Affective Memory in Gamified Learning: A Usability Study

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Abstract. *Gamified learning has the potential to improve learning outcomes, but most strategies are focused on using Points-Badges-Leaderboards (PBL) while neglecting other game elements. Drawing upon research discussing nostalgia's potential to improve user experience and engagement, we hypothesized affective memory could aid in designing gamification's visual aesthetics. To start testing that hypothesis, we conducted a moderated usability study aiming to understand how Pokémon-based gamification compares to a trophy-based approach. Nine undergraduate students used two versions of a gamified quiz prototype (Pokémon and trophy-based) to complete multiple-choice items, then discussed their experiences in a semi-structured interview. Our findings suggest affective memory plays a significant role in gamified learning and indicate Pokémon-based gamification might maximize intrinsic motivation. Thus, informing practitioners that gamification targeting affective memory can enhance learning by increasing engagement and intrinsic motivation, and calling researchers to further investigate affective memory and other brands in gamification research.*

1. Introduction

Gamified Learning, the use of game elements in educational activities to improve motivation, has been widely researched [Deterding et al. 2011, Koivisto and Hamari 2019]. Overall, empirical research shows gamified learning can boost motivational learning outcomes compared to not using it [Sailer and Homner 2020]. However, studies also show gamification can be ineffective and even harmful to learning if not well-designed [Toda et al. 2018b]. Design Frameworks and Personalization Strategies have attracted substantial attention as means to mitigate undesired outcomes, such as performance loss and indifference [Toda et al. 2018a, Rodrigues et al. 2020]. With these frameworks and strategies, gamification designers are equipped with a process to follow and/or suggestions on which game elements to use. Nevertheless, it remains up to their creativity to implement gamification and its the game elements' visual aesthetics [Koivisto and Hamari 2019].

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In that visual context, [Linehan and Kirman 2017] highlights *nostalgia* - a mental state activated by personal elements experienced in the past - plays a substantial role in user experience [Harborth and Pape 2020]. They argue Pokémon Go and Ingress, both developed by Niantic, are similar in design but different in exploring or not a branding that causes nostalgia, which consequently affects the extent of their success. Accordingly, nostalgia relies on affective memory, a key factor in people's experiences and interactions with products [Cardoso et al. 2017]. Based on that, an interactive system that causes nostalgia likely evokes positive experiences based on valuable past experiences. [Chou 2019] share a similar view, suggesting designers should relate gamification to users' personal interests and past memories. To our best knowledge, however, prior research has not explored the role of affective memory, operationalized through nostalgia, in gamified learning.

To start addressing that gap, this paper aims **to understand how affective memory affects user experience in gamified learning**. Hence, given that usability is highly related to user experience [Barbosa et al. 2021], we conducted a moderated usability study to investigate how learners perceive gamification designed to connect to affective memory compared to a standard, trophy-based design. Our results revealed most participants preferred the gamification design targeting affective memories, supporting its significant role and indicating it can maximize learning through intrinsic motivation. On the other hand, results also suggest such an approach might be ineffective if it fails to reach users' affective memory. These findings inform practitioners on the potential of designing gamified learning focused on past experiences valuable to users, instead of relying on general-purpose game elements, and call for further research to scrutinize nostalgia's role in gamification. Thus, we contribute new empirical evidence on how affective memory influences learners' experiences with gamified learning which informs both future gamification practice and research.

2. Background and Related Work

By adding game elements to educational activities, gamified learning targets motivational and engagement issues, a prominent problem in the learning domain [Palomino et al. 2019]. To achieve that goal, gamification must be well-designed, or it can be ineffective or lead to performance loss and indifference, among other negative effects [Toda et al. 2018b]. That happens because poor designs can, for instance, decrease motivation and, consequently, lead to negative behavioral effects, such as careless completion of educational activities [Landers et al. 2018, Rodrigues et al. 2022]. Using design frameworks and personalization strategies, among other alternatives, can maximize gamification effectiveness [Toda et al. 2018a, Rodrigues et al. 2020]. However, a key task remains up to designers: creativity [Koivisto and Hamari 2019].

Relevant research has explored ways to help design meaningful gamified experiences. Specifically, we limit our discussion to *acknowledgments* (i.e., feedback that praises users' actions, such as badges and trophies) because it is the most used element [Toda et al. 2019b, Huang et al. 2020]. For instance, [Kao and Harrell 2018] investigated how badges' effectiveness varies depending on whether they visually show role models, personal interests, or achievements. Similarly, [Pereira et al. 2021] proposed badges based on distinguished Human-Computer Interaction researchers to connect them to students of that course. More broadly, [Linehan and Kirman 2017] proposes exploring nos-

talgia to provide users with meaningful experiences connected to their affective memory. Specifically, they argue designers should add nostalgia particles (i.e., elements that connect to positive experiences from users' memories) to interactive systems, instead of using general-purpose elements (e.g., a trophy), to improve user experience and engagement. As suggested by the Octalasys framework [Chou 2019], such approaches are valuable because they can cause feelings of *relatedness* (e.g., to personal interests and past memories).

For instance, take the case of Pokémon Go and Ingress. On the one hand, the design of these games is similar. On the other hand, the former has been way more successful than the latter. As discussed by [Linehan and Kirman 2017], the reason for such a huge difference likely is the Pokémon layer in Pokémon Go. Specifically, Pokémon[1] is a branding involving Anime, Video Games, and Card Games, among others, which has been successful for decades. Note that nostalgia relates to personal elements experienced in the past [Harborth and Pape 2020]. Accordingly, it is reasonable to assume that Pokémon Go's huge success, compared to Ingress, relates to the nostalgic experience its Pokémon layer offers to users [Harborth and Pape 2020]. Thereby, as discussed by [Linehan and Kirman 2017], such a nostalgic effect might similarly contribute to user experience and engagement with interactive systems. However, prior research has not empirically explored how those approaches influence gamified learning experiences.

Based on that context, this paper aims to understand affective memory's role in gamified learning. Building upon prior research [Pereira et al. 2021, Kao and Harrell 2018], we study it in the context of the acknowledgments game element. Similarly, we examine a gamification design that uses Pokémon visuals to explore affective memory, following [Linehan and Kirman 2017]. Lastly, to maximize external validity, our study is based on a quiz prototype. Gamification research has used general-purpose tasks, such as image tagging, to study general-purpose gamification (e.g., [Tondello et al. 2019]). However, this study differs in its educational focus. Hence, we chose a quiz-answering task so it is meaningful to users, a requirement for effective gamification [Palomino et al. 2019]. Note that despite quizzes being simple learning activities, our choice is based on strong empirical support for quiz-answering's positive effect on learning outcomes [Rowland 2014].

3. Method

This research aims to understand how affective memory affects user experience in gamified learning. Based on the relationship between user experience and usability, we achieved that goal with a moderated usability study. In summary, it is an evaluation method based on observing target users' guided experiences, which is suitable to compare designs and allows understanding users' subjective experiences [Barbosa et al. 2021]. Next, we detail the study and its materials, which are available in the following link to support open science: `https://osf.io/yx5kv/`.

First, to enable this study, we created a high-fidelity prototype of a quiz application (see Figure 1). Fundamentally, it featured four pages: *welcome*, showing its purpose; *instructions*, describing how to use it; *question*, presenting one question at a time; and *thank you*, thanking the user for participating and providing contact information. The

[1]https://www.pokemon.com/br/

prototype featured five multiple-choice questions concerning garbage recycling, each with three wrong alternatives and one correct (Figure 1a). We limited the number of questions to maintain prototyping feasible, while allowing users to grasp the prototype's experience, and selected a broad yet socially relevant subject that is meaningful to most people.

(a) Question **(b) Pokémon Acknowledgment**

Figure 1. Screenshots of the prototype[2] participants used to complete multiple-choice questions.

Second, we defined the gamified prototype should target motivating users to keep completing questions. To achieve that goal based on past research (see Section 2), we used acknowledgments aiming to attend users' competence needs by rewarding them after each correct answer. The goal was to motivate users to keep answering based on the desire to receive more acknowledgments. To clearly pass this goal, all acknowledgments are always visible on the *question* page. However, users only see the shadow of acknowledgments yet to be rewarded.

Third, we created the comparative versions. To understand how nostalgia affects gamified learning, we needed a standard, control design for comparison. Therefore, we created a gamification design based on Pokémons, aiming to reach users' affective memory following [Linehan and Kirman 2017], and a control version based on trophies, which are widely used in gamification research (see Figure 1) [Sailer and Homner 2020,

[2]This prototype was created using Pokemon icons created by Roundicons Freebies - Flaticon: https://www.flaticon.com/br/icones-gratis/pokemon.

Koivisto and Hamari 2019]. In summary, the versions differed in i) acknowledgments (Pokémons vs trophies), feedback for correct (*Gotcha!!!* vs green correct symbol) and wrong (Oddish image - a poison Pokémon vs red X image) answers, and thank you image (Pokéball vs Thank You). Note that, because trophies are widely used in gamified systems [Huang et al. 2020], we understand it provides external validity as a standard gamification design [Wohlin et al. 2012].

Next, we planned the study design and procedure, which was organized in five phases (see Figure 2). **First**, we introduced the study and its goals, requested the participant's consent, explained the tasks they would do, and started recording upon their acceptance. Then, participants used the prototype according to the within-subject design [Wohlin et al. 2012]. In the **second** phase, we asked participants to complete at least one question in one prototype version, allowing them to choose how many questions (up to five) to complete in total. Our goal was to give them autonomy and check possible differences among versions. After the participant finished using the prototype, we asked some open-ended questions (e.g., *What did you think about completing the questions in the prototype?*), similar to a semi-structured interview, to understand their perceptions. The **third** phase was similar, but based on using the other version to complete the same five questions. To mitigate order effects, we used counter-balancing: half of the participants used the standard version, then the nostalgia one, whereas the other half followed the opposed sequence. Next, participants answered comparative, open-ended questions (e.g., *What did you think of this version compared to the previous one?*) in phase **four**. Lastly, phase **five** opened for participant questions and concluded the study.

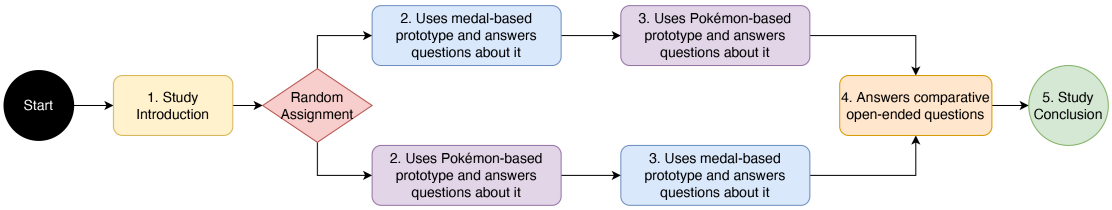

Figure 2. Study overview. One researcher completed steps one and five, while participants accomplished steps 2 to 4.

Fourth, we defined which data to collect and how to analyze them. Mainly, we relied on participants' answers to the open-ended questions, which we analyzed using Content Analysis [Corbin and Strauss 2014]. In this process, one researcher analyzed video recordings' data based on each question's answer. Similar to past research [Schmidt-Kraepelin et al. 2019], the researcher used open coding to code participants' comments, compare similarities and differences, understand users' experiences, and group them accordingly. As groups emerged, three independent researchers revised and discussed them iteratively for coherence and reliability. Furthermore, we also captured quantitative data (i.e., the number of multiple-choice questions completed time using each version) to enable triangulation. For quantitative data, we analyzed descriptive statistics because they i) aim to complement qualitative results and ii) the typical sample size of a usability study (i.e., five) leads to under-powered statistical tests [Wohlin et al. 2012, Barbosa et al. 2021].

Finally, we conducted the study online. First, we relied on convenience sampling [Wohlin et al. 2012]: one author invited Software Engineering students of the Faculty of Industry - SENAI Londrina, through the course's social media, regardless of whether they knew Pokémon. Nine students agreed to participate, a sample size within the usability test standard [Barbosa et al. 2021]. Participants' average age was 22.56 years (standard deviation: 3.36), with eight of them self-reporting as males and one as female. Following the invitation acceptance, each student participated in the study at a separate time by communicating and sharing their screen through Microsoft Teams. This procedure received ethical clearance (CAAE: 42598620. 0.0000.5464).

4. Results

The nine tests took between 12 and 24 minutes. Participants spent an average of 94 seconds using the Pokémon version (Standard Deviation, SD: 21) and 91 seconds on the trophy-based gamification (SD: 28). All but one participant (Participant 1, P1) completed the five questions in the Pokemon version. Specifically, P1 misclicked the exit button in both versions, after completing three and one questions using the Pokémon and trophy-based gamification. P9 purposefully completed four out of the five questions in the trophy version. Furthermore, seven out of the nine participants considered the Pokémon version more motivating and/or preferred it, compared to two participants who preferred the trophy version.

The content analysis revealed eight themes. Note that topics beyond the scope of this paper emerged during the usability tests, such as the relevance of the questions' subject (i.e., recycling). However, according to this paper's goal, we limit our discussion to perceptions directly related to gamification designs. The most recurrent among participants (9/9) was *gamefulness*. This theme concerns the prototype presenting game-like elements, and was often perceived in both versions. For instance, P5 mentioned that having trophies *"is cool because it seems you are being rewarded [...]"* and P6 *"it is cool when you hit [a question], receiving a little medal as a reward, you know?"*. Similarly, P7 *"liked [the Pokémons] [...] it's kind of a reward, isn't it? capturing them"* and P1 mentioned the prototype *"has the little progress bar in the top it's each Pokémon"*. Overall, these results show participants perceived the prototype as a gameful application.

Next, the most frequent theme (7/9) was *affective memory*, which concerns a connection between the rewards available in the prototype and the users' affective memory. It was mostly found in the Pokémon version, with participants mentioning, for instance, that *"if the person likes the theme, they will continue [to use the application]"* (P2), that *"[...] the reward system is pretty cool for those who know Pokémon, right?"* (P4), and that *"[I] liked the fact of having Pokémons [...] I think it's my attachment to Pokémon"* (P9). Nevertheless, P6 also brought this theme in the trophy version, connecting them to sports (i.e., *"it's cool because you are being rewarded [...] like in the real life in a sport"*). These results show that, based on affective connections to Pokémon, participants considered that version especially valuable, despite a participant perceived medals similarly.

Three themes tied as the third most frequent (6/9 participants). One of those is *relatedness*, which concerns Pokémon elements affecting user experiences. For instance, P1 and P9 considered the Pokémon version more motivating *"because of the Pokémons"*, as well as P4 did so because *"it's a Pokémon, the others are medals, like, here I get a*

Pokémon". Similarly, P6 mentioned the Pokémon version is funnier *"due to the fact of having Pokémon"* and P3 said the *"gotcha is a little cool too"*. These results show the relationship between participants and the Pokémon elements within the prototype, further supporting their effect on participants' affective memory.

Another theme mentioned by six participants was *curiosity*, which concerns participants feeling curious about the prototype. Despite P9 mentioning a weak curiosity related to the trophy version (i.e., *"I kind of wished to see how the trophy would get, but I think it wasn't enough for me to finish [answering the five questions]"*), this theme is mostly related to the Pokémon version. For example, P1 mentioned *"you only see the ?, and you want to see which [Pokémon] will appear"*, P2 *"wanted to see the other Pokémons there [...]"*, and P6 wanted to get all Pokémons *"to the little face of them all [...] a curiosity of you with yourself"*. The third theme brought by six participants was *audience*, which concerns the extent to which the prototype versions might (or not) be suitable for broad audiences. On one hand, two participants considered the Pokémon version was suitable for a broad audience (e.g., *"[for] children as well as adult audiences; I think there is no age limit"* (P4)). On the other hand, four participants had concerns with the version's effectiveness for adults (e.g. *"I liked the medals better because they encompass more...in a way more general than Pokémon"* (P3), *"I think this [medal] version more serious, more adult [...]"* (P7)). Although P6 contented this might relate to familiarity with Pokémons (*"maybe people who didn't play [Pokémon], or didn't watch it, wouldn't understand, right?"*), P8 had similar concerns with the medals (*"[trophies"* would work for a child, but for an adult they wouldn't attract much of their attention). While these results question the effectiveness of reward-based gamification for the adult audience, they also demonstrate the importance of designing user-centered game elements.

Lastly, there are the topics a single participant mentioned. One is *distraction*, which concerns a perception that Pokémons might distract users from the main task. In that case, P5 considered the trophy version *"better than the other because it was simpler than the other [...] it didn't have the Pokémon image that would distract [them]"*. The second topic is *confusion*, which concerns difficulties in understanding Pokémons' role in the prototype (*"I couldn't understand what [Pokémons] are for"* (P3)). While distraction and confusion are related to the Pokémon version, the last topic concerns the trophy gamification. This topic is *pressure*, which concerns a perception that the trophy gamification makes users feel pressed. Specifically, P7 thought the medal version *"puts more pressure on who is taking the test [...] because the medal, the little x [...] it makes you more nervous than a Pokémon on the screen"*.

5. Discussion

In summary, our results demonstrate participants considered the Pokémon version more motivating than the trophy-based gamification. Based on their perceptions, the main reason is the Pokémon elements connecting to people's affective memory, supporting their relatedness needs, and making them curious. Additionally, we found that the Pokémon version might alleviate the pressure of taking tests compared to using medals. Nevertheless, we also found the Pokémon approach might be limited to some audiences, as well as distract and confuse some users. Next, we discuss and further interpret these findings.

Our findings support the idea of exploring visual aesthetics that connect to users'

affective memory. We found that, for many participants, Pokémon elements (e.g., *Gotcha* and Pokémon images) were praised due to affective memories they had with the brand. Additionally, even participants that did not mention such a connection explicitly said it exists for many people. This connection is important because affective memory and user experience are tightly related, consequently affecting an application's usability, which is a key determinant of retention and engagement [Cardoso et al. 2017]. Thus, gamifying learning to exploit visual aesthetics that connect to learners' affective memory seems to hold the potential to maximize learning through an increase in engagement.

Furthermore, our findings suggest that Pokémon-based gamification affected participants' intrinsic motivation. Based on the Self-determination Theory, intrinsic motivation involves an internal driver related to curiosity, as well as depends on attending basic psychological needs, such as relatedness [Ryan and Deci 2017]. Accordingly, we found that most participants were motivated to keep using the Pokémon version due to curiosity. Additionally, participants often felt related to specific elements of the Pokémon version (e.g., Pokémons' faces). Such a finding is important because intrinsic motivation is considered ideal within the educational domain [Vansteenkiste et al. 2009]. Thus, our results suggest Pokémon-based gamification, as well as other approaches able to evoke similar feelings, can improve gamified learning's outcomes mediated by intrinsic motivation.

Moreover, we also found the Pokémon version can mitigate how pressuring a test is perceived to be. One participant considered the trophy version, which also features correct and *x* symbols instead of Pokémons and the Gotcha symbol, more pressuring than the Pokémon-based gamification. This insight is important because many students perceive tests as pressuring, besides approaching them with anxiety [Rodrigues et al. 2021]). However, such assessment is prominent for learning [Rowland 2014]. Thus, although a single student mentioned this issue, further investigating the extent to which similar approaches can mitigate feelings of anxiety and pressure will likely provide valuable contributions to the learning domain.

On the other hand, we found three concerns regarding the role of Pokémon-based gamified learning. Mainly, participants contented this version could not suit some audiences. A similar issue was discussed for the trophy-based gamification to a smaller extent. Additionally, one participant was unable to understand Pokémon's role in the quiz prototype, but did so for the trophy version. Given the audience issue, we hypothesize the lack of relatedness with Pokémon is the reason for that confusion. Moreover, one participant said the Pokémon version distracted him from the main task (answering multiple-choice questions), while the trophies did not. This is one of the cases wherein gamification ends up having a negative effect [Toda et al. 2018b], which was likely caused by the participant having more interest in seeing new Pokémons than in correctly completing the learning activity. Overall, these results corroborate prior research (e.g., [Morschheuser et al. 2018, Toda et al. 2019a]) highlighting the importance of properly designing gamification for it to be successful. Thus, it would be interesting to understand how other kinds of branding might influence the experiences of, for instance, people from other cultures and generations. As an example, one could rely on acknowledgments related to other brands, such as Star Wars and Matrix, and Game of Thrones characters, to reach other generations.

Similarly, the finding that the Pokémon-based gamification might not suit some

audiences points to research on personalized gamification, which aims to overcome similar limitations by providing different users with gamification designs aligned to their likes and needs [Tondello 2019]. However, according to a recent literature review [Rodrigues et al. 2020], empirical evidence is inconclusive on whether it maximizes learning outcomes compared to the one-size-fits-all approach. Importantly, the same review found that most research personalized gamification to users' personal characteristics. However, to our best knowledge, no research personalized gamification to users' affective memory. If future studies confirm affective memory's positive effect on gamified learning, personalization strategies would certainly benefit from considering it. Thus, we call for research to explore, test, and understand how affective memory can contribute to personalizing gamification.

5.1. Limitations

Four main limitations must be considered in interpreting our findings. First, relying on a prototype. Although we designed a high-fidelity prototype, it was limited to five questions. That led to short-term experiences, which are common on usability tests [Barbosa et al. 2021] and likely led to the ceiling effect on our quantitative results (i.e. completing the maximum number of questions). Additionally, addressing this limitation is especially important because gamification is known to suffer from the novelty effect [Sailer and Homner 2020]. Second, our sample. Despite nine participants being above the standard for usability studies, we were limited to convenience sampling and to the drawbacks of such few participants [Wohlin et al. 2012]. Hence, a broader sample (e.g., more participants unfamiliar with Pokémon) would further inform us of our findings' generalization. Third, the coding process. While two researchers revised and validated the content analysis themes, a single coder revised the usability tests to create the initial themes. To increase the process reliability, this coder iteratively revised quotes and themes based on a systematic script [Corbin and Strauss 2014]. Besides, this coder is experienced with qualitative studies. Nevertheless, this limitation must be considered as, for instance, different themes could have emerged based on other people's points of view. Lastly, the gamification designs. We opted for acknowledgment-based gamification, which also provided a sense of progress to users because that game element is one of the most used in gamified learning [Sailer and Homner 2020]. Additionally, we sought to reach participants' affective memory based on Pokémon due to its wide success [Linehan and Kirman 2017]. In interpreting our findings, we discussed similar approaches (e.g., using other well-known brands, such as Star Wars) that could lead to similar benefits. However, only future empirical research can confirm (or not) those expectations.

6. Final Remarks

Situations wherein gamified learning fails to maximize learning outcomes motivated researchers to understand how to avoid such failures. Whereas frameworks, personalization strategies, and other alternatives provide valuable guidance, the creativity to design game elements' visual aesthetics remains up to gamification designers oftentimes. Drawing upon prior research, we hypothesized gamification designs targeting users' affective memory (e.g., through nostalgia) would be more effective than a generic approach (e.g., using trophies). Then, to start testing that assumption, we conducted a usability study comparing two versions (trophy and Pokémon-based). This choice is based on the fact

that affective memory and user experience are closely related, with both influencing an application's usability.

Overall, our findings show that relying on a specific, well-known brand such as Pokémon, might boost gamified learning compared to using generic visuals, such as medals and trophies. Specifically, the findings are threefold. First, they support the assumption that affective memory plays a significant role in gamified learning's user experience. Second, they suggest this approach might maximize intrinsic motivation, based on its effect on relatedness and curiosity. Note that usability and intrinsic motivation are predictors of engagement and learning, respectively. Therefore, our findings suggest gamification targeting affective memory can ultimately enhance learning. Thus, this paper's main contribution is new empirical evidence on the usefulness of Pokémon-based gamification, compared to a generic trophy design, for the educational domain.

This is the first paper to empirically analyze how affective memory affects user experience in gamified. Thus, our contribution holds two main implications. First, we inform practitioners that using well-known visuals, which appeal to learners' affective memory, is likely to maximize learning outcomes by increasing engagement and intrinsic motivation. Second, we inform researchers that such an approach might enhance gamification designs but demands further empirical validation. Hence, we recommend future research to replicate this study, from both qualitative and quantitative perspectives, to test our findings' generalization to designs based on other brands, different samples, and varied experimental tasks. Given that prior research has not addressed similar questions, we provide an additional contribution by sharing our study materials. Thus, contributing to open science by facilitating replication studies and, consequently, scientific advance.

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