement process for *CURIO* is illustrated in Fig. 10. Players engage with the game, actively becoming involved with the purpose as they choose topics, ask and answer questions. Some game phases, such as the introductory animation and decorating the ship, direct players' attention away from the purpose and towards game elements alone. The facilitator can pause the game at any point to start a discussion. Attention is directed away from the game completely to focus on extra-diegetic purpose, after which gameplay resumes. Finally, players may interact with each other during play, e.g., to discuss the extra-diegetic purpose. Of course, other players may also act as a distraction that unintentionally directs attention away from the game altogether.

A downside of CURIO is that it requires constant moderation, rather than being a product that functions 'on its own', as the previous examples aim to do. Therefore, it externalises some of the responsibility for engagement, and its success largely depends on the moderator.

4.4. Discussion

The games discussed above do not intend to cover all possible applied games, nor do they show all the possible forms a process of engagement can take or how design can direct attention. Rather, they were chosen to illustrate common designs of applied games. *EndeavorRx* represents many games for health and training purposes that use the training activity as the main gameplay loop and additional game elements for motivational purposes. *Never Alone* is similar to many educational and simulation games, where the gameplay is supplemented with educational content. Finally, *CURIO* is an example of a type of applied game, where the game functions as a sandbox to be shaped by an external party (e.g., teacher). Another example of this is the *Education Edition* of *Minecraft* [60]. Together, these games illustrate various game designs that can be found across a wide array of applied games. They show differently designed connections between diegetic systems and extra-diegetic purpose, instances of purposeful direction of attention, and involvement of extra-diegetic purpose elements. As such, they exemplify how the model can be applied in identifying, analysing, and discussing different designs.

For example, the video vignettes in *Never Alone* are only loosely integrated with the diegetic systems. Yet, it is the vignettes that provide the main educational content of the game. If players decide to ignore them, they may gain familiarity with an Iñupiat story and some aspects of this culture, but they lose out on the real-world information the game aims to convey. It is possible to reason that someone interested in the game's mechanics also takes time to watch the additional material, but this is not a guarantee. More importantly, this leads to different engagement graphs when using AGEM: an ideal version that shifts between engagement with the diegetic systems and extra-diegetic purpose in a balanced manner, and a 'worst-case' in which the balance is tilted towards diegetic systems.

Furthermore, if interaction with those mechanics is disappointing (as reviews of *Never Alone* suggest), players might be even less inclined to invest attention in absorbing all information. Engagement graphs can be used to show both sides — the intended locus of attention by developers, and the actual locus of attention during evaluation.

Contrast this with *EndeavorRx*, which has a close integration of extra-diegetic purpose and game mechanics. The aim of this game is to have students perform certain actions, namely a combination of attention-based tasks that lend themselves well to being a part of a game loop. Hence, the game adopts elements from casual and mobile games (e.g., endless levels, customisation, unlock-able worlds, points, excessive

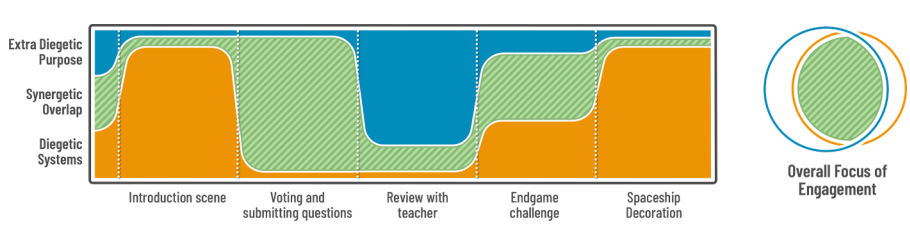

Fig. 10. Engagement graphs for the game *CURIO*.

visual feedback) that encourage players to repeatedly engage with that loop.

Although task and game are better integrated in *EndeavorRx* than they are in *Never Alone*, this does not necessarily mean that the former is a more engaging game. This article has posited games as tools that can be used for other purposes and argued for the inclusion of extra-diegetic purpose and all its elements in discussing them. This opposes the general trend of seeing applied games as independent artefacts that can achieve their goal through gameplay alone. *EndeavorRx* is an example of such a game — ideally, players can independently turn on the game, play for the expected duration, and repeat this as often as the treatment requires. In practice, however, it is unlikely that extra-diegetic elements are not involved in the act of playing. For example, the use of motivational game elements that have proven to be highly effective in the commercial market can cause friction with the game's forced point of disengagement. While mobile elements aim to keep the player involved and return to the game frequently, *EndeavorRx* requires players to play for a specific amount of time and only once per day. Assuming the motivational elements are successful in engaging players, forcing them to stop playing can be met with negativity. There is no mention in the documentation of the game on managing players' expectations to limit frustration that might arise from disengagement. There are ways in which the game's design can help prepare for this (e.g., a clearly visible countdown), but this role likely falls onto caregivers as well.

In terms of what the two games aim to achieve, *Never Alone* has the arguably more difficult task of imparting knowledge (a process that requires internalisation and reflection) than *EndeavorRx* does in encouraging specific actions. Imagining a game that would teach players about Iñupiat culture by tightly integrating information and gameplay, might easily veer into the realm of simulation where game experience is traded for accuracy. Instead, the developers of *Never Alone* decided to balance information with an artistic experience delivered through narrative and aesthetics. It is important to remember that the game was not developed for an educational setting. As such, it is not essential that each player gains all information. If this game would be part of a school curriculum, however, ensuring that the design is as likely as possible to convey the necessary information to the players becomes more important.

Note that the issues identified above are not unique to these two applied games, nor are they the only aspects of their design that can be explored using the AGEM. However, they provide two concrete examples to contrast with the third case study, *CURIO*. The first difference lies in how *CURIO* is presented as a game-based toolkit rather than a standalone game [59]. This suggests that it is an instrument to be wielded by facilitators, rather than a self-standing product that accomplishes its purposes autonomously. Its core game loop revolves around encouraging students to think about a topic. In this sense, *CURIO*'s goal is different than that of *Never Alone*, which is to impart knowledge. However, it is not impossible to imagine elements of *CURIO* used in tandem with the story and gameplay that *Never Alone* provides if it were to be used in an educational setting — encouraging external reflection through moments of redirecting attention, either involving an external agent or not. How elegantly these moments are integrated in the game experience is up to designers. This relates to the other issue identified in *EndeavorRx*, where an abundance of motivational elements might cause a negative response when players are forced to disengage. *CURIO* solves this by limiting the number of game elements in order to ease the transition between moments of engagement with the diegetic systems and extra-diegetic purpose. It also requires the teacher to be a mediating factor in this game experience, rather than a passive bystander.

None of the design approaches outlined above is necessarily better than the other, nor guaranteed to fit any particular purpose perfectly. Every applied game's design is a balancing act between the purpose of the game and the game experience it provides. While *CURIO* is focused in its design and solves some of the issues the others games experience, it heavily relies on the willingness of a teacher to use it as intended. Games such as *EndeavorRx* and *Never Alone* do not have this requirement. At the same time, while *EndeavorRx* might be more effective in motivating players to do their daily training than *Never Alone* is in communicating information about the Iñupiat, the latter is more likely to leave a lasting impression on the people that it resonates with through its presentation.

5. Conclusion

This article examined the discourse on engagement with applied games and provided a critical analysis of said discourse. Up until now, research on entertainment games predominantly fuelled the understanding of engagement. As a result, the study of engagement with games focuses on measurable, observable behaviour that arises from a player's interaction with the game. Engagement, thus, becomes both the primary goal of a game and a measure of its success. This article argues that such an approach ignores clear differences between applied and entertainment games.

Rooted in theory from various fields, the presented Applied Games Engagement Model (AGEM) returns the understanding of engagement to the original work from psychology, as a state of focusing one's attention. The limited resource of attention can be actively directed through the design of an applied game, focusing on interaction with the diegetic systems, the extra-diegetic purpose of the applied game, or a combination of both. While previous work on engagement focused on the subjective experience of playing, the new approach presented in this article frames it as the foundation for understanding a player's attention. As such, it is less concerned with the affective and behavioural manifestations that may follow from engagement, and more with providing understanding for how it might be used most effectively in applied gaming projects. Previous models for understanding the subjective gameplay experience provide valuable additional perspectives that help to explain engagement with diegetic systems. To this, the model adds the recognition of how attention is inevitably split between diegetic systems and extra-diegetic purpose, how these two aspects are integrated, and how purposeful direction of the locus of attention may support the applied game's intentions. In doing so, it offers insight into how engagement manifests and which factors can contribute to or detract from it.

This article focused on introducing the model and explaining its use in analysing and discussing applied game design. Although the article gave some indication of how the model can be applied during development, future work needs to examine how the model can be integrated with existing design approaches and possibly how it relates to specific game mechanics. Additionally, it could further be examined how the model can inform validation studies of applied games, deepening the understanding of how and whether a game effectively serves its purpose. Finally, while this article is focused on applied games, the model could be used to describe entertainment games as well. Entertainment games can be used in service of another purpose, introducing an extra-diegetic purpose and rendering them 'applied'. Players can furthermore play games with specific purposes in mind (e.g., relaxation), and certain games aim to convey a serious message as part of their design (e.g., *The Witness* [61]). On such occasions, extra-diegetic elements outside of the game are limited and the circles fully overlap. The model may prove useful in understanding engagement with entertainment games as well, perhaps especially when considering the process of engagement when combined with other models. The authors of this article invite researchers and developers in the field to join in these efforts, in order to further inform, develop, and extend the model and this vocabulary for discussing applied games.

The article's contribution is to further the discourse on engagement within applied games. By straightening out the terminology, adopting valuable theory from other fields, and refocusing the understanding of engagement from the subjective game experience alone, the practice of applied games can take the next step toward its promised potential.

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.

References

[1] I. Bogost, Persuasive games: The expressive power of videogames, MIT Press, 2010.
[2] S. Deterding, D. Dixon, R. Khaled, L. Nacke, From game design elements to gamefulness: defining "gamification", in: Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments, 2011, pp. 9–15.
[3] K. Procci, C.A. Bowers, F. Jentsch, V.K. Sims, R. McDaniel, The revised game engagement model: Capturing the subjective gameplay experience, Entertainment Computing 27 (2018) 157–169.
[4] E.A. Boyle, T.M. Connolly, T. Hainey, J.M. Boyle, Engagement in digital entertainment games: A systematic review, Computers in human behavior 28 (3) (2012) 771–780.
[5] G. Hookham, K. Nesbitt, A systematic review of the definition and measurement of engagement in serious games, in: Proceedings of the Australasian Computer Science Week Multiconference, 2019, pp. 1–10.
[6] N. Whitton, Game engagement theory and adult learning, Simulation & Gaming 42 (5) (2011) 596–609.
[7] H. O'Brien, P. Cairns, Why engagement matters: Cross-disciplinary perspectives of user engagement in digital media, Springer, 2016.
[8] R.D. Axelson, A. Flick, Defining student engagement, Change: The magazine of higher learning 43 (1) (2010) 38–43.
[9] M. Czikszentmihalyi, Flow: The psychology of optimal experience (1990).
[10] B.G. Witmer, M.J. Singer, Measuring presence in virtual environments: A presence questionnaire, Presence 7 (3) (1998) 225–240.
[11] J.L. Sherry, Flow and media enjoyment, Communication theory 14 (4) (2004) 328–347.
[12] J.W. Schouten, J.H. McAlexander, H.F. Koenig, Transcendent customer experience and brand community, Journal of the academy of marketing science 35 (3) (2007) 357–368.
[13] T.H. Bijmolt, P.S. Leeflang, F. Block, M. Eisenbeiss, B.G. Hardie, A. Lemmens, P. Saffert, Analytics for customer engagement, Journal of service research 13 (3) (2010) 341–356.
[14] M. McMurran, Motivating offenders to change: A guide to enhancing engagement in therapy, Vol. 52, John Wiley & Sons, 2003.
[15] M.J. Macgowan, A measure of engagement for social group work: The groupwork engagement measure (gem), Journal of Social Service Research 23 (2) (1997) 17–37.
[16] W.B. Schaufeli, What is engagement?, in: Employee engagement in theory and practice, Routledge, 2013, pp. 29–49.
[17] A.M. Saks, Antecedents and consequences of employee engagement, Journal of managerial psychology.
[18] V. Trowler, Student engagement literature review, The higher education academy 11 (1) (2010) 1–15.
[19] G. Rowe, L.J. Frewer, A typology of public engagement mechanisms, Science, Technology, & Human Values 30 (2) (2005) 251–290.
[20] R.P. Adler, J. Goggin, What do we mean by "civic engagement"? Journal of transformative education 3 (3) (2005) 236–253.
[21] M. Csikszentmihalyi, Finding flow: The psychology of engagement with everyday life, Basic Books, 1997.
[22] L. Ermi, F. Mäyrä, Fundamental components of the gameplay experience: Analysing immersion, Worlds in play: International perspectives on digital games research 37 (2) (2005) 37–53.
[23] G. Frasca, Ludologists love stories, too: notes from a debate that never took place, DiGRA '03 - Proceedings of the 2003 DiGRA International Conference: Level Up.
[24] M.-L. Ryan, Avatars of story, U of Minnesota Press (2006).
[25] A.C. Graesser, B. Olde, B. Klettke, How does the mind construct and represent stories, Narrative impact: Social and cognitive foundations (2002) 229–262.
[26] R. Busselle, H. Bilandzic, Measuring narrative engagement, Media Psychology 12 (4) (2009) 321–347.
[27] J.Y. Douglas, A. Hargadon, The pleasures of immersion and engagement: Schemas, scripts and the fifth business, Digital Creativity 12 (3) (2001) 153–166.
[28] L.A. Annetta, M.-T. Cheng, S. Holmes, Assessing twenty-first century skills through a teacher created video game for high school biology students, Research in Science & Technological Education 28 (2) (2010) 101–114.
[29] A. Ferko, Z. Černeková, J. Dadová, V. Major, D. Onačilová, E. Šikudová, R. Švarba, M. Valíková, I. Varhaníková, M. Vataha, et al., Schola ludus, serious games, and measurement of interestingness, in: 2011 14th International Conference on Interactive Collaborative Learning, IEEE, 2011, pp. 557–558.
[30] D. Lomas, J. Stamper, R. Muller, K. Patel, K.R. Koedinger, The effects of adaptive sequencing algorithms on player engagement within an online game, in: International conference on intelligent tutoring systems, Springer, 2012, pp. 588–590.
[31] D. Codish, G. Ravid, Detecting playfulness in educational gamification through behavior patterns, IBM J. Res. Dev. 59 (6) (2015), 6–1.
[32] Y.-H. Hsieh, Y.-C. Lin, H.-T. Hou, Exploring the role of flow experience, learning performance and potential behavior clusters in elementary students' game-based learning, Interactive Learning Environments 24 (1) (2016) 178–193.
[33] F. Ke, T. Abras, Games for engaged learning of middle school children with special learning needs, British Journal of Educational Technology 44 (2) (2013) 225–242.
[34] K. Kiili, T. Lainema, Foundation for measuring engagement in educational games, Journal of Interactive Learning Research 19 (3) (2008) 469–488.
[35] D.R. Michael, S.L. Chen, Serious games: Games that educate, train, and inform, Muska & Lipman/Premier-Trade (2005).
[36] C. Shen, H. Wang, U. Ritterfeld, Serious games and seriously fun games: Can they be one and the same?, in: Serious Games, Routledge, 2009, pp. 70–84.
[37] D. Djaouti, J. Alvarez, J.-P. Jessel, Classifying serious games: the g/p/s model, in: Handbook of research on improving learning and motivation through educational games: Multidisciplinary approaches, IGI Global, 2011, pp. 118–136.
[38] P. Mildner, et al., Design of serious games, in: Serious games, Springer, 2016, pp. 57–82.
[39] E. Brown, P. Cairns, A grounded investigation of game immersion, in: CHI'04 extended abstracts on Human factors in computing systems, 2004, pp. 1297–1300.
[40] C. Jennett, A.L. Cox, P. Cairns, S. Dhoparee, A. Epps, T. Tijs, A. Walton, Measuring and defining the experience of immersion in games, International journal of human-computer studies 66 (9) (2008) 641–661.
[41] H.L. O'Brien, E.G. Toms, What is user engagement? a conceptual framework for defining user engagement with technology, Journal of the American society for Information Science and Technology 59 (6) (2008) 938–955.
[42] G. Calleja, In-game: From immersion to incorporation, MIT Press, 2011.
[43] N.R. Prestopnik, J. Tang, Points, stories, worlds, and diegesis: Comparing player experiences in two citizen science games, Comput. Hum. Behav. 52 (2015) 492–506, https://doi.org/10.1016/j.chb.2015.05.051. URL https://www.sciencedirect.com/science/article/pii/S074756321500432X.
[44] M. Sicart, Defining game mechanics, Game Studies 8 (2).
[45] University of Washington, Center for Game Science and Department of Biochemistry, Foldit (2008).
[46] W. Ijsselsteijn, H.H. Nap, Y. de Kort, K. Poels, Digital game design for elderly users, in: Proceedings of the 2007 conference on Future Play, 2007, pp. 17–22.
[47] K.M. Gerling, F.P. Schulte, M. Masuch, Designing and evaluating digital games for frail elderly persons, in: Proceedings of the 8th international conference on advances in computer entertainment technology, 2011, pp. 1–8.
[48] K.M. Gerling, R.L. Mandryk, M. Miller, M.R. Kalyn, M. Birk, J.D. Smeddinck, Designing wheelchair-based movement games, ACM Transactions on Accessible Computing (TACCESS) 6 (2) (2015) 1–23.
[49] P. Dezentje, M.A. Cidota, R.M. Clifford, S.G. Lukosch, P.J. Bank, H.K. Lukosch, Designing for engagement in augmented reality games to assess upper extremity motor dysfunctions, in: 2015 IEEE International Symposium on Mixed and Augmented Reality-Media, Art, Social Science, Humanities and Design, IEEE, 2015, pp. 57–58.
[50] A. Echeverría, C. García-Campo, M. Nussbaum, F. Gil, M. Villalta, M. Améstica, S. Echeverría, A framework for the design and integration of collaborative classroom games, Computers & Education 57 (1) (2011) 1127–1136.
[51] T. Fullerton, Game design workshop: a playcentric approach to creating innovative games, CRC Press, 2014.
[52] Akili Interactive, EndeavourRx, Self-Published (2020).
[53] U.S. Food and Drug Administration, FDA Permits Marketing of First Game-Based Digital Therapeutic to Improve Attention Function in Children with ADHD, https://www.fda.gov/news-events/press-announcements/fda-permits-marketing-first-game-based-digital-therapeutic-improve-attention-function-children-adhd, Accessed: 2020-08-04.
[54] S.H. Kollins, D.J. DeLoss, E. Cañadas, J. Lutz, R.L. Findling, R.S. Keefe, J.N. Epstein, A.J. Cutler, S.V. Faraone, A novel digital intervention for actively reducing severity of paediatric adhd (stars-adhd): a randomised controlled trial, The Lancet Digital Health.
[55] Akili Interactive, EndeavorRx, https://www.youtube.com/ watch?v=2c0DDAaLjUM, Accessed: 2020-08-04.
[56] Upper One Games & E-Line Media, Never alone, E-Line Media (2014).
[57] 'never alone' named game of the year at the 12th annual games for change festival, http://www.gamesforchange.org/press_releases/never-alone-named-game-of-the-year-at-the-12th-annual-games-for-change-festival/, Accessed: 2020-08-04.
[58] Never alone, https://www.metacritic.com/game/pc/never-alone, Accessed: 2020-08-04.
[59] M.A. Gómez-Maureira, I. Kniestedt, S. Dingli, D.M. Farrugia, B. Berg Marklund, Curio 2.0: A local network multiplayer game kit to encourage inquisitive mindsets, in: 15th International Conference on the Foundations of Digital Games (FDG'20), September 15–18, 2020, Bugibba, Malta, Association for Computing Machinery (ACM), 2020.
[60] Mojang Studios, Minecraft: Education Edition, Microsoft Studios (2016).
[61] Thekla Inc., The witness, Self-Published (2016).