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Gamification in Architecture Heritage Education. Virtual Interaction with Architectural Heritage from Cluj County, Romania

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Abstract

The paper presents the search for new methods in teaching architecture heritage in order to achieve goals such as: to communicate the importance of heritage and transmit cultural values generation to generation; perpetuate the sensibility for intangible heritage through tangible architecture; learning and interacting with new challenging concepts; triggering the state of play-and-flow to engage students in the educational process. Further, the potential of gamification is explored in achieving educational and didactic objectives. In this sense, the paper reveals the six-stage process of implementing a fifth dimension into architectural heritage education. In the framework of gamification tools, such as digitalization, implementation of technological advancement, and augmented and virtual integration of architectural heritage, the research investigates techniques to achieve the state of flow that allows learning and memory reinforcement. Finally, the research questions value comprehension, perception accuracy, and the dichotomy of authenticity and gamification in architectural heritage and education.

1. Introduction

Neil Leach underlines the idea that play is a human intelligence trait separating it from artificial intelligence. Hence, play is not only a human trait, but it also a distinguishable particularity from the artificial counterpart of intelligence (Leach, 2021). Still, what is play and game relationship? While play is a melange of creativity, curiosity and exploration, games may also refer to strategy, reward and gain. In architecture education is paramount to communicate the importance of heritage and transmit cultural values generation to generation while perpetuating the sensibility for intangible heritage through tangible architecture. Learning and interacting with new challenging concepts and triggering the state of play-and-flow engages students in the educational process. The paper explores ways of communicating knowledge through interaction with architectural heritage, both on-site and via digital realm, through the interaction between architectural heritage and computer games technology. A fifth stage is introduced to the four-stage conventional architectural heritage research process. The regular research is comprised to shift architectural heritage next stage from a digital twin to a virtual instance. The user and the virtual instance of architectural heritage are immersed in an interactive application with multiple purposes: architectural heritage dissemination, virtual rescuing, rising awareness and proliferation of memory, increasing significance in the collective memory while consolidating cultural identity. Architectural heritage sites from Transylvania currently under research process are case studies to be explored via a six steps virtualization process. The article focuses on the field situated at the intersection of three main domains: Architecture, Education and Heritage and the impact of the Gamification phenomenon on the selected field. Further on, the intersection between the three is interpreted as a Matryoshka, one engulfing the other, one field adding a new layer to the other. To the heritage core, architecture, education and gamification are added layers reinforcing culture (Figure 1).

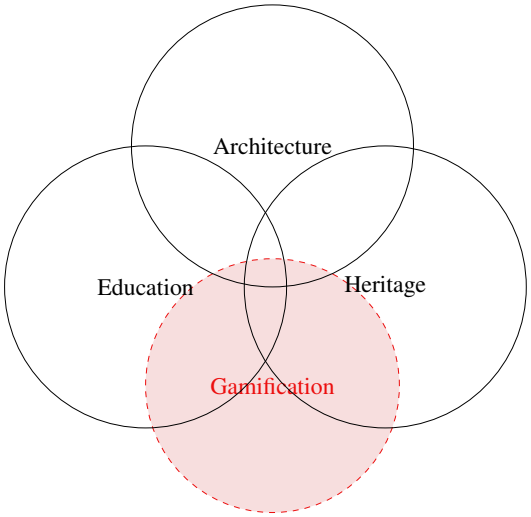

Figure 1. Research field

Both intelectual activity and practical processes are important in learning and orientation in the professional realm. Architecture, as a complex field is characterized by practice and supported by theory, both being strongly intertwined. From the point of view of education and cultural heritage, architecture is highly permeable for interdisciplinarity within an infinite number of fields. The gamification process of architectural heritage in education is profoundly fluid throughout the practices. It is a reflection of the cinematic process prepared not only for passive learning of observation and reflection, but also for active participation and knowledge building and appropriation. The practical process consists of iterating the actions in building a medium of interaction between the reality and the learning environment. Therefore, the application the participatory learning process in the virtual environment is a two phase project: the scenery and the scenario, context and content, setting up the materiality of the game and the interactivity of the play in an virtual environment.

2. Method

The paper presents the ongoing process of exploring alternative educational methods for architectural heritage. Hence, practical application intertwines with a documentation process, the two sides of the present research reinforcing the study and each other. Documentation supports the practical process, while the application requires return to literature review.

2.1 Research field and documentation

The documentation is based on three types of literature: literature reviews, research results and theory and applications outcomes. While the selected literature reviews cover publications untill 2020, the documentation studied was mainly selected in the last five years, 2020-2025. Therefore, the studied literature was filtered based on the keyword gamification, analysing research on gamification alone or associated with one or more of the following concept: education, architecture and heritage 2. Within the realm of gamification the educative process takes place (Figure 2). In the field of education architecture finds its rightful place with the heritage domain integrated, one domain is engulfed by the other.

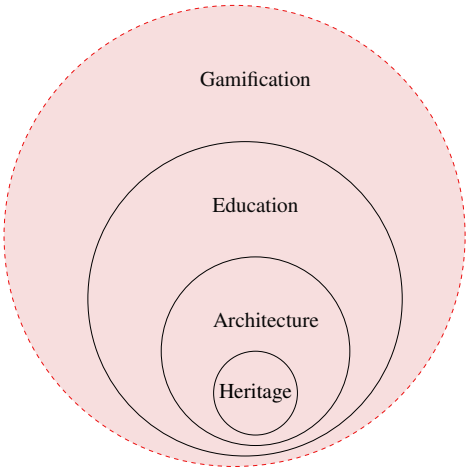

Figure 2. Research field Matrioshka

2.2 Practical application

In the practical application of gamification, the initial fourth process of architectural heritage communicating between four paralel realms, the user and the exploratory realm, real and augmented/virtual spaces: archival documentation, on-site study visit, digital duplicate via photogrammetry and 3D scanning, survey and complete comprehension. The fifth dimension is created and explored - user interaction by importing gaming technologies (Debailleux et al., 2018) and overlapping the four realms, the explorer and the explored, reality and the augmented/ virtual. A paradigm change in architecture education is the interaction with architecture digital heritage through game technology. Learning is triggered in interaction while in a play-and-flow process, while understanding and memorizing. The journey of developing methods to transpose architectural heritage into accessible and explorable spaces is presented in figure 3.

Each six phase of the application ramifies in several stages and according activities. The paper showcases the challenges of integrating the user participation into the educational process while having the opportunity of tailoring the interactivity process with the volume of available and communicated information.

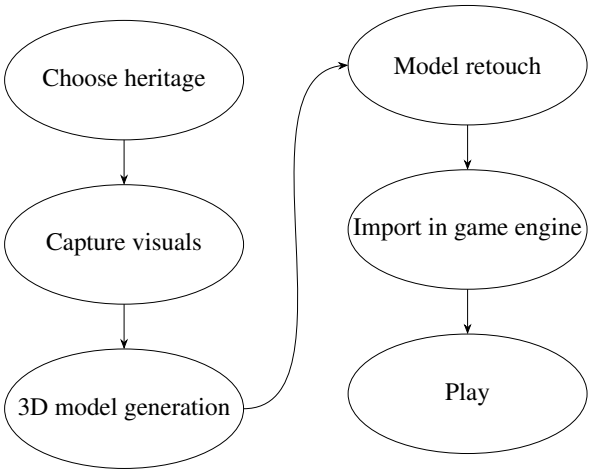

Figure 3. Real to virtual instance workflow

2.2.1 Digitalising architecture heritage First step of the process consists of creating a digitized version of the architectural heritage building and site.

1. choosing heritage: the first stage of the process is the selection of architecture heritage sites to be documented. The selection is driven by educational purposes and preservation needs. Therefore, endangered sites with architecture values are included in the project.

2. capturing visuals: the second step of the process is acquiring data. Data acquisition is done mainly on site and supported by technological facilities, drones and scanners. An important part of the documentation is gathering available data on the building, history, architecture evolution and all information available that can contribute to accurate reconstitution.

3. 3D model generation: in the third step the digital twin of the architectural heritage site is reconstituted. This required rapping up the data with the help of software using mainly point data from laser scanning.

2.2.2 gamifiying architecture heritage At this stage the architectural heritage digital twin is processed as an active instance.

1. model retouch: the digital model is corrected and prepared for the game next stage.

2. import game engine: the digital twin of the heritage site is imported as a game environment and further on processed for user accesibility, exploration and interaction.

3. play: at this stage the user is able to explore the virtual instance of the architectural heritage site as an active participant.

2.2.3 play and flow state of learning Mediated by the virtual environment, students have access to architecture heritage, having the freedom to explore and interact with in a personalized and individualized manner. In the learning process at this stage, architectural heritage virtual instance is explored in a individual diegesis in the interactive medium (Peng et al., 2024).

3. Results

To answer the question: “How can digital interaction with architectural heritage contribute to the educational experience and enhance knowledge and meaning?” we are embarking in a process of adding a fifth dimension to the architectural heritage, beyond the digital. The process follows the steps: a. building complex knowledge in selected architectural heritage sites; b. enhancing architectural heritage from a digital instance to an interactive virtual instance; c. creating a story to engage the user and the architectural heritage virtual instance; d. creating the virtual space place where the user meets the architectural heritage for the story to take; e. allowing the story to unravel and unable the user to unfold its own storyline. In this study the current stage of experiment is presented while implementing software and technological tools to transform architectural heritage from digital to virtually interactive instances.

Gamification has a paramount contribution to exploration and stirring curiosity to motivate the drive for discovery. The gaming techniquies are constantly improving their quality of supporting tools in reinforcing cultural heritage with architectural and educational dimension.

3.1 Literature review

In the documentation phase two types of literature are analyzed: reviews of gamification, as well gamification literature. In the later category we identified four main impact areas of gamification in education, architecture and cultural heritage: soft psychological and sociological, on different scales of the environment, on sustainability of the educational realm, and technical implementations.

3.1.1 Reviews of gamification literature Literature shows gamification integrates game elements and strategies in non-game environments, scenarios, and situations. In education domain Zeybek et al. (Zeybek and Saygı, 2024) analyse the aim, field, level and methodology of gamification outlining positive effects and the potential of gamification in education to solve problems. Khan et al. point out the benefits of ”gamification and cultural heritage dissemination”. Authors show that engaging in play via a game improves key skills and competencies. A cause for gamification of the digital heritage field are technologies such as IoT, digital sensors, devices, wireless technology, smart technologies, smart sensors (AR). These are facile tools to be implemented in non-entertainment environments. The study questions gamification in cultural heritage as a tool for entertainment or knowledge enhancement (Khan et al., 2020).

Further on, in cultural heritage, Maques et al. (Marques et al., 2023) are questioning the position and direction of gamification. The authors are ”leveling up, going beyond”, first, identifying main actors in the field of publication European and GLAM Institutions for tangible and intangible heritage. The need for substantial networks and collaborative work between researchers is underlined (Marques et al., 2022). Second, the research identifies key elements and questions gamification process and phenomenon and four key elements in gamification are pointed out: motivation, engagement and creativity enhancement; intrinsic motivation as a prioritezed dimension; target public mainly tourists and visitors children; technologies and tools (mobile apps, AR, VR). They are searching for answers for the following: gamified heritage, gamified projects orientation towards institutions or tourists, designing dimensions, integrated technologies, target public and future directions (Marques et al., 2023).

Awan et al. prove the efficacy of introducing gamification in architecture education, defining five phases of gamifying architecture modules:

1. identifying skills, knowledge and techniques;
2. issues of retension, engagement and understanding;
3. choosing gamified concepts to be applied;
4. testing and recording the results;
5. reviewing and redesigning based on feedback.

Authors draw attention to the setbacks of gamification. First and foremost, there is the risk to become an abused practice when games are oversold and gamification is promoted as solutions instead of addressing problems. Since gamification is an alternative tool in teaching difficult concepts in engaging ways and a mean to implement new technologies future project can arise. It is paramount for this kind of projects to have integrated user interaction, deep learning, engagement, community development, ”gamification principles mindfully and purposefully integrated” (Awan et al., 2022).

Bayraktarli et al. review the pedagogical innovations in architecture education. The study highlights the importance of large scale studies to evaluate the drawbacks and asses oversimplification (Bayraktarlı and Selçuk, 2025).

Research underlines the intrinsic value and soft outcomes of gamification. Suh et al. reveal that gamification has the effect of enhancing user experience due to psychological needs of satisfaction such as autonomy, competence, and relatedness achieved in the interplay between game and enjoyment. According to the study, for gamification to achieve success it must address people’s psychological needs and include rewards, altruism, competition, and self-expression (Suh et al., 2018).

3.1.2 Gamification literature The gamification literature in the last five years has focused on four main impacts gamification on architecture heritage education conveying the wide territory it continuously conquers.

On the first level, studies discover the soft impact of gamification through assessment (Fonseca et al., 2021) as contributing to life satisfaction (Sestino and Nasta, 2025), value system reconstruction (de Andrade, 2022), connections stimulation (Chauhan and Karthikeyan, 2025) by constructing narratives, through story-telling (You, 2024), (Özgüleş, 2022), intra and extra diegesis in seriuous games interactive mediums (Peng et al., 2024), having effects on hedonic and eudaimonic experiences (Battista et al., n.d.), as an incentive to participatory democracy (Battista et al., n.d.), community engagement (Dipasquale et al., 2023) and encouraging public engagement in architectural design (Ehab et al., 2023).

On the second level, considering the impact on the environment through transformation (Peng et al., 2024), gamification is enabling national heritage sites study (Murodillaevich et al., 2021), addressing challenges in experiencing museums (Bavi and Gupta, 2022), (Ribeiro et al., 2024), has turistic enhancement (Paliokas et al., 2020), and cultural heritage engagement purposes (Lin et al., 2024), contributes to experiencing built heritage (Garcia et al., 2024), to heritage disemination (Khan et al., 2020), enhancement (Afshar et al., 2024), preservation (Srdanović et al., 2025), and promotion (Bonacini and Giaccone,

2022), of the memory of the place (Rosser and Soler, 2024), shaping the future city (ÖZDEN et al., 2023), contributing to collaborative urban design and citizen partnership (Redondo et al., 2020a).

On the third level, literature is addressing impact of gamification to sustainable education (Christopoulos and Mystakidis, 2023) through student engagement (Ghatak et al., 2023), (Chauhan and Karthikeyan, 2025), artistic learning (Durán and Fuentes, 2024), enhancing user experience in education (Bugeja and Grech, 2020), or in tourism (Garcia et al., 2024), learning engagement (Lin et al., 2024) and (O’Connor et al., 2020), history education (Moseikina et al., 2022), implementing current trends (Karahan and Gül, 2021), collaborative learning (Nofal et al., 2020), enhancing architecture education (Atiyat et al., n.d.) and experiential learning (El Mehelmy and El Zeini, 2024), descriptive geometry (Álvaro Tordesillas et al., 2020), innovative materials (Fernandez-Antolin et al., 2021) or urban design (Redondo et al., 2020a).

On the fourth level, research exhibits technical implementation with the help of gamification tools in interior architecture (Babacan Çörekci, 2023), bim systems and video-games (Fonseca et al., 2020), software engineering (Pedreira et al., 2020), digital twin (Bucchiarone, 2022), applicability (Palócz and Katona, 2021), extended reality and AI insights (Perlaza Rodrígu et al., 2024), technical courses of gamification (Shareef and Rauf, 2022) and implementing gamification in higher technical education (Fernandez-Antolin et al., 2021).

3.2 Application

By reviewing three selected case studies, Wang et al. guide us in ”How to use gamification principles effectively in cultural heritage exhibitions” in eight steps: Multimodal Data Integration and 3D; Technology integration and immersive; application of advanced technology; Interactive narrative and gamified learning; Personalized Experience and User Engagement; Balancing educational objectives with entertainment value; Cultural sensitivity and accuracy; Evaluation and Feedback Mechanisms (Wang et al., 2024).

Afshar et. al present a development process consisting of ten steps: Creating a gamified immersive virtual in Unreal Engine; Importing the photogrammetry model; Integrating dynamic environmental elements, animations, and audio; Implementing and configuring the first-person character; Integration of AI in educational gamification: the role of Convai; Character creation; Integration of Convai plugin with Unreal Engine; Enhancing educational gamification with MetaHuman framework; Dynamic interactions with AI characters in gamification; Navigational intelligence in AI characters: NavMesh and NavLinkProxy (Afshar et al., 2024).

The present research reveals five dimensions of the gamification phenomenon in architecture heritage education. The dimensions can be interpreted as evolutive, a fair attitude evolving from one dimensions to the other, or different facets of the architectural heritage from the point of view of participation both in the game and in learning.

3.2.1 Architecture heritage fifth dimension Following the six-stage method of architectural heritage interaction in the educational realm, a five-dimensional process of gamification is revealed to achieve the state of flow in creativity by playing.

Figure 4. On-site data check

Figure 5. Tioltiur Church, Point Cloud and Mesh

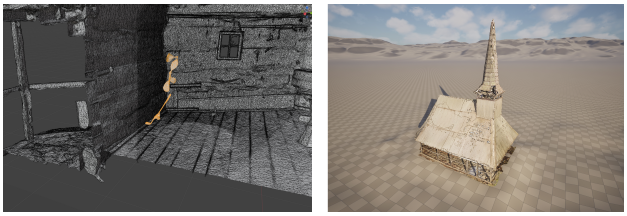

Figure 6. Model retouch and import in game engine

Figure 7. Play

1. building complex knowledge in selected architectural heritage sites: involves documenting the heritage site, both traditionally and with digital tools by reconstructing the memory of the place and digitally duplicating the site via photogrammetry and scanning. (Figure 4, Figure 5)

2. enhancing architectural heritage from a digital instance to an interactive virtual instance: processing data into accessible and interpretable information (Figure 6)

3. creating a diegesis to engage the user and the architectural heritage virtual instance: a story is constructed from the information gathered from the first two stages, the history and the edifice. (Figure 7)

4. creating the virtual space where the user meets the architectural heritage for the story to take place: the story is placed in the environment to produce and diseminate new knowledge. At this stage the extra diegesis is created.

5. allowing the story to unravel and unable the user to unfold its own storyline: in the fifth dimension, the learner interacts with the story and appropriates it with its own knowledge, perception, and experience. The story is fluid, therefore the actor interacting with the story can interpret it and transform it through an intra diegesis.

3.2.2 Play and flow state of architectural heritage interaction The five dimension gamification is a reflection of the ancestral way of transmitting heritage, through storytelling by engagement, participation and collaboration into creating the story. At this age, the spoken word has been replaced by digital instances, while the aliveness of communication in the real palpable medium has moved in the virtual intangible world. The need of participation in education, educatee, and educator as well, to be the active part, not only passive, unlocks a new level in the game of architecture heritage. The new stage of gamification in architecture heritage education is having the user as a virtual actors participating in the virtual community to observe and to be observed. Therefore, an active actor in the virtual environment exposed as a participant is becoming and appropriating its new found environment as an participatory virtual instance. Within the evolutionary thinking, from the role of aiding design, the computer enables the virtual educational environment for learning in a play and flow state in the context of collaboration between artificial and natural intelligence.

4. Discussion

Gamification has become a phenomenon caused by the search of extraordinary and unique sensations to which the sedimented culture seems not to cope anymore without the technological advancements. With this premises, the research unfolds ” what” and ”how” questions such as: What areas of understanding architecture values is the virtual interaction reinforcing? What are the means and resources needed for digital exploration and should they become the norm in the educational space? (Albourae et al., 2017) How is the perception on the architecture heritage altered via virtual interaction? How can architects and teachers contribute to the discourse on authenticity can commodification contradiction of architectural heritage in the gaming industry?

In gamifiying educational environments there is a individuation tendency. Even if personalization has been proven to be an important component in gamified education, students also tend to individualize the gamifying process while involved in the process. In this sense studies underline the contribution of gamification in development of civic spirit, democratic participation and social collaboration.

According to the cognitive theory of gamification, as observed by Suh, Wagner and Liu, gamification outcomes are connected with psychological needs (Suh et al., 2018). The theory of Sestino and Nasta reinforces the fact that meeting psychological needs through gamification contribute to life satisfaction, the augmented reality acting like a panacea to the reality (Sestino and Nasta, 2025).

In the gamification learning environment, Bruno Andrade and Pereira Roders observe, students are more driven by personal values than collective values in heritage practice. Moreover, there is a clear observation students are personalizing the gamified learning environment, rather than including collective values. The students are evolving into the mindset of integrating values and attributes in heritage practice, while education in architecture is preparing for the new profile of the student (de Andrade, 2022). Both the students are slipping into their gamers costumes, and the education is preparing the environment of play and game. While gamification is a challenge for all actors in the game of education in architecture heritage, there is social impact related with behavioural change with positive outcomes such as enabling communication between the actors and building community (de Andrade, 2022).

Entertainment and educational value benefit architectural heritage in the educational environment. Although there is a distinction between hedonic and eudamonic drives, the outcomes of experiencing gamified environments are significant in each case. Gamification mainly triggers hedonic drives generating a user-centered environment (Sangamuang et al., 2025).

Research reports gamification can also act as a pretext for promoting digital technologies in the context of collaborative urban design and citizen participation having the advantages of perceived realism, immersive nature of the experience and understanding architectural space, although diziness, details and accuracy are downsides to be taken into account (Redondo et al., 2020b).

Already access to technology is enabling digital participation. Gamification together with technological access unlocks data interoperability in Unity3D game engine. In the continous transformation of the interaction with cultural heritage, future will bring for cultural heritage educational role-playing and active engagement in a safe environment (Battista et al., n.d.).

Gamification has extrinsic and intrinsic effects. Extrinsic effects contribute in acquiring 21st century skills as Moseikina et al. showed (Moseikina et al., 2022). It ”bridges the gap between traditional heritage preservation and the expectations of a digitally native audience” (Srdanović et al., 2025) presenting the information in appealing ways to the younger generations (Bugeja and Grech, 2020). Martusciello et al. point out the conjuction between AI and AR have an enhancement effect on ”context-aware exploration, fostering engagement and knowledge retention” (Martusciello et al., 2025). Moreover, research proves that AR is already standardized for museum usage. Intrinsically, gamification fosters emotional connections (Chauhan and Karthikeyan, 2025) as well as inclusion promoting ”ownership, consent, and use” (Bavi and Gupta, 2022), but also critical thinking and enable community consolidation among learners (Afshar et al., 2024).

5. Conclusion

With technological and artificial intelligence advancements, gamification in architectural education is inevitable. It is a tool that enables learning by enhancing connection and inclusion. Gamification in architecture heritage education is an experience mediated by technology with causes and effects. Gamification, although directed at the young public, it also offers tools for other age groups. On one hand, through technology people can reach remote places of cultural heritage through the virtual environment. On the other hand, the virtual interaction is an option for intense turistification and an alternative for environmental issues. Therefore, there are positive influences and shortcomings that cause and encourage educational transformation with gamification techniques. Research shows gamification effects in education, architecture, and cultural heritage are multilayered and multifaceted. The educational process is mediated by the virtual environment with the help of technological advancements. The interactivity and participation of the learner integrates the user into its own educational process, while having control on its own professional formation and collaboration with the virtual gamified version educator. The two instances meet in the educational environment to tailor a new approach on educational process and interaction both within the actors and with architectural heritage. Scenario and strategy are actions of each step. The scenario builds information from data, while strategy is play within the game. The three aspects that contribute to the success of the gamification integration are: the joy of play, learner benefits and cultural outcomes:

1. The joy of play: Gamification is integrated to trigger curiosity, generate active learning, enhance knowledge and skills.
2. The learning benefits:
    - enables education by boosting motivation, enagagement, networking
    - improves memory, engagement, contributes to problem solving
    - rises cultural awareness, contributes to immersion in the learning activities and to attention
3. The cultural outcomes:
    - digital preservation and archiving of cultural heritage
    - creating a virtual environment for user-heritage interaction with minimal resources
    - cultural heritage fast promotion and proliferation

Gamification in architecture heritage education acts itself as a tool, experience enhancer and evolutionary model. Gamification acts as a phenomenon with causes, effects and interpretation of the phenomenon. Is bridging between entertainment and education, between passion and curiosity, technology and heritage. In preserving cultural heritage, we have to ask ourselves: is gamification a placebo or a medicine coming with side effects that have to be attended? On one hand, technology improves the potential of heritage. On the other hand trivialisation, comodification of heritage, distorted perception are risks of heritage gamification. One important aspect of gamification is triggering and maintaining the desire for learning. It acts as a stimuli, as an incentive to architectural heritage. What happens in the absence of the stimuli with the preoccupation for cultural heritage? Are users of gamified tools are seeking more the projection of technology, rather than understanding and taking an attitude and contributing to the development of cultural heritage?

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