



Stamp-Based Gamification for Enhancing Museum Engagement and Informal Learning

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Abstract

Museums increasingly compete for visitors' attention while pursuing educational missions that depend on sustained engagement and meaningful interaction. This paper presents a stamp-based gamification model designed to increase museum engagement, support informal learning, and encourage repeat visits. The intervention combines a physical "passport" for collecting stamps with an optional QR-supported layer that enables hybrid participation and flexible visitor routes. The model was developed through course-based projects in marketing and cultural management and informed by established gamification design principles (e.g., clear goals, feedback, autonomy-supporting choices, and meaningful rewards). Each museum implementation integrates a curated route, micro-tasks and inquiry prompts linked to exhibits, and lightweight rewards (stamp collection milestones) to stimulate exploration and reflection. The approach was piloted with small visitor groups across 15 museums in Bulgaria. Feedback was collected through a mixed-method design: (1) on-site observation and immediate debriefing, and (2) structured, on-site interviews supported by a short survey form. "Recall" was operationalized as correct responses to 2-3 post-visit questions delivered via the survey form, targeting core information from the curated route. Across pilot sites, participants reported higher satisfaction and perceived involvement than in typical unguided visits, while observational notes indicated longer dwell time around selected exhibits. Post-visit responses also suggested improved short-term recall of key content addressed by the prompts. The paper concludes with operational guidelines for low-cost deployment (station placement, flow management, staff coordination, and QR integration) and discusses transferability to other cultural institutions seeking scalable, human-centric engagement tools.

Keywords: gamification, museum education, visitor engagement, informal learning, hybrid physical-digital experience, stamp rally

1. Introduction

Museums increasingly operate in attention-competitive environments while maintaining educational missions that require sustained visitor engagement. Museum learning research emphasises free-choice, constructivist and contextual learning, in which visitors actively construct meaning through objects, narratives, social interaction and spatial experience [1], [2], [3]. Visitor attention is a key precondition for such learning, because exhibit information must first become detectable, valuable and worth sustained consideration [4].

Despite significant advances in digitalization, many museums continue to seek effective ways to combine physical and online interactions without relying exclusively on resource-intensive immersive technologies such as virtual or augmented reality. Recent research on immersive and hybrid museum experiences suggests that immersion can also be achieved through embodied interaction, spatial exploration and playful engagement rather than technological simulation alone [5].

This paper presents the design and descriptive pilot findings from a student course project that developed a stamp-based gamification system for Bulgarian museums. The project combines traditional tangible interaction with digital extensions, offering both a physical and an online support layer. While the project originates in an educational setting, it is analysed here through a design-based research lens, positioning student work as a testing ground for scalable, low-cost user-experience solutions in cultural institutions.

The Industry 5.0 perspective is used only as a light framing device to emphasise human-centric, non-intrusive and resource-efficient engagement design: an approach aligned with sustainable museum interventions rather than technology-intensive solutions [6], [7]. The paper contributes by proposing a low-cost stamp-based model with optional QR support, reporting a multi-site pilot across diverse Bulgarian museum types, and synthesising a transferability framework for varied institutional contexts.



2. Related Work

2.1 Gamification in Cultural and Museum Contexts

In museum learning research, visitors are not treated as passive recipients of information. They construct meaning through interaction with objects, spatial sequences, prior knowledge, social context and interpretive cues [1], [2], [3]. This supports the use of short, cue-linked prompts that guide attention without imposing a rigid didactic path. The design challenge is to scaffold observation and reflection while preserving the autonomy and open-endedness of the museum visit.

Gamification is commonly defined as the use of game design elements in non-game contexts to enhance motivation and engagement [8]. In museums and cultural heritage settings, prior reviews and design studies suggest that game-based or gamified elements can be associated with improved motivation, perceived learning and visitor engagement, although effects remain context-dependent and design-sensitive [9], [10]. Many implementations rely heavily on digital interfaces, which may introduce accessibility barriers, require maintenance capacity or distract from physical exhibits.

2.2 Stamp Rallies as a Gamification Model

Stamp rallies represent a long-standing form of collectible-based gamification, particularly visible in tourism-oriented cultural routes. Checkpoint-style missions and reward structures can shape visitor behaviour and satisfaction, while also highlighting the need to balance game tasks with the primary experience of sightseeing or cultural engagement [11]. Despite their simplicity, stamp rallies embody core gamification principles such as progression, achievement, feedback and reward [12].

The model presented here deliberately uses lightweight mechanics: a curated route, a passport, visible milestones, short prompts, immediate feedback and optional rewards. These elements are designed to support attention and movement through the museum while keeping the material collection at the centre of the experience.

2.3 Hybrid Immersion and Industry 5.0

Hybrid museum experiences combine physical and digital interaction without treating immersion as dependent on a single technology [5]. A physical passport can provide the core progression mechanism, while QR access can support navigation, additional information or follow-up content. This division keeps the main interaction embodied and object-centred, and uses digital media only where it reduces friction or increases flexibility.

Within Industry 5.0, the focus shifts toward human-centric, sustainable and resilient systems [6], [7]. From this perspective, museum immersion is a socio-technical experience shaped by interaction, context and meaning-making. A low-cost physical-digital model can therefore be more appropriate for many cultural institutions than costly immersive installations.

3. Research Design and Methodology

The study was guided by three research questions: RQ1, what engagement patterns are observed and reported during stamp-based gamified museum visits; RQ2, how the optional QR-supported layer functions within pilot implementations and what forms of friction or support are observed; and RQ3, which implementation factors enable the model to be transferable across different museum types and collection logics.

The study was conducted as a course-based design project and analysed through a design-based research lens. Student teams of four to six members developed and piloted stamp-based routes in collaboration with museum staff. The research design prioritised ecological validity in real museum settings and methodological triangulation through observation, structured on-site interviews and a short survey administered immediately after participation.

3.1 Design Process and Pilot Sites

The design process followed four iterative phases. First, teams conducted context analysis of museum mission, target audiences, exhibition themes, spatial constraints and visitor flow. Second, they selected stamp stations, defined tasks or prompts and aligned these with learning cues. Third, they developed



the physical passport, stamp logic and optional QR-supported layer. Fourth, they conducted on-site testing and rapid refinements based on visitor and staff feedback.

Quality assurance measures included a shared design rubric used across teams, covering clarity, safety, accessibility and museum fit; screening of prompts for factual accuracy by supervising instructors; and a minimum set of comparable post-visit questions used to operationalise engagement and recall across sites.

Table 1. Pilot-site categories and implementation logic.

Institutional group	Sites included	Typical route logic	Evaluation sources
Art and galleries	4 sites: National Gallery Square 500; Sofia City Art Gallery; SAMS; Vaska Emanuilova Gallery	Artwork/detail identification, interpretive prompts and stamp milestones.	Observation, interview, survey and R1 recall.
History and archaeology	4 sites: National Historical Museum; Regional History Museum Sofia; National Military History Museum; Archaeological Park Serdika	Chronological or object-based route with factual micro-quiz and identification tasks.	Observation, interview, survey and R1 recall.
Literature and house museums	2 sites: National Literary Museum; Ivan Vazov House Museum	Room-, author- and object-based narrative prompts supporting reflection and recall.	Observation, interview, survey and R1 recall.
Science and natural history	5 sites: Polytechnic Museum; Museum Earth and Man; Mineralogy Museum; Astronomical Observatory; Natural History Museum	Specimen-, concept- and observation-based tasks with optional QR support.	Observation, interview, survey and R1 recall.

3.2 Data Collection, Measures and Coding

Data collection combined three on-site sources captured immediately after the activity: structured observation of route-following and attention patterns around selected exhibits; short structured interviews; and a brief survey form containing Likert items, one open-ended item and recall questions. Observers recorded whether participants followed the curated route, completed stations and spent visibly extended time at target exhibits. Field notes documented breakdowns such as unclear station placement, crowding and spontaneous visitor comments.

The observation protocol treated dwell time as a contextual indicator rather than as a precise behavioural metric. Observers noted stops, returns, visible comparison between objects and prompts, and bottlenecks at stamp points. These notes were later interpreted only in combination with interview and survey responses, which reduced the risk of overstating observational impressions as outcome measures.

The interview protocol captured perceived engagement, clarity, perceived learning value and concrete improvement suggestions within one to two minutes. It included prompts on the clearest part of the route, places where visitors experienced friction or confusion, whether the stamps changed how they looked at the exhibits, and whether a QR-supported layer would be useful.

Recall was operationalized as correct responses to a small set of route-linked questions. R1 was recognition-based and coded correct or incorrect using a pre-specified answer key per site. R2-R3 were short-answer items coded for semantic alignment with the intended cue in the curated route; borderline cases were discussed between the lead researcher and the relevant student team.

Qualitative data from interviews and open-ended survey responses were analysed through thematic coding. The initial codebook covered engagement drivers, friction points, route clarity, perceived learning and implementation constraints, and was iteratively refined. A subset of responses was double-coded and disagreements were resolved through discussion. Likert-type items were summarised descriptively at site level and across sites, without inferential testing because pilot groups were small, heterogeneous and not randomly assigned.

Table 2. Measures and coding scheme used across pilot sites.

Construct	Instrument / item(s)	Scale / coding	Interpretation
Engagement and involvement	E1-E5 short survey	Likert 1-5	Higher scores indicate stronger self-reported engagement and intention to recommend or revisit.
Route clarity and usability	E2-E3 plus interview prompts	Likert 1-5 plus thematic codes	Used to identify spatial, linguistic and procedural friction.
Recall recognition	R1 post-visit	Correct / incorrect	Immediate recognition of a core cue from the curated route.
Recall open	R2-R3 post-visit	Semantic alignment 0/1 plus notes	Captures salient remembered content and memorable stations.



Construct	Instrument / item(s)	Scale / coding	Interpretation
Dwell-time cues	Observation notes	Contextual indicators	Triangulation only; not treated as stand-alone outcome.

3.3 Field Protocol, Participants and Ethics

To support comparability, teams followed a shared field protocol: provide the passport and a one-minute explanation at entry; allow visitors to complete the route at their own pace with minimal researcher interaction; conduct a short on-site structured interview immediately after the route; administer the short survey on a mobile device; and capture brief observation notes on dwell-time cues and bottlenecks without recording personally identifiable information.

Participants were recruited on-site using convenience sampling and voluntary opt-in. Pilot groups were small and heterogeneous, reflecting real-world museum visitation patterns such as students, families and tourists. The study involved minimal-risk, non-invasive feedback collection in public museum settings. Participants were informed about the purpose of the activity and the voluntary nature of participation, consent was obtained prior to interviews or survey completion, no sensitive personal data were collected, and responses were anonymised for analysis and reporting.

4. Analysis and Results

4.1 Implementation Vignettes

The National Gallery Square 500 case illustrates how stamp stations can be embedded into a large room-based gallery visit. The route balanced autonomy, through multiple possible pathways, with light guidance through a curated sequence of stations. Recognition tasks, short interpretive prompts and stamp milestones provided immediate feedback, while optional QR access offered route information without requiring dedicated hardware.

At the National Historical Museum, stations were aligned with a chronological narrative and key artefacts. Tasks were primarily factual and recognition-based, using micro-quiz prompts linked to exhibit labels. The design emphasised clarity and low cognitive overhead so that diverse visitor groups could follow the route with minimal staff mediation.

The National Museum of Natural History used a question-led scavenger format encouraging visitors to search for answers across halls and display cases. Stations were tied to distinctive specimens and explanatory panels, making the format suitable for families and student groups. Stamps served as progression markers, and the QR layer was reserved for follow-up information and route navigation.

The National Literary Museum case demonstrates transferability to institutions organised as networks of related sites, such as house museums. The literary passport logic supports both single-visit engagement and continuity across multiple locations by framing the experience as an ongoing collection of cultural checkpoints. Narrative prompts connected exhibits to authors, works and biographical episodes.

4.2 Cross-Site Patterns

Across the 15 pilot sites, triangulation of self-reports, interview notes and observational records suggested three recurring non-causal patterns. First, route-following appeared more consistent when stations were spatially legible and tasks were short, requiring one prompt and one action. Second, perceived engagement was higher when stamps acted as immediate feedback and milestones rather than purely decorative collectibles. Third, immediate recognition recall was strongest when prompts pointed to a single salient exhibit detail, such as a date, symbol, material or narrative cue, and the post-visit question mirrored that cue.

The mixed-method design helped distinguish enjoyment of the game mechanics from attention to museum content. Visitors commonly described the activity as guiding and making the visit purposeful, while observers recorded visible stops, returns or longer attention cues around exhibits explicitly referenced by prompts. Where QR support was used, it primarily reduced friction through navigation and optional follow-up information rather than replacing the physical route.

Table 3. Cross-site descriptive results from pilot implementations.

Site	n	Engagement M(SD)	Clarity M(SD)	R1 correct	QR used	Main friction point
National Gallery Square 500	12	4.45(.64)	4.12(.38)	58.3%	16.7%	Staff coordination for stamp availability
Sofia City Art Gallery	10	3.64(.61)	3.47(.66)	80.0%	10.0%	Station discoverability in crowded areas
Sofia Arsenal Museum (SAMS)	9	4.12(.59)	3.41(.31)	66.7%	33.3%	Station discoverability in crowded areas
Vaska Emanuilova Gallery	9	3.87(.53)	4.34(.40)	66.7%	44.4%	Staff coordination for stamp availability
National Historical Museum	8	4.11(.42)	3.48(.77)	75.0%	50.0%	Prompt clarity / language level
Regional History Museum Sofia	6	3.60(.62)	3.93(.36)	66.7%	16.7%	Queue/bottleneck at stamp point
National Military History Museum	11	3.76(.62)	3.77(.56)	72.7%	18.2%	Queue/bottleneck at stamp point
Archaeological Park Serdika	12	4.28(.73)	4.47(.60)	83.3%	16.7%	Queue/bottleneck at stamp point
National Literary Museum	12	3.55(.48)	3.87(.44)	75.0%	25.0%	Staff coordination for stamp availability
Ivan Vazov House Museum	9	4.04(.41)	4.36(.34)	77.8%	44.4%	Station discoverability in crowded areas
Polytechnic Museum (Sofia)	9	3.51(.68)	4.25(.66)	77.8%	11.1%	Staff coordination for stamp availability
Museum Earth and Man	12	3.62(.70)	4.15(.47)	58.3%	25.0%	Staff coordination for stamp availability
Mineralogy Museum	10	4.09(.46)	4.07(.49)	80.0%	50.0%	QR scanning friction: connectivity / device
Astronomical Observatory, Sofia University	10	3.74(.45)	3.45(.66)	60.0%	30.0%	Station discoverability in crowded areas
National Museum of Natural History	8	4.40(.54)	4.08(.65)	62.5%	37.5%	QR scanning friction: connectivity / device
Overall / weighted	147	3.92(.63)	3.96(.61)	70.7%	27.9%	Multiple site-specific constraints

Note. Engagement and clarity were measured on 1-5 Likert-type scales. R1 correct and QR used are reported as percentages of valid responses at each site. The overall row reports weighted descriptive summaries across the 15 pilot sites (N = 147).

4.3 Descriptive Findings and Implementation Constraints

Across the 15 pilot sites, 147 participants completed the post-visit survey. Engagement ratings were generally positive (weighted M = 3.92, SD = 0.63), while route clarity was similarly rated above the midpoint of the scale (weighted M = 3.96, SD = 0.61). Immediate recognition recall was correct in 104 of 147 valid responses (70.7%). QR access was used by 41 of 147 participants (27.9%), suggesting that QR access functioned as a supplementary layer rather than as the main driver of activity.

The most frequent implementation constraints were station placement competing with existing signage or crowding, varying staff availability for brief onboarding and uneven mobile connectivity affecting the optional QR layer. To strengthen validity, the study relied on immediate post-visit measurement, comparable core survey items across sites and triangulation of visitor accounts with observation notes. However, the evidence remains preliminary because the pilots used small groups, prioritised feasibility over experimental control and did not employ a randomised comparison condition.

4.4 Site-Level Interpretation

The art and gallery sites showed that stamp logic can work even in object-rich spaces, but only when stations are visible without competing with existing signage. National Gallery Square 500 had the highest engagement rating in this group, while Sofia City Art Gallery and SAMS revealed the importance of station discoverability in crowded areas. The results suggest that gallery implementations should prioritise visual-detail prompts that are immediately verifiable through looking at the artwork itself.

History and archaeology sites benefited from object-based or chronological route logic. The Archaeological Park Serdika case combined high route clarity with the highest recognition recall value in the pilot, which is consistent with the use of spatial wayfinding and identification tasks. In contrast, the National Historical Museum highlighted the need to calibrate prompt language, especially when factual micro-quiz items must remain accessible to mixed visitor groups.

The two literature and house-museum sites indicate that the model can support narrative routes rather than only factual identification tasks. In these settings, the passport becomes a device for connecting rooms, objects, authors, works and biographical episodes. The main implementation challenge is that narrative prompts must remain brief enough to fit the rhythm of a house-museum visit while still supporting reflection.

Science and natural-history sites showed the strongest need for balancing observation tasks with conceptual explanations. Mineralogy Museum and the National Museum of Natural History displayed relatively high QR use, but also made connectivity and device friction visible. This suggests that the QR layer should remain optional and should duplicate, rather than replace, the minimum information needed to complete the physical route.



Overall, the site-level evidence supports a conservative interpretation: the model appears feasible across different institutional logics, but its success depends less on the stamp mechanism alone and more on the alignment among station placement, prompt design, staff coordination and visitor flow.

5. Discussion

The descriptive findings suggest that stamp-based gamification can function as a low-cost hybrid museum experience in which engagement emerges from embodied interaction, narrative progression and playful discovery rather than from technology-intensive simulation. This interpretation is strongest where stations are spatially legible, prompts are directly tied to observable exhibit cues and stamps provide immediate feedback without distracting from the exhibits.

The evaluation supports design utility and transferability rather than causal inference. Pilot groups were small, self-selected and heterogeneous, and the study did not include random assignment or a controlled comparison condition. Therefore, observed engagement, recall and dwell-time patterns cannot be attributed causally to the intervention. Self-reported engagement may also reflect novelty and social desirability, while dwell-time cues are contextual proxies rather than precise behavioural measures.

Trustworthiness was strengthened through a shared field protocol, pre-specified answer keys for the recognition recall item, an explicit qualitative codebook, double-coding of a subset of responses and triangulation across surveys, structured interviews and observation notes. Student reflections were treated as contextual design evidence rather than primary outcome data, and field interactions were kept minimal to reduce expectancy effects.

Adapting the model to other museums requires sensitivity to local cultural norms, technical infrastructure, educational priorities, visitor density and staff capacity. Negative cases and boundary conditions are important. The model is likely to underperform when visitor flow is already constrained, when routes are too long relative to typical visit duration, when station placement creates queues or when staff capacity is insufficient to maintain stamp stations. For young children, a mediator such as a parent or educator may be needed to prevent the activity from becoming purely completion-oriented.

Table 4. Transferability parameters: stable and adaptable elements.

Stable parameters (should remain consistent)	Adaptable parameters (site-specific tailoring)
Curated route with limited station count; prompts tied to observable exhibit cues; milestone feedback through stamps; short post-visit reflection; non-intrusive facilitation and minimal researcher interaction.	Station count and spacing; reward framing; visual identity of passport; QR depth (none, light or rich); prompt difficulty and language; survey delivery channel; staff involvement intensity.

6. Operational Guidelines and Future Work

The pilot results point to several practical guidelines for low-cost deployment. First, station placement should be decided jointly with museum staff and tested during normal visitor flow, because a theoretically meaningful location may still fail if it is hidden, crowded or too close to existing signage. Second, the number of stations should be limited; a short route with clear prompts is more likely to support attention than a comprehensive route that attempts to cover the entire exhibition.

Third, onboarding should be brief and consistent. A one-minute explanation at entry is sufficient when the passport design makes the task sequence visible. Fourth, stamps should function as feedback and milestones rather than as a separate reward economy. The collectible element is useful when it marks progress, but it may undermine learning if visitors focus only on completion. Fifth, the QR layer should be treated as optional infrastructure. Its strongest role in the pilot was to reduce friction through navigation or follow-up information, not to replace the physical passport.

Future iterations should test streamlined routes and alternative prompt formats in high-density settings. They should also include delayed recall after 24-72 hours, stronger instrumentation of dwell time and QR interactions, and comparison conditions that distinguish the effect of the stamp route from the effects of novelty, instructor presence or museum type.

Table 5. Operational deployment guidelines.

Implementation issue	Guideline	Reason
Station placement	Place stations where they are visible but do not obstruct movement or signage.	Reduces discoverability problems and bottlenecks.
Prompt design	Use one short prompt linked to one observable exhibit cue.	Supports attention and immediate recall without cognitive overload.



Implementation issue	Guideline	Reason
Staff coordination	Assign a clear responsibility for stamp availability and visitor onboarding.	Prevents breakdowns in the physical route.
QR integration	Use QR codes for optional navigation, accessibility or follow-up content.	Prevents the digital layer from displacing object-centred engagement.
Evaluation	Collect a brief post-visit reflection and one recognition item.	Keeps assessment feasible while documenting design utility.

7. Conclusion

This study provides preliminary, design-oriented evidence that stamp-based gamification can be used as a pragmatic strategy for structuring attention, route-following and immediate reflection in museum visits. Descriptive findings from 147 post-visit surveys across 15 Bulgarian sites indicate generally positive self-reported engagement and route clarity, but the design does not allow causal inference about learning gains, dwell-time increases or repeat visitation.

The model value lies in its low-cost physical passport, optional QR support and prompts tied to observable exhibit cues. Its transferability is conditional: it is most appropriate when stations can be made spatially legible, routes remain short, staff coordination is feasible and QR use is treated as optional rather than required. Under these conditions, the approach could provide a practical basis for international collaboration and comparative research on tangible, human-centred gamification in informal learning settings.

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