MyStoriesBAG, a Tool for Scientific Learning in Physics and Astronomy Through Play

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Abstract. *MyStoriesBag* is a tool designed to facilitate and guide the creation of games or stories for those unfamiliar with technical implementation. The visual editor allows users to actively create content and then play with the stories created. We will show how the tool, initially developed for cultural heritage, has been applied to other fields of science, giving rise to a couple of games on physics and astronomy that have been successful with the public and students.

Keywords: Game Generation Editor, Serious Games, Web-Based Engine, Games for Science, Education Games.

1 Introduction

Active learning can make students feel more positive about school subjects. New technology tools on the web are changing the way we access and interact with educational content, creating new opportunities. Integrating elements such as motivation, innovation and challenge into the education system creates a more active and dynamic learning environment, shifting the teacher's role from central figure to companion and making learners an essential part of the teaching-learning process.

Significant examples include gamification and problem-based learning (PBL), which introduce playful learning methods and problem-solving strategies, involving novel approaches to knowledge application. Combining both methods is considered an innovative approach in education and can motivate and engage students (Bayley et al., 2021).

But what does playing mean? According to Suits (Suits, 2014), to play is the 'voluntary attempt to overcome unnecessary obstacles'. It is a free and voluntary process governed by rules, taking place outside ordinary life in specific spaces and times. It totally absorbs the player. The obstacles and rules encountered determine the possible actions

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and create motivation, triggering a cycle of challenge and satisfaction (Ciancia et al., 2022).

The experience gained through gaming remains memorable because it is personalised and the player plays an active role in the learning process. Furthermore, and very importantly, it allows for both revenge and replayability, which in turn encourages a feeling of success. As Campbell pointed out as early as 1949 (Campbell, 2008), an important aspect of digital storytelling and gaming is the "hero's journey", outlined in three fundamental stages and a well-defined number of detailed steps. During this journey, a hero travels from the everyday world to a region full of supernatural wonders. There, he learns about fabulous forces and begins his adventures with various adversities and decisive crises, from which he finally emerges victorious and returns home changed and improved by what he has learned.

Even in the fields of cultural heritage and archives, the incorporation of digital storytelling and game design elements into non-playful contexts can motivate users and increase their attention (Sailer et al., 2017). Introducing fundamental game elements such as scores, rewards, avatars and stories together with concepts such as competition and progress can promote human motivation and gratification (Sherry et al., 2006).

Multiple gaming experiences have now been created using archives and cultural heritage, aiming to capture and engage users while raising awareness. Examples of these new forms of storytelling and ways of presenting museums, their history and their materials can be found everywhere, from State Archives to Museums, see for example the project 'Parchium, the archive tells', (*https://www.parchium.it/it/visitare-la-valle-dei-templi/scopri-il-parco-con-archi/*) a trivia game that unlocks puzzles by guessing the answers or 'Father and Son' (*http://www.fatherandsongame.com/*), developed by Tuo-Museo in collaboration with the National Archaeological Museum of Naples, which is a storytelling game where players' choices during the experience influence the story's outcome.

Both tangible and intangible cultural heritage provide good material for the creation of games and guided tours. However, scientific subjects can also be developed in a way that engages and attracts a larger number of users. This is because games provide physical and mental stimulation through objectives, rules, challenges and interactions, which improves and speeds up learning by breaking knowledge down into short-term, achievable goals (Tirado-Olivares et al., 2026).

In this article, we present the '*MyStoriesBAG: Tell a Story, Build a Game*' prototype designed to generate games. The system has so far been used to generate games in the field of intangible cultural heritage, and we have now tested its application in the scientific field by creating the two interactive games presented here.

MyStoriesBAG is a prototype framework designed to allow experts, researchers and teachers without the necessary technical skills to use complex gaming platforms to create interactive stories and simple games. It acts as a simplified interface with the underlying engine and facilitates the dissemination of various topics and contents to users of different ages, including the elderly, tourists and students. The games created involve players in challenges and adventures, enabling them to learn about and discover cultural and scientific heritage while enjoying a fun experience (Artese et al. 2024).

The tool consists of two parts: the game editor and the player. The former helps to collect and organise the data needed to create the game, while the latter enables users to play the finished product. We will present two science-based applications that were introduced to students at the “European Researchers' Night 2025” event in Milan in September 2025: “*A World of Symmetries*”, and ”*Escape Moon*”, which are riddle games designed for children and teenagers. The former relates to the world of algebraic structures, while the latter relates to the basic principles of dynamics in the Solar System.

2 A Framework for Game Creation

The realized framework comprises two components: the platform to create and edit the games and the player package to play with them. The game editor is an online dashboard where operators and users can actively collect and organize materials and content useful for generating games that can be played client-side via the downloadable player software available on the platform.

The system implements a workflow that starts on the dashboard. Here, experts upload educational materials which are exported in the universal JSON format, which are finally processed by the Unity engine.

To our best knowledge we are not aware of any other systems that separate the game editing phase from the gameplay phase in this way, using a standard format, thereby enabling content creators to interact with the Unity engine without needing to understand its complexities.

The project is designed in the context of the “Cleverness” project, which is intended to create services dedicated to the elderly and associations that support them, promoting active ageing and more active social participation, developing cognitive technologies and educational tools for social support.

2.1 The Dashboard for Game Editing

The multi-user platform allows users to create their own games and manage them; games can be saved as private or can be shared if saved as visible to all. Once logged in, users are supported by a visual control panel that facilitates the organisation of content and offers a variety of graphic materials for defining characters and scenarios. Depending on the type of game they wish to create and the level of depth, game creators can choose among four game types:

- *Board game*: the player rolls a die to move around a map and answers riddles at each square to score points and stay there. If he gets the riddle wrong, goes back to the previous spot.
- *Exploring game*: the game involves exploring topics via the senses and completing a "find the objects" quest.
- *Riddle game*: consisting of an exploring section and a quiz section: players explore the topics suggested by the various information points to learn about the content offered. In the quiz section, they receive points for each correct answer.

- *Storytelling*: this format offers various information points to visit with the aim of telling a story, accompanied by multimedia materials for a playful approach to scientific and cultural themes.

The metadata that defines a game's structure is organised in a tree hierarchy. The root contains the game's definition and main information, while subsequent levels can be repeated as necessary. In *Riddle games*, for example, the first level introduces the game's main components, or subjects, which can be divided into multiple topics for greater depth. Each topic is accompanied by several learning points that describe it in detail, and each learning point can be linked to a series of riddles (Fig. 1).

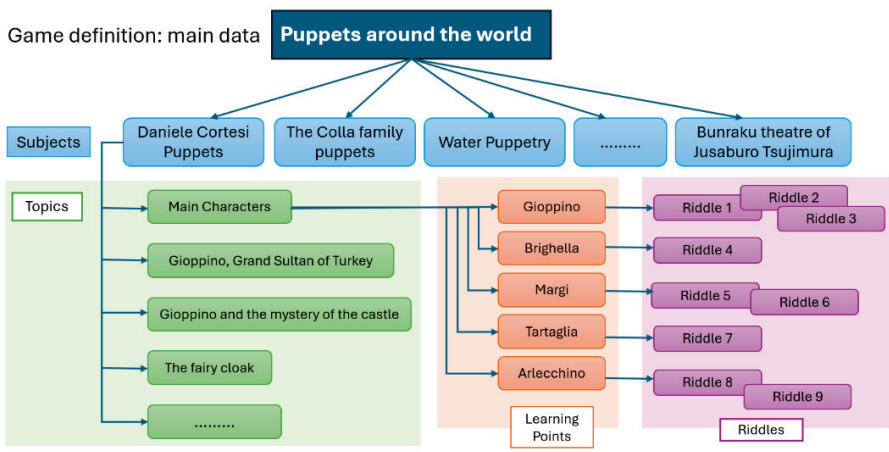

Fig. 1. The organization of data for a *Riddle Game*.

In *Exploring games*, the learning points level is replaced by the Wheel of Senses, and instead of Riddles there are Challenges. In *Board games*, there are Questions linked directly to topics that will be used to create the board cells, whereas *Storytelling* games are defined as riddle games, but without the riddles, as they are organized as simple interactive tours.

2.2 The Player Package

The player tool is a software package created using the Unity engine programming level and can be downloaded from the *MyStoriesBAG* portal website. Communication between the game editor and the player takes place via a JSON file. Once complete, the game can be exported from the editor in JSON format and saved on the web server in a game library. This action makes the game a “cassette” containing all the materials needed to run it, ready to be ingested by the Unity engine to automatically generate the game. Once the player has been downloaded and is running on a client computer, it will read the “cassette” from the game library, open it, and make the game available for the user to play immediately.

The player has been designed to implement a point-and-click game mode with 2D scrolling in which characters move around in two dimensions to visit interesting points and learn the information needed to tackle the quiz and challenge sections.

3 Gaming for Scientific Learning

Scientific literacy is important for developing a workforce capable of tackling the new challenges of the information economy, as well as for promoting scientific thinking through educational and cultural tools. In their research, Morris et al. argue that video games have the potential to be used effectively in science education, and that different classes of video games can be considered a cultural tool that supports the three key elements of scientific literacy: knowledge of scientific content, procedural skills, and an understanding of the nature of science.

Science education could be improved by incorporating features of games that influence motivation, cognition, and metacognition. Games can serve as a useful cultural tool that enables effective use to be made of existing capabilities in teaching (Morris et al., 2013).

In fact, video games aid the development of scientific thinking through three categories of mechanism:

1. motivational incentives, such as feedback, rewards, and interactive features that engage students more effectively than traditional learning tools. This is achieved through the puzzle-based game structure of *MyStories* BAG, which links each quiz question to the correct answer. If a student makes a mistake, there is no punishment—instead, the system gives the opportunity to return to that learning point to review and learn more effectively.
2. cognitive scaffolding, such as simulations, integrated reasoning skills and organization of data, which compensate for limitations in the cognitive system of the individual. From the design stage, our editor is built to incorporate this aspect into its core and is constrained by the hierarchical data architecture defined by subjects, topics and learning points.
3. metacognitive support in the form of guided learning and identity adoption. These two aspects are both ensured in *MyStoriesBAG*, as the learning experience is created directly by the experts themselves. The tool then guides them in shaping it as a hero's journey, ensuring identity engagement.

Furthermore, Cheng, She and Annetta (Cheng et al., 2017) recently proposed the concept of immersion, which describes the degree of engagement in a game. Although this is a relatively new concept, studies by Cheng et al. demonstrate that interactive computer games can effectively support students' science learning, particularly about higher-order cognitive knowledge. Even when games incorporate complex scientific concepts, appropriate design can offer users an immersive and engaging experience that can influence science learning.

3.1 "A World of Symmetries": Playing with Symmetries in Physics

The game "A World of Symmetries" has been developed by B.L. Cerchiai, A. Ippolito (a mathematics teacher) and M. Artese as an outreach activity in the framework of the "Co-Science" project "Meet Research to Connect Science and Society" for the "European Researchers' Night 2025" in Milano. It is targeted at high school students and an adult audience.

It is intended to clarify the concept of symmetries (which is the game definition of the schema presented in Fig. 1) as defined in mathematics (first subject) and show their overarching role in nature, primarily in physics (second subject), but also in biology and in the arts (subjects 3 and 4). The game is structured as a riddle game, for each subject a certain number of topics have been defined, often immersing the player in explicit examples of symmetries governing phenomena in the different areas. For example physical systems in elementary particle physics for the second subject, animals and plants for the biology subject, works of M.C. Escher and others for the art subject. Some of the physical systems presented are taken directly from B.L. Cerchiai's research material.

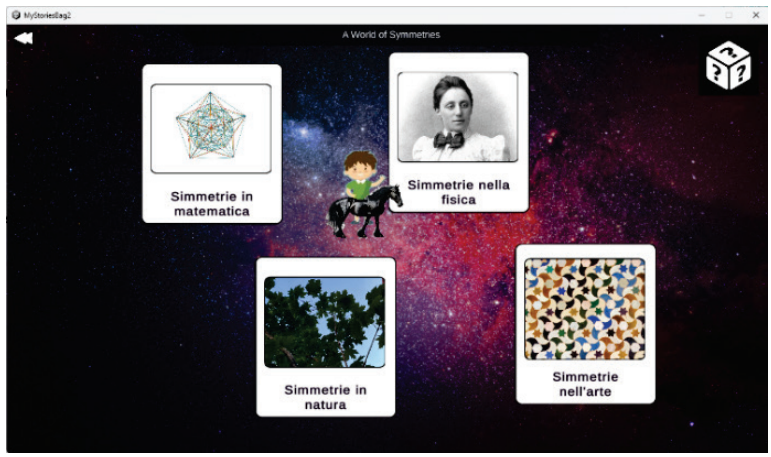

Fig. 2. The main board of the game "A world of Symmetries".

The game has been quite successful in attracting players at the "Co-Science" event and has proven to be capable of retaining their attention for a long time. Most players were young adults, but also a few middle school students have tried it. Almost all players started directly from the riddles, going back to the learning points with curiosity when the answer was wrong, thus demonstrating the potential of the motivational incentives described previously. In this way, they ended up completing the entire game to the very end, despite the time and effort required, and their commitment to immersive engagement was evident. Apart from asking questions, some people even took notes and snapped photos of the learning points they came across during the game, and inquired whether a copy was publicly available.

Fig. 3. The two workstations of the game at the Researcher's Night.

This experience has provided us with useful insights for improving performance in the game. For example, we could allow players to return directly to the same riddle after reviewing the relevant learning point following an error. We could also divide the game into difficulty levels based on the score awarded for each question.

3.2 "Escape Moon": a Game for Learning Meteor Streams

Escape Moon (Alessi, 2025; Alessi et al., 2025) was born as an outreach activity of the ESA LUMIO mission (Cipriano et al., 2018; Topputo et al., 2023). LUMIO will observe impact flashes on the farside of the Moon due to the impact of small meteoroids. Thus, the primary goal of Escape Moon is to communicate basic principles regarding the solar system, orbital mechanics and impact processes. Originally, the game targeted kids at primary school and first-grade secondary school level. It was conceived as an escape room, that is, the kids were motivated to answer well-defined questions to open a given door at the end. The questions regarded the topics just mentioned.

Thanks to *MyStoriesBag,* the material developed can be used for an audience at a higher level, second-grade secondary schools but also for a general public. Also, while the original Escape Moon is thought as an activity to be implemented in class in about 2 hours, the *MyStoriesBag* version turns out to be more flexible, both in terms of duration and places where it can be used.

The *MyStoriesBag* version is based on four subjects, namely, the solar system, how we move in the solar system, the meteor showers, the impacts (see Fig. 4, left side). In each one, it is provided the explanation of different scientific topics, together with some historical perspective and actual space missions targeted at obtained a deeper understanding, also providing cognitive scaffolding and metacognitive support.

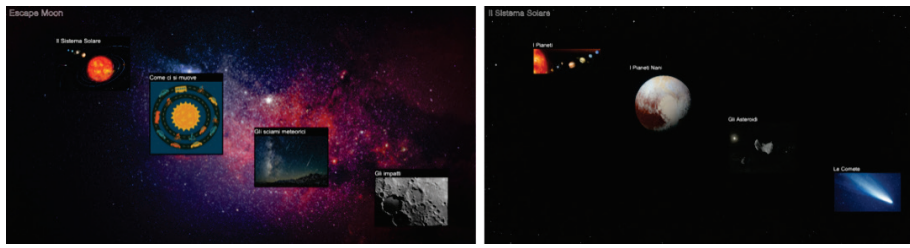

Fig. 4. The four subjects of Escape Moon and the topics of the "solar system".

To make an example, in the “solar system” section, the user can find four topics: the planets, the dwarf planets, the asteroids and the comets (see Fig. 4, right side).

By going into the dwarf planets, different learning points explain the official definition, who they are and the missions that have visited them (see Fig. 5).

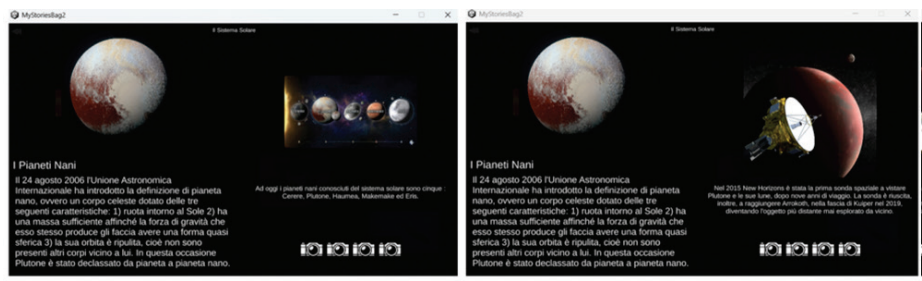

Fig. 5. Two learning points regarding the dwarf planets.

4 Preliminary Evaluation

The article presents two case studies based on the architecture described in the DIPP2024 paper (Artese et al., 2024). The games were previewed at Research Night 2025 in Milan. The first game developed, “A World of Symmetries”, was presented to test its initial impact on the various target audiences identified: secondary school students and the general public with an interest in the subject. The second game, “Escape Moon”, is still being finalised and is based on an adaptation of a board game created for primary schools by the same authors.

An initial qualitative assessment has shown that both games are highly engaging and succeeded in holding players’ attention for the entire duration of the gaming session. The point-and-click gameplay makes the learning process easier, and the possibility for players to correct their mistakes without incurring any penalties makes learning both effective and enjoyable.

Furthermore, from the perspective of the expert generating the content, the system helps to organise knowledge hierarchically without having to worry about implementation aspects, thanks to the separation between the game editor and the player.

We are planning how to assess the impact of the games on a wider audience; the analysis will use standard validation metrics and will be conducted after the games have been presented in schools.

5 Conclusions

MyStoriesBag is a tool designed to facilitate and guide the creation of games or stories, intended for those who are unfamiliar with technical implementation but are experts in specific materials and topics. The online visual editor allows users to actively create content and then play with the stories they have created. In this article, we illustrate how the tool, which was initially developed for cultural heritage, has also been effectively applied in the field of science. This has given rise to two games on physics and astronomy topics that have been popular with the public and students of different ages, with the aim of being used as cultural tools for scientific learning.

As for future developments, we are considering the possibility of updating the game's structure to include a multilingual version, adding different difficulty levels, and creating a release of the player for the web, with the aim of allowing users to play directly from their browsers, thereby overcoming the complexity and limitations of the Unity platform.

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