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LOCATION-BASED METAGAMES FOR LEARNING

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Abstract: *Research argues that digital educational games have the potential to make learning more interesting and more effective, creating unmatched learner engagement. However, creating captivating game-based learning experiences remains challenging. Designing and developing games to support learning is still a costly and time-consuming experience that require a multitude of skills. An easy-to-play game does not equate with an easy-to-create design and development process. Creating game-based experiences is more complex than designing a linear lecture or a static online learning module. Moreover, game customization remains limited, making it difficult for teachers to adapt a game to specific learner needs and subjects. To address these challenges, the authors present the game authoring pipeline of the Beaconing Platform that enables the construction of location-based metagames by non-programmers. In the context of this work, a metagame is defined as the component that provides the overarching narrative experience for players. The paper describes the construction and implementation of two such metagames for two different cities - Targoviste, Romania and Coventry, UK. The location of the device is used to enhance the user experience and to customize the content that is made available to the learners. The metagames integrate quizzes into location-based challenges to create more flexible and more engaging learning experiences that blend virtual and real worlds. In these metagames, participants have to find a real world Point of Interest (POI), defined through GPS coordinates, or a series of them, through indirect clues and complete an activity (e.g. Minigame) there to further the narrative (or unlock the next clue/POI).*

Keywords: *minigame; context-aware; authoring pipeline; BEACONING.*

I. INTRODUCTION

Most of us have experienced rather boring online courses at some point of our lives. Regardless of the supporting technology that is used, digital learning experiences might not be as engaging and interesting as expected, even if their commercial counterparts are popular and successful among diverse categories of users. Games represent such an example. According to [1] games have the capacity to create interactivity in learning delivery; to overcome disengagement; to provide opportunities for reflection; to change behaviours; and to provide context for authentic practice. Employing games in education usually comes with the promise of effortless, fun-driven learning.

However, constructing interactive play-learn experiences remain expensive and time-consuming process.

The BEACONING Project has addressed this challenge by developing a set of tools integrated into a platform that eases the game authoring process, making it accessible for teachers that would like to act as learning designers. The BEACONING Platform comprises the following main components that enable the construction of location-based metagames: an Authoring Tool for Gamified Lesson Paths (AT-GLP) that enable minigame customization; an Authoring Tool for Context-Aware Challenges (AT-CC); and minigames. Within the context of this paper, a metagame is the game component that provides the overarching narrative experience for players.

Through this approach, the BEACONING project aims to take advantage of playful pervasive learning and integrate informal ways of learning into the curricula to provide personalized learning paths. The main focus is on STEM and problem-based learning.

This paper presents two location-based metagames that have been customized for the cities of Târgoviște (Romania) and Coventry (UK). This specific kind of game is defined within the BEACONING AT-CC as a Treasure Hunt (as opposed to different location based activities still in development, such as Stratego or Capture the Flag) [2]. In these metagames, participants have to find a real world Point of Interest (POI), defined through GPS coordinates, or a series of them, through indirect clues and complete an activity (e.g. Minigame) there to further the narrative (or unlock the next clue/POI).

This concept exploits the evolution of software and hardware components that support location-based services, opening up new opportunities for creating more engaging learning experiences. Devices such as mobile phones, portable computers, and wearables, are capable of sensing, computing, running applications, reporting and connecting [3, 4], enabling the construction of user-centred learning environments. The location of the device is used to enhance the user experience and to customize the services that are made available to the end-users [4]. In addition to the information of where a user is at any given time, the location context can be linked to the user profile, including the storage of preferences and history, that are employed to anticipate user requirements and predictably offer enriched, context-aware content, functions, and experiences. Providing location-based services is still subject to challenges, such as collecting and managing large amounts of location data [5]; providing privacy [6, 7]; or improving the accuracy of location services. Also, usability of indoor location based services remains of particular interest for education [8].

II. CONSTRUCTING LOCATION-BASED METAGAMES

This section describes the tools that enable the construction of location-based metagames and details two metagames that have been customized for the cities of Târgoviște and Coventry.

2.1 The Authoring Pipeline of the Beaconing Platform

The purpose of educational authoring tools is to turn teachers into learning designers [9]. Authoring tools aim to increase productivity, and be easy to use and learn [10]. Beside usability, equally important is whether the resulting content and context are effective at supporting learning [11]. To increase effectiveness, narrative learning has been identified as a suitable approach for the development of cognitive abilities and for knowledge acquisition [12]. In the case of game-based learning, the role of authoring tools is to enable users to design, construct and run games, without requiring programming skills [13].

The Beaconing Platform has implemented an authoring pipeline that enables the creation of location-based metagames. The pipeline integrates the following key components (see [14] for details:

- *An Authoring Tool for Context-aware Challenges* that provides an easy-to-use, point-and-click graphic interface for creating context-aware challenges by placing real world POIs on a digital map. For each POI, the learning designers define the clue that players can use to identify the location, as well as the activity that occurs when the player reaches a POI (play a minigame challenge), e.g. a quiz game.
- *Minigames*, short game-based activities that are used throughout the location-based challenge.

- *An Authoring Tool for Gamified Lesson Path*, a multipurpose tool that can be used for minigame customizations.

The authoring pipeline has been used to create a metagame that has been customized with POIs from several cities across Europe. The following sub-sections describe the location-based metagames created for Târgoviște and Coventry. The two metagame are constructed using the same game plot, but display local POIs.

In the first screen of the metagame, the player receives information about the story and the game plot (Fig. 1). The story revolves around a corporation that is dedicated to the research and development of renewable energy technologies. A special investigation agency, the Earth Special Agency, discovers that there are some secret locations where the corporation is hiding toxic products, which they use to make profits illegally. The Agency needs all the support they can get to discover all the clandestine underground facilities scattered around the cities of Targoviste and Coventry. To complete the metagame, players need to walk through the cities, and answer questions related to climate change for discovering POIs.

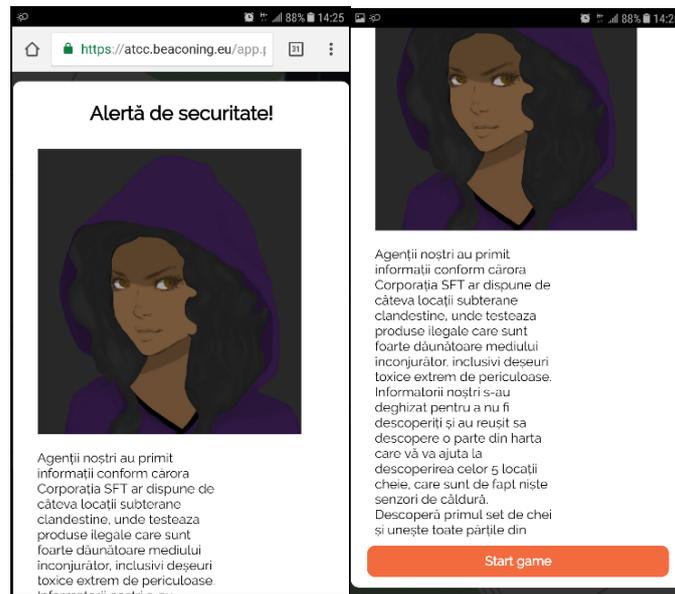


Figure 1. The plot of the metagame

2.2 Treasure Hunt Game - Târgoviște

When the player starts the game, s/he is provided information on the first challenge (Fig. 2).

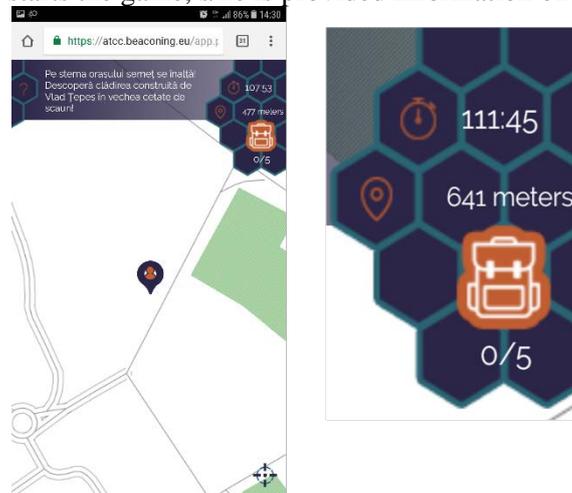


Figure 2. The clue for the first POI in Târgoviște

The player is given a clue where the s/he can find the first POI and the estimated distance until the first POI. As the player starts to walk, the game offers information about the current position of the player and the distance to the POI located on the map.

After each movement, the player has the possibility to verify if s/he is nearer or further from that point. The distance decreases as the player approaches the POI. As Târgoviște is the former capital of Romania and the city where Vlad the Impaler ruled, the POIs that have been chosen for the Târgoviște game were historical landmarks.



Figure 3. The quiz minigame

After the student discovers the first POI, the game continues the story and displays a short text where the player is asked to prove his/her identity by answering correctly to a question about climate change. By providing the correct answer, the player receives information of the POI s/he has discovered. The player is able to see on the map the location of the POI, and the points s/he has obtained by completing the first challenges. Next, the player can access the clue for the second POI s/he needs to discover. The same game mechanics are applied until the end of the metagame.

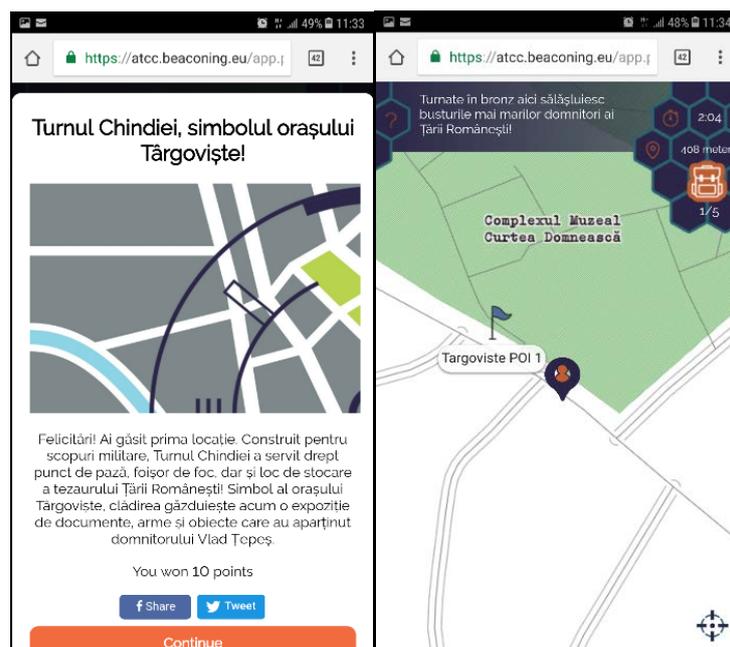


Figure 4. Information on the first POI that has been discovered

The Hidden facilities were used as a fun and interactive way to rank the winners. Upon completing the metagame, the players are asked to take a selfie to prove that s/he discovered the last POI in the metagame. The last screen of the metagame shows a congratulation message to the winner, the points collected and the time spent in order to complete the metagame. 42 players have played the Treasure Hunt metagame in Târgoviște. Prizes were given to the first 13 players that completed the quest.

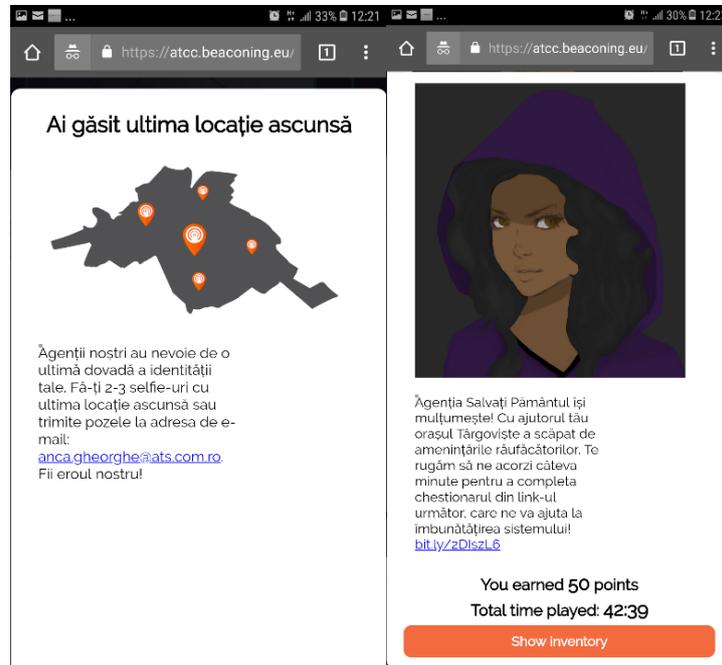


Figure 5. Final score obtained by the player

2.3 Treasure Hunt Game - Coventry

The Coventry instance of the Treasure Hunt game followed precisely the same template and steps, but was designed to be open for the public, for an 1-week long event. This was to maximize the amount of feedback and data, although reliance on the general public instead than on recruited students rendered the population harder to track, and the data gathered was more complex to contextualize and interpret. Still, at this technical testing point, it was deemed appropriate to expose the technology to as many people as possible, for both testing and dissemination reasons.

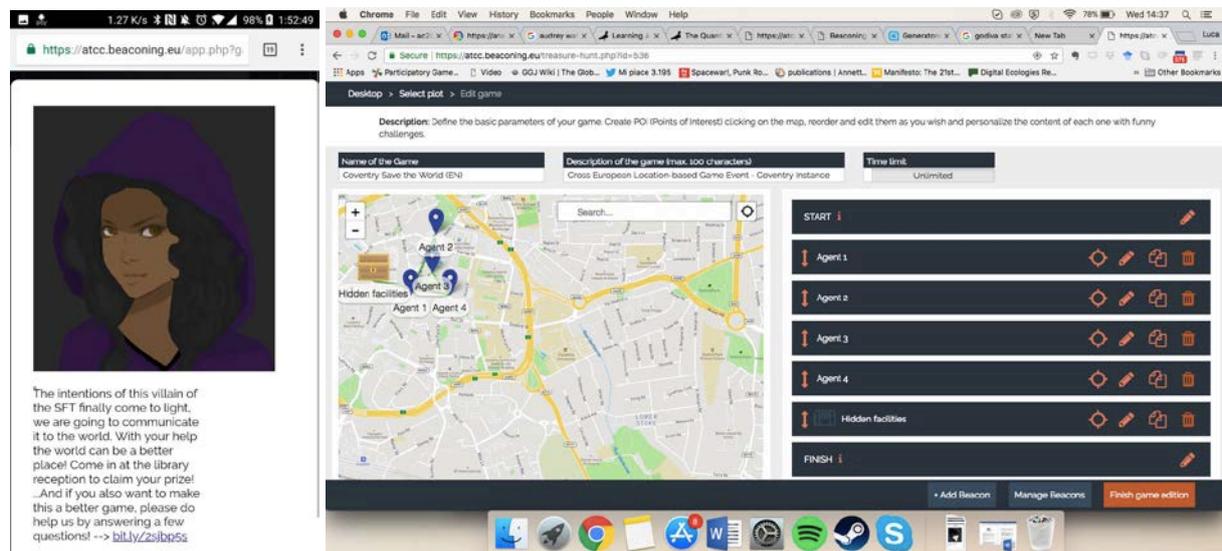


Figure 6. Authoring of the Treasure Hunting in Coventry

To maximise participation, the first POI/agent was placed in the very heart of the city, near the statue of Lady Godiva in the main town square. This way, people might be seen playing, and attract curiosity and interest.



Figure 7. Placement of the first POI

The meta game also included social media functions, with the opportunity to tweet/post on Facebook successful completion of a POI. This way, participants could contribute to digitally promoting the event beyond its initial reach.

The last POI/Secret facility was again placed with dissemination and public access criteria in mind, within the main city library. This was also the location where most of the (non-digital) dissemination of the event took place, so as to create a circular path for the participants to explore.



Figure 8. Integrated Social Media functions



Figure 9. Coventry's last POI location

At the library, the first 25 participants to complete the Treasure Hunt received prizes in the form of BEACONING branded USB chargers. 45 people played the game throughout the week, with 25 of them completing the game and receiving the prize. In the integrated feedback form, all of the

respondents considered the game narrative interesting or compelling, and a large majority of them confirms that they would consider the integration of location based games in formal learning environments to be very valuable.

III. CONCLUSIONS

Authoring tools for education have been constructed to enable teachers to create more engaging learning experiences without support from programmers. As technologies embedded into educational contexts have become more complex, efforts have been made to provide enhanced authoring capabilities. An authoring tool for creating location-based metagames has been developed in the BEACONING Project. The AT-CC has been developed by GEOMOTION and it enables the integration of minigames as context-aware challenges. Minigames developed by IMAGINARY have been used to create the two metagames, for Târgoviște and Coventry, presented in the paper. The metagame has been customized and tested in several other cities around the world: Ankara, Barcelona, Bremen, Haywards Heath, Lyon, Madrid, Marseille, Milan, Montreuil, Paris, Porto, Strasbourg, Singapore, Toulouse, and Vila Real.

Feedback has been collected online and it will be presented in detail in future papers. The team that has organized the metagame playing session in Târgoviște had the opportunity to meet most of the players at the last POI. The overall feedback from those players was positive. They said they have enjoyed the authenticity of a learning experience that blended virtual and real worlds. They stated that the storyline was easy to follow, but the context-aware challenges were much easier than they had expected. They suggested that the quizzes should be more difficult to solve, in order to make the metagame more engaging and to motivate them to do more research. Players also suggested that the metagame would be more entertaining if it had been designed to be more competitive. When asked if it would be interesting to use such metagames during classes, players stated that they will strongly recommend, but they are not sure how demanding it will be for teachers to use it.

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