Using Gamification Mechanisms and Digital Games in Structured and Unstructured Learning Contexts

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Abstract. The transition from the pre-defined and often inflexible tools and practices of institutionalized mass-education towards dynamic and flexible learning contexts remains a challenge. Enabling rich and engaging learning experiences that consider the different progression rates and routes of each student require new approaches in education. This paper analyzes opportunities for employing gamification and digital games to construct navigable dynamic learning channels and enable pathways towards turning users into adaptive learners able to reach learning goals both in structured and unstructured contexts.

Keywords: Lesson plan · Location-aware · Game customization · Tingo

1 Introduction

In recent years, games have found a new application, as the era of gamification has been launched. Gamification represents the application of game-thinking, game dynamics, and game mechanics in non-game contexts, with the purpose of engaging users, increasing participation, facilitating learning, and solving problems [1]. Gamification has emerged as a strategy across various disciplines such as education, environment, government, health, marketing, web, mobile applications, social networks, etc. Applying gamification in each of these contexts require a deep understanding of the relationship between the needs of the gamification project and the appropriate choice of game elements to apply [2]. Research on gamification has bloomed, and design practices, such as the 6G framework [3] brought the promise of successful gamification. At the core of gamification lies the following game element hierarchy [3, 4]:

– *Components*: the specific examples of the higher-level features, such as points, virtual goods, quests, etc.

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- *Mechanics*: the elements that drive player involvement and include elements like chance, turns or rewards.
- *Dynamics*: elements that provide motivation through features like narrative or social interaction.

Even if gamification brings the promise of engagement, there are also challenges to be considered when applying gamification mechanisms, especially in educational settings. Most elements used in gamification rely on competition and rewards. In games where competition lies as the core of the experience, we can identify two main categories: (a) head-to-head competition, where players compete directly against one another; (b) Asynchronous competition, where a player competes against other players by comparing the outcomes of their play [4]. These approaches cannot be applied as a universal solution. It is necessary to consider that each student has different needs and not all are motivated by competition [5]. Therefore, other mechanics need to be identified to lead motivation and engagement. Cooperative play experiences and chance-based play provide an alternative. In cooperative play, players can work simultaneously to achieve a common goal or take turns, in order to find success, while in chance-based games use randomness and chance to enhance the variety of decisions need to make. Such implementations reflect the basic human activity matrix that ranges from solo (hobby, audience, analysis) to competitive (job, sport, criticism) and collaborative activities (community, performance, teaching) [6]. Just like in non-digital or less technologized collaborative learning environments, where students work together on a collaborative assignment and at the same time they deepen their knowledge and their understanding [7], games have also the potential to increase participation in learning activities by enlarging availability of opportunities to collaborate; enhancing the accessibility of those opportunities, as well as the affordability [8].

Digital Educational Games build upon major learning theories [9]. In line with the behaviorism theory, games deliver stimuli to learners, gather their responses and provide feedback [10]. Following the constructivist approach, games involve learners in active processes, enabling them to construct new ideas or concepts based on their existing knowledge and experiences [11]. Social constructivism is applied in games by providing diverse cultural, language, and environmental contexts in which learning can take place. Connectivism is strongly represented in virtual environments [12], where the ability to make decisions [13], as well as nurturing and maintaining connections is explored to facilitate game achievements through continual learning.

While employing gamification to stimulate learning is the latest trend [14], the use of games in education has gained momentum in the last decade. However, designing games with a good game-play and immerse game players in a realistic setting while also encouraging re-playability is considered a true craft. Employing games in education require the consideration of the variables that influence learning and a learning theories need to be incorporated into the game design practices [15]. However, promising games are for the educational setting, a significant issue that needs to be addressed is the limited opportunities to tailor games for specific learning activities. Game customization remains a job for developers, even if efforts are being made to implement deeper levels of customization foe end-users [16–18].

Learning experiences span from effortless to difficult, where the gratification of accomplishment is delayed [19]. The challenge is not to motivate; it is to support them finding a path to success. Coupled with technology advancement, at strategy level, the priorities for Education and Training 2016–2020 focuses on more open and innovative learning and teaching; sustainable and efficient investments in educational systems; relevant and high quality skills and competencies; inclusive education, equality, and non-discrimination; as well as strong support for educators.

The European Qualification Framework [20] also recognizes the need to support validation of non-formal and informal learning towards core skills such as literacy, numeracy, science, foreign languages; and horizontal skills such as learning to learn, social and civic responsibility, creativity, to support learners in finding personal fulfilment, and later in life find employment and engage in society. All require new approaches in pedagogical practices and experimentation in smart, scalable, inclusive learning environments.

Key to addressing these challenges is the flexibility and elasticity of the learning space, of its contents and assessment methods that enable the learning space be reshaped based on learners' needs, performance, abilities, as well as on the learning objectives that have to be met. Digitally supported pedagogy today still relies on pre-defined (rigid) learning contents and assessment methods, and learning systems that are too assistive, leading to a distorted learning outcome. They do not adopt student-centred learning and do not present the required level of flexibility to accommodate both structured and unstructured learning.

In the context of this paper, structured learning contexts are constructs that are modeled by teachers in order to implement a certain learning plan. Unstructured learning contexts are constructed by students based on given assignments. Constructing consistent, yet dynamic learning spaces is an increasingly important issue in the context of the advancement and expansion of technologies for learning and skill development.

This paper reports work in progress on designing gamified lesson plans that are applied in structured and unstructured learning contexts. This approach creates new levels of flexibility in reaching learning objectives by employing emerging gamification mechanisms and digital educational games.

2 Constructing Structured and Unstructured Learning Contexts

The shift towards more flexible learning implies the adoption of new methodologies and practices. The emergence of gamification and gaming technologies offer opportunities to construct new approaches to learning, giving learners more freedom, strengthening collaboration skills, and stimulating their creative mind.

This section presents the transition from a traditional classroom-based approach to a gamified approach that employs technology to build specific language competencies. In the context of this paper, structured learning is learning that is continuously regulated by the teacher; while an unstructured learning context occurs when the teacher initiates the learning, but does not impose the steps to achieve the learning objectives and meet the assessment metrics.

2.1 Classroom-Based Lesson Plan

A significant part of the teaching activity relies on traditional methods, while the technology-oriented generations expect more engaging learning methods. Even if significant efforts are being made, the tradition from teacher-centers to student-centered education remains challenging. To address it, this paper follows the transition from conventional teaching methods to new approaches that integrate gamification and games as consistent stimuli for motivation and engagement.

Table 1 presents a lesson plan created for advanced English students in the 10th grade. The lesson plan details the curriculum objectives, the language skills that will be developed, the general and the specific objectives of the lesson plan, as well as the specific set of activities that will be carried out during the class.

2.2 Gamified Learning

Starting from the lesson plan presented above, to ease the transition to emerging teaching methods, a gamified approach has been constructed. Tables 2 and 3 present a set of activities that can be implemented to enhance student engagement and motivation to learn.

Table 1. Classroom-based English lesson plan

Lesson topic: Târgoviște City – past, present and future	
Subject: English	Grade: 10th
Level: Advanced	Time: 50 minutes (1 course)
Location: Classroom	ICT: PowerPoint presentation, video clips
Objectives set in the national language curriculum for the 10th grade, advanced level	**Language skills targeted by the lesson plan**
Objective 1. Comprehend oral and written messages in diverse contexts	Listening: receptive skill Reading: receptive skill
Objective 2: Speaking or writing on diverse topics	Speaking: productive skill Writing: productive skill
Objective 3: Oral or written collaboration	Speaking: productive skill Writing: productive skill
General objectives of the lesson: - To improve the student's vocabulary with words related to history, city architecture and civic responsibility - To develop communication and collaboration skills - To assess comprehension of oral and written messages - To enable students to use previous knowledge - To enhance civic engagement	
Specific objectives to be achieved by the end of the lesson: - Students will be able to use vocabulary related to history and city architecture	

(*Continued*)

Table 1. (*Continued*)

- Students will be able to recognize positive, negative, and neutral comments - Students will be able to describe historical events and historical figures - Students will be able to comprehend the oral and written messages given by the teacher concerning the history and architecture of Târgoviș te City - Students will be able to present ways in which they can participate in the life of the local community and can get involved in shaping the community's future.
Teaching techniques - Conversation - Questions and answers - Questionnaire - Discussion
Organization of the class **Activity 1 – Speaking** The teacher asks the students to comment on the role of the Târgoviște City as the former capital of Romania **Activity 2 – Reading** The students work individually. The students are asked to go scan a text that present the architectural styles of the buildings in the city and find out what is the topic of each new paragraph. After reading the text, the students do the exercise at the bottom of the text. **Activity 3 – Speaking, Listening** The students form pairs. They talk about different categories of buildings from Târgoviș te. They are asked to match names with building images. After discussing in pairs, the students present their feedback to the rest of the class. **Activity 4 – Listening, Speaking** Before listening to a text on civic responsibility, the students make predictions about what they are going to hear. The teacher reads the text on civic responsibility. Afterwards, the students discuss if/ how their perspective on civic responsibility has changed. **Activity 5 – Writing** The teacher asks the students to write a short composition on the buildings of Târgoviș te, historical figures and civic actions that can be taken to preserve the historical heritage of the city and support its future development.

An example of smartphone app that provides information about points of interest around the current location of a user is Field Trip. The application is a good indication of what can be achieved in terms of user experience for the students (https://play.google.com/store/apps/details?id=com.nianticproject.scout). However, it is not tailored for a formal learning environment and does not provide any kind of APIs or reporting that could be used by teachers to select the list of relevant topics that should be provided or to understand how students have engaged with the information and how long they have been following a particular topic.

Table 2. Structured indoor learning

Organization of the class **Activity: "Fill-in exercise" – Writing, Reading, Listening** Students will work in groups of four. Each group will choose a name for their team. Each team selects a letter. Each letter is associated with a different set of fill-in exercises. The set of exercises is divided into several levels of difficulty: **Level 1. Vocabulary practice. (10 points/ 1 badge)** The students will fill in the blanks with words they learnt in previous lessons. 1 point is given for each correct answer. 1 badge is given if the set of exercise is completed without errors. **Level 2. Vocabulary practice. (20 points/ 2 badges)** The students will match a given set of new words with the blank spaces. 2 points are given for each correct answer. 2 badges are given if the set of exercise is completed without errors. **Level 3. Vocabulary practice. (30 points/ / 3 badges)** The students will listen to an audio message/ watch a clip presenting the historical buildings in Târgoviște City and fill-in the blanks. 3 points are given for each correct answer, as the level of complexity increases. 3 badges are given if the set of exercise is completed without errors. *If the general and specific objectives of the lesson plan are extended to include grammar practice, the following levels can be added:* **Level 4. Grammar practice. (20 points/ 2 badges)** The students will fill-in the blanks with adjectives from a given list using the right degree of comparison. **Level 5. Grammar practice. (30 points/ 2 badges)** The students will fill-in the blanks with the right tense of the verb in brackets. *To make the activity more interesting, hints can be places in the classroom or within the school. The team that gathers the largest number of hints will get extra points. Time limits can be added to certain activities, in order to be able to comply with the estimated time of the lesson.* The team that collects the largest number of points or the largest number of badges wins the game. Special credit is given to the teams that have obtained best results per level.

2.3 Blending Technology into Unstructured Learning Contexts

One of the key challenges in providing students with unstructured learning is to set up an environment where users can have access to on-demand knowledge that is relevant to their current context and desired learning outcomes.

Existing technologies offer opportunities to create rich learning experiences at user level, building upon wide databases and supporting large-scale reuse. The tools proposed therein are:

Table 3. Unstructured outdoor learning

Activity: "Puzzle" – Writing, Reading, Listening, Speaking
Students can play and collaborate to put together a map of Târgoviște City. Students will work in groups of six. Each group will choose a name for their team. Each team selects a different type of map: historical buildings, churches, modern buildings, favorite shops, memorial houses, parks, local markets, etc. All the documentation process is carried out outside the classroom. The role of the teacher is to set the goals of the game, without setting up rules or restrictions on how the research should be carried out or how the project should be elaborated. Each team has to document their project with information and pictures of the buildings they have identified. A team obtains or loses points based on the following criteria: - Number of buildings included in the project. (10 points per building) - Quality of information. (1-5 points per building) - The originality of the work. *E.g. if pictures are taken by the team members and not from the Internet.* (30 points) - Spelling mistakes. (-2 points per mistake) - Grammar errors. (-5 points per mistake) Evaluation is carried out by the competing teams and not by the teacher.

a. **DBpedia**, a project that provides semantically classified information that can be queried using a vast number of descriptors, including geo location. Because the resources contained in the datasets are classified semantically, it provides a straightforward way to retrieve these resources based on specific topic of interest and also to locate related content using knowledge graphs.
b. **Wikipedia,** the premier online open encyclopedia offers basic API functions that can search for articles that are in a specific radius from a particular geo location (https://www.mediawiki.org/wiki/Extension:GeoData#API). The limitation of this service is that it cannot be used to filter the results based on particular topics of interest. In some context this could be beneficial because students are exposed to the entire set of information that is available, but it can also be a factor that distracts their attention from the desired learning outcome.
c. **Wikimapia**, a service that aims to describe and categorize physical locations.

2.4 Game-Enhanced Learning with Tingo

Tingo is a Digital Educational Game developed by Advanced Technology Systems, Romania (http://desig.ats.com.ro/). The game was created to support foreign language learning, while coupling specific curricular competences and game activities.

A significant issue that occurs when teachers aim to employ digital games as support tools for learning is to adapt the game to the specific learning objectives within a lesson plan. To address this issue, the Tingo game has been designed to enable a basic

level of customization, allowing teachers to create simple learning contexts. The applied scenario builds upon location-aware technology.

Starting from a simple map, several game objects can be added to create a fantasy map of the city (Fig. 1). Information dragged from the tools presented in the above section and GPS coordinates can be added for each of the buildings included in the map.

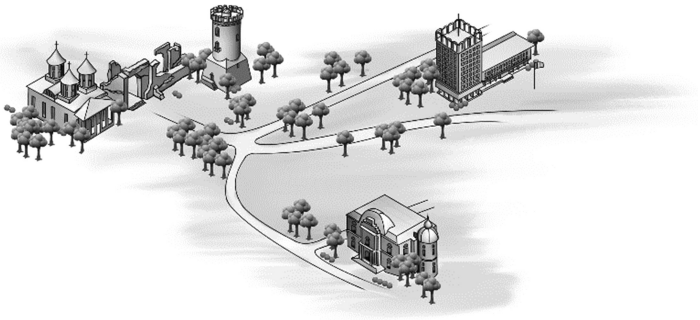

Fig. 1. Map of Târgoviște City in the Tingo game

When the player explores the virtual world, the background images changes color for the areas the players has visited (Fig. 2).

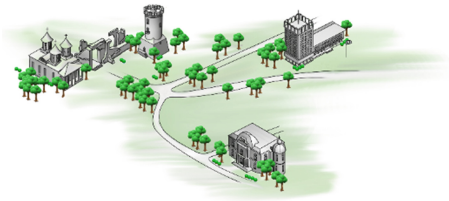

Fig. 2. Student activity within the game

When the player physically reaches a building, the game uses GPS coordinates from the device to determine the building and change its color on the map. If available, additional localization devices such as Bluetooth beacons or Wi-Fi base stations can also be used (Fig. 3).

Fig. 3. Student activity in physical locations

Table 4. Curriculum-based specific competences

Curriculum Objective 1. Comprehending oral and written messages in diverse contexts		
Reference	Specific competences	Support materials
1.1	Anticipate the information in a text based on its title or a visual stimulus	Provide texts of various lengths and diverse difficulty Provide audio/ video clips Present dialogues Provide mass-media articles Provide authentic texts extracted from books
1.2	Identify the message in a given text	
1.3	Identify key information in original texts	
1.4	Identify details from oral/ written messages	
1.5	Select information from several texts in order to fulfil a task	
1.6	Identify the logical structure from a given text	

In Tingo, individual players can set up their own bookcase. To collect books, players need to complete additional quests. Players can combine individual bookcases to form a public library.

Table 5. Unstructured outdoor learning

Reference	Game activities
1.1	The game displays several buildings and the player has to guess their category. The player is requested to match different activities with building categories.
1.2	The game displays a text message and the player has to act upon the information the game has provided.
1.3	The game displays a text message and the player has to identify words from a certain category: e.g. nouns, verbs; or categories of buildings.
1.4	The player listens to an audio message and is required to perform certain tasks, such as click on the building that has been described in the audio message.
1.5	The game displays text messages that provide information on historical buildings in Târgoviș te and the player is requested to classify them based on their architectural profile, the year they were built, etc.
1.6	The player is requested to identify the chronological order of the historical facts that are presented in several written or audio messages.

To increase motivation, the game enable players to set up an individual vocabulary. As they progress in the game and learn new words, their individual vocabulary becomes larger and larger. The game displays a scoreboard with the following categories of players: (a) players that have the largest collection of words; (b) players that have the largest number of unique words that do not appear in other players' vocabulary; and (c) players that have the largest number of similar words.

Starting from specific competences that are targeted (Table 4), the activities presented in Table 5 have been created using the wizard feature of the game.

These scenarios can be extended to support, for example, problem based learning. By coupling learning foreign languages with other disciplines such as math, the lesson plan on the architecture of the Târgoviște City can include specific tasks that address math topics.

3 Discussion and Next Steps

Students will invariably experience different progression rates and routes, which often lead to different learning outcomes than those expected. This can be a consequence of several factors including the pre-defined and often inflexible tools and practices of institutionalized mass-education, but above all else emerge two key considerations: on one hand, learning is a choice, an act of personal agency and even if the best blend of technologies is available, without sustained motivation, learners will not truly engage in deep learning processes; on the other hand, when technologies are not available or are not easy to integrate into learning spaces, the experience might prove too frustrating even for motivated learners.

To address these challenges, it is necessary not only to turn ICTs into navigable dynamic learning channels, but also to enable pathways towards turning users into adaptive learners able to reach learning goals without a high dependency on certain technologies. Technology is a guide for learners and a mean to reach learning goals. Therefore, technology dependency should be avoided. The aim is to foster self-regulated learning by assisting learners in how to comprehend and realize when they do not know something and to stimulate discovery such that learners seek out the necessary knowledge or information. The immediate benefit of such a learning environment is that it affords ambient leaning including adaptive and personalized teaching and assessment.

This approach contrasts to recent developments and solutions where the software is too assistive letting the learner know what is 'needed' in every step of the learning journey rather than letting the individual conduct reflective and summative learning. Removing agency from the equation of learning (and teaching) has implications from the pedagogical perspective. It limits the quality of the learning experiences by creating automatons and the consequential reliance of learners becoming highly dependent on software.

Instead, the approach proposed in this paper follows a completely different paradigm, where learners are given the freedom of choice based on a plug&learn approach (e.g. smartphone apps; digital games). It considers the fact that the outcomes of learning experiences that occur outside of formal, structured settings are not assessed

and valuable information about the learner is lost. Moreover, the solution proposed herein builds upon the fact that many students own mobile devices. This offers a significant opportunity for bring-your-own-X (device, cloud, applications, etc.) enabling individuals to find one tool that performs every function they need, removing the hassle of working with problematic tools that do not address all their needs.

The paper presents lesson plan scenarios that employ gaming technology to construct engaging learning experiences. Future work involves the testing of the prototype and of the scenarios with students from different high schools, with the purpose of extending the learning scenarios for problem-based learning and enhancing the functionalities provided by the Tingo game.

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