

Mitigating the challenges of mobile games-based learning through gamified lesson paths

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ABSTRACT

The application of gamification in both educational and vocational training contexts is commonly associated with learner engagement, improved learning outcomes, and increased performance. While the benefits of gamification are evident in these contexts, the creation of gamified learning spaces, especially those that employ mobile technologies, remains challenging. This paper explores the key challenges discussed in the literature in relation to mobile games-based learning, and presents the Authoring Tool for Gamified Lesson Paths (AT-GLP) which incorporates a set of features teachers can utilise to create gamified lesson paths playable on both desktop and mobile devices. A lesson path can be constructed around a customisable storyline and it can integrate minigames engaging students with the learning content while enabling teachers to evaluate student learning. The authoring tool is the core component of the BEACONING platform which was initially developed to support Science, Technology, Engineering, and Mathematics (STEM) subjects. The system has been implemented across ten countries and has been piloted with over 5000 students. In this paper the authors discuss how the system can be applied in other disciplines, such as language learning, and how it can help mitigate some of the challenges associated with mobile games-based learning. Lessons learnt and suggestions for improvement are also discussed.

Author Keywords

Gamification, Mobile learning, Learner engagement, Inclusivity, Adaptive learning

INTRODUCTION

The integration of game design elements in non-game contexts (Walz and Deterding, 2014), including educational settings, is not a new trend. The idea of using gaming principles and concepts in non-gaming circumstances with the aim to increase engagement was initiated in the 1980s, while educational gamification platforms started flourishing around the turn of the century (Giannakouloupoulos et al., 2020). In recent years, advances in mobile digital technology have accelerated the application of gamification in all educational levels, as well as in workplace training settings (Ștefan et al., 2019). Nevertheless, contemporary research findings appear to be mixed (Adams, 2019; Giannakouloupoulos et al., 2020). On one hand, various authors proclaim the potential that gamification holds for engaging learners and improving learning outcomes suggesting that gamification can enable higher thinking skills associated with creating, assessing, and applying new knowledge. On the other hand, studies on the effect of educational gamification on student engagement and learning have reported inconclusive results. Despite the advent of high-performing mobile devices and mobile educational apps founded on gamification principles, the connection between gamification and actual learning still seems to be vague (Giannakouloupoulos et al., 2020). Furthermore, in the literature, there is insufficient systematic analysis and understanding of what makes up effective approaches to gamification (Böckle et al., 2017; Raleiras et al., 2020). Ștefan et al. (2019) argue that “even if the concept of gamification is widely popular, it remains a very specific challenge to engage individuals in a smart way and be innovative in the process” (p.11). Hence, while the benefits of gamification for learner engagement are evident, there are various challenges that remain underexplored. Mobile games-based learning brings additional barriers for both teachers and students, especially when physical presence is not possible. This was evident in the recent, unprecedented situation caused by Covid-19 pandemic, and the lockdown imposed in many countries around the world.

In this paper we outline some key challenges in relation to the application of games-based learning in mobile educational settings and we present an authoring system that has been developed in an attempt to address these challenges. The BEACONING authoring system enables teachers to create Gamified Lesson Paths (GLPs) that are playable in both mobile and desktop contexts. GLPs aim to offer embedded learning activities adapted to the needs of the students, while providing deep engagement through narrative game plots and minigames, as well as supporting exploration and learning outside the classroom. The authoring system has been piloted with more than 5000 students in ten countries (Ștefan, 2018; Türker, 2017). The paper first outlines the main components of educational gamification and proceeds with a discussion of key challenges associated with mobile games-based learning, which were synthesised from the studied literature. Finally, the authors describe the BEACONING system, and elaborate on how this system attempts to address the identified challenges.

COMPONENTS OF EDUCATIONAL GAMIFICATION

Games-based learning approaches can promote learner engagement and supplement traditional instruction through hands-on practice and immersive experiences. Gamification can be broadly defined as the integration of game design elements in non-game contexts (Walz and Deterding, 2014). Gamification has been used as a supplementary, informal method in teaching adults as well as young children. Within training and work environments, gamification has been described as the application of game thinking and game mechanics to support long-term user engagement, behavioural change, and problem solving (Ștefan et al., 2019). Several components need to be considered and incorporated into a gamified learning

environment. These include elements such as goals, feedback, reward, progress, points, badges, leaderboards, levels, and challenges, as well as concepts such as rules, conflict, competition and cooperation, time, reward structures, storytelling, curve of interest and aesthetics, amongst others (Adams, 2019; Walz and Deterding, 2014). These components are also discussed in relation to game elements, game mechanics, and game thinking. Numerous attempts have been made to classify and categorise these game elements proposing different taxonomies (e.g. Deterding et al., 2011; Nah et al., 2013; Werbach and Hunter, 2012; Zicherman and Cunningham, 2011). Ramirez and Squire (2014) also describe four overarching and overlapping design features used in gamification: point systems, achievements, quests and challenges, and narrative structures. The multifaceted attempts to identify, categorise, and analyse the various components embedded in educational gamification signify the complexity in understanding the various dimensions of gamification and its impact on engagement and learning. These mechanics were considered thoroughly when designing and developing the Authoring Tool for Gamified Lesson Paths (AT-GLP) presented in this paper and have been incorporated at the GLP and minigame levels (Türker et al., 2019).

KEY CHALLENGES IN MOBILE GAMES-BASED LEARNING

Challenge #1: Going Mobile (Lack of Physical Presence)

Mobile games-based learning can be applied both inside and outside the classroom, with or without the teacher's physical presence. Rigby (2014) suggests that a key catalyst which has led to the explosion of the popularity of gamification over the past few years, is "the ongoing evolution of technology that has created new "rules of engagement" shifting power away from corporations and organizations and putting it into the hands of each individual consumer" (p.113). While Rigby discusses the motivational dynamics of gamification in a broader organisational context, his ideas evidently apply in educational settings. Within higher education, advancements in mobile and other computing technologies have resulted in empowering learners and shifting pedagogical design towards student-oriented and self-directed approaches. Students no longer need to rely entirely on their instructors' knowledge transfer or pedagogical approach in order to acquire new knowledge and skills; they can look up the latest published research online, access e-books, watch instructive videos, create content in blogs, participate in newsgroups, contribute in forums, and many more, all through their personal mobile devices. These possibilities empower learners to engage in a more knowledgeable and direct way, as 'partners' in the learning process. Despite evidence that mobile learning can help students take ownership of their learning, and the fact that mobile learning contexts have the potential to deepen the knowledge acquisition process, Gierdowski (2019) suggests that the great majority of students still prefer face-to-face instruction. This phenomenon gives rise to a key challenge: while learning approaches and strategies (such as when and where to learn, what to learn, how to study, and with whom) shift towards a mobile ecosystem, there is a growing need to motivate behaviour at the level of the individual learner. This, however, is not a straightforward endeavour when the teacher is not physically present. The fact that most students feel face-to-face instruction is more effective and efficient than online, remote education (Gierdowski, 2019) means that motivating and engaging students at a distance requires additional time and effort for providing timely feedback and developing appropriate instructional, assessment, and reward strategies. Hence, the balance between physical presence and remote interaction is a key aspect to be considered as we emerge towards the next generation of mobile games-based learning contexts.

Challenge #2: Sustaining – Not Merely Attaining – Learner Engagement

According to Rigby (2014), "any institution, organization, or company that wants to hold the engagement of the individual must figure out how to reach that specific individual more deeply" (p.114). Therefore, educators need to be motivated to understand what motivates learners in order to keep them deeply engaged (i.e. to sustain their engagement). Gamification is pursued as a means to achieve deep engagement which, in turn, leads to improved learning outcomes. Engagement is a complex, multidimensional construct defined by what a learner does (e.g. interacting with a computer game, watching a video, blogging, etc.), feels (e.g. enjoying the learning process, feeling fascinated, bored, or uninterested, etc.), and thinks (e.g. reflecting on experiences, connecting and synthesising information, etc.) (Piki, 2017). Engagement is also commonly associated with attributes such as attention and interest (Rigby, 2014). The real value of gamification lies in its ability to sustain engagement rather than merely grab the learners' attention momentarily. Several personal, pedagogical, social, group-level, and technological factors may affect learner engagement particularly in mobile computer-supported collaborative learning environments (Piki, 2017). Therefore, in addition to creating captivating game plots and attention-grabbing graphics, having clear objectives and ensuring 'purposeful interaction' and constructive alignment between learning tasks and assessment strategies are central issues to consider when creating engaging technology-enhanced learning contexts (Piki, 2012; Piki, 2017). Even though engagement is widely cited as a primary outcome of gamification, very few studies have examined the influence of gamification on the varied dimensions of engagement (Adams, 2019).

Challenge #3: Inclusivity, Adaptability, and Personalisation

Research on the effects of gamification on student engagement and learning confirms that the gamified approach employed should be tailored to fit individual user needs (Hallifax et al., 2019; Raleiras et al., 2020), rather than applying the standard "one size fits all" approach (Böckle et al., 2017). Within educational literature, research on adaptation focuses on developing ways by which learners and instructors alike can easily adjust educational content to meet particular learning needs and accommodate specific learning contexts. The application of adaptive gamification in education attempts to leverage both foci to provide enhanced learning experiences (Hallifax et al., 2019). Promoting inclusivity, adaptation, and personalisation entails taking into account personal characteristics, needs, requirements, and preferences (Böckle et al., 2017, Hallifax, et al., 2019), as well as diverse learning styles, approaches to studying, and engagement profiles (Piki, 2012). These aspects suggest that effective gamified lessons require a high level of flexibility and adaptability, focusing on

the individual user, which will ultimately maximise the effects of gamification on learning and engagement (Raleiras et al., 2020). While educational gamification principles can enhance learner engagement, gamification must be carefully tailored and seamlessly integrated with the learning environment in order to bring the required learning outcomes (Adams, 2019).

Challenge #4: Blending Entertainment and Educational Elements

Another key challenge is to make games educational as well as enjoyable and fun. But what does ‘fun’ mean? What counts as entertainment? And how can these features be applied in an educational context? Enjoyment and fun in game contexts is commonly attributable to core psychological needs such as competence, autonomy, and self-determination (Rigby, 2014). Ştefan et al. (2016) investigate the game elements and game mechanics of entertainment games (which provide valuable insights on how to construct successful game goals) and explore alternative ways in which these can be applied to engage learners with digital educational games. In essence, in gamified learning approaches the aim is not merely to encourage learners to play a game; rather the aim is to learn through playing (including new skills development, accumulating new information, or enhancing current knowledge and competences by applying them in new, unique contexts, amongst other learning scenarios). The notion of ‘purposeful interaction’ (Piki, 2012) applies here highlighting the fact that to engage with an activity as part of their learning, students need to see a clear ‘purpose’, that is to understand the ‘why’ behind the required actions (what Rigby (2014) refers to as the ‘energy to take action’). This has two practical implications: first, instructors need to understand why a learner might or might not be motivated to learn, and second, they need to make it clear to students how a particular game or educational activity will help them learn (and what they will ‘gain’). Hence, the issue of formulating rewards and assessment strategies which are aligned with the intended learning emerges as another challenge, as discussed below.

Challenge #5: Rewards, Feedback, and Assessment

Adams (2019) argues that educational gamification can support and enhance behaviours that are conducive to learning, yet to achieve the desirable learning outcomes requires relevant and meaningful learning activities in combination with carefully considered reward and feedback mechanisms. Feedback is an invaluable part of the learning process. Gamification can successfully afford timely feedback through self-paced activities, visual cues, question-and-answer activities, the provision of a progress bar, or written comments to provide guidance and, in turn, improve performance (Dichev et al., 2014). Overall, giving feedback and rewarding high performance are considered conducive to learning (Nah et al., 2013). Ramirez and Squire (2014) assert that just-in-time feedback is one of the key hallmarks of good game design. They also argue for a participatory approach in which all constituents can participate in defining badges, achievements, or structures, in order to maximise the effects of gamification. However, designing such a system is not straightforward. Gaytan and McEwen (2007) argue that in addition to striving to provide students with a variety of instructional and assessment strategies to meet their varied learning styles, teachers are challenged to offer meaningful and timely feedback as an important element of their courses. This is a challenge still facing instructors today despite the advancements and increased availability of mobile digital technologies and communication tools.

Challenge #6: Technological Constraints

Mobile technology is a dynamic enabler of omnipresent interaction, collaboration, and learning. Nevertheless, constructing a gamified lesson plan to support distance, mobile learning, without the physical presence of the instructor, can be complicated. In addition to accommodating diverse learning styles, varied learner engagement profiles, and other individual preferences and attributes, instructors need to consider technological issues such as: the small screen size of mobile devices (e.g. smartphones) limiting the amount of text that can be displayed; Internet connection speed and quality; limited battery life that can hinder the learning experience enabled by complex and resource-demanding technology settings; as well as the variability (and availability) of personal mobile devices (we cannot assume that every student has a ‘good’ smartphone which allows them to participate without inhibiting their learning process). Ng’ambi et al. (2016) proclaim that although digital devices have become more readily accessible to the average student, there are still students with limited access to personal devices, and even those who have access to technology they may lack basic literacy skills. The latter becomes especially critical when the teacher is not in proximity to provide the support and guidance required, as in the case of distance learning. Furthermore, in addition to students, teachers may also need to be trained in using games-based learning approaches or developing gamified lessons plans. This requires a substantial amount of time, preparation, and effort. Most importantly, teachers need to be mobilised towards achieving higher levels of learner engagement and performance through novel pedagogical models, while also taking into account the technologies at hand and their inherent constraints.

ADDRESSING THE CHALLENGES THROUGH GAMIFIED LESSON PATHS

The Role of Gamified Lesson Paths

Before delving into the intriguing phases of designing and developing gamified educational platforms and tools, it is essential to formulate a clear idea of what a gamified lesson plan (or path) aims to achieve, and to explicitly consider how to address some of the inherent challenges discussed in the literature. From an educational point of view, an engaging, effective, and learner-centred lesson plan is the teacher’s key strategy to offer learning experiences that meet the needs of all students, creating inclusive learning environments. The lesson plan must be implemented in a way that encourages students to reflect, formulate questions, apply their knowledge, and practice high-level thinking skills. At the same time, it must be carefully designed to help students retain the information acquired and to engage them in long-term learning experiences. When creating the lesson plan, teachers must focus on quality and efficiency, as this will determine how class time will be utilised and how students will engage with the learning content. The lesson plan does not have to be very large or very elaborate, but it should provide a clear picture of how the learning process will unfold, what the objectives of the

lesson plan are, and how students will be evaluated. Starting from this point, teachers must address and integrate three key components in order to design a successful lesson plan: learning objectives, learning activities, and assessment strategies. Learning objectives must be presented in an explicit and accessible manner, formulated as measurable elements, and must clearly describe the student's expected behaviour; learning activities must be adjusted to the specific subject and target user group; and assessment strategies must be purposive and aligned with the learning aims. Heinich et al. (2001) refer to the 'ABCD' elements that need to be considered when writing objectives: Audience (individuals involved in the learning experience); Behaviour (the outcome of the teaching and learning process, such as knowledge, skills or competences); Condition (the situation in which students can demonstrate a behaviour obtained from the learning process); and Degree (the amount of a specific behaviour expected to be obtained during the learning process). Having these elements in mind can help teachers design appropriate learning activities and assessment methods. Authoring tools can assist teachers in consistently and efficiently constructing gamified lesson plans, as described next.

Description of the Authoring Tool for Gamified Lesson Paths (AT-GLP)

Web-based and mobile tools are increasingly utilised in education for creating engaging learning activities, by delivering the main components and addressing the key challenges inherent in games-based learning. Based on these premises, the BEACONING platform (Beaconing, 2019) adopts a modern approach to managing learning which occurs in a pervasive context, marking the shift towards new learning spaces that are reshaped based on learners' needs, performance, abilities, as well as on the learning objectives that have to be met. The Authoring Tool for Gamified Lesson Paths (AT-GLP) is the core structure and the main authoring tool developed as part of the BEACONING platform. The AT-GLP enables access to other tools that support gamified learning experiences such as metagames, minigames, and an Authoring Tool for Context-Aware Challenges (Türker et al., 2019). The AT-GLP enables the authoring, editing, and deployment of a lesson plan, according to specific learning needs, through accessible and scalable interfaces both for teachers and students. In particular, the AT-GLP offers learning scenarios that can be adapted to a specific curriculum, supports both desktop and mobile devices, and focuses on acquiring skills and competencies relevant to the requirements and challenges of today's society (Gheorghe et al., 2017; Ştefan et al., 2018a; Ştefan et al., 2018b). Each GLP is built around a storyline (i.e. narrative structure) which includes challenging and intriguing tasks students must solve before accessing the next level of the GLP. The storyline can be either created from scratch or customised based on an existing one. Several minigames can be added to each GLP. These minigames are also customisable, and subject-specific content can be added to assess student knowledge. The AT-GLP enables teachers to create fully mobile learning experiences as well as hybrid learning activities that blend physical and digital components, accommodating a diversity of needs. Teachers can use the AT-GLP to create various types of GLPs that integrate simpler or more complex game features. This component enables the partition of the learning content, and of assessment units, according to certain criteria deriving from data collected on learners, while also supporting motivation and boosting performance. In doing so, it is easier to map the GLPs to minigames, allowing teachers to configure inclusive and adaptable gamified experiences for their students (Beaconing, 2019). The GLPs developed particularly for mobile contexts may also integrate physical Points of Interest that are associated with specific GLP tasks (Türker et al., 2019).

The BEACONING authoring system was originally developed to support the acquisition of competencies in the fields of Science, Technology, Engineering, and Mathematics (STEM). The system has been subject to large-scale pilots across ten countries with more than 5000 students participating in the piloting phase (Türker, 2017). The implementation settings were diverse and many of the technical challenges highlighted above were encountered. Further to the large-scale piloting, the AT-GLP was successfully deployed in a variety of disciplines and it is still in use, providing evidence that the authoring system can be employed to create GLPs in diverse contexts. In this paper, we explore the use of the authoring system to create GLPs in the context of foreign language teaching and learning. To explain how the interface works and how the innovative approach to customise lesson plans has been implemented, we analyse a GLP both from the teacher and student perspective. The main objective of this GLP is to improve the English vocabulary for 1st – 4th graders while developing skills such as problem solving, critical thinking, and language fluency. The learning aims and expected learning outcomes are intertwined with an attention-grabbing game plot hence combining learning with entertainment (towards addressing challenge #4). With the help of intriguing graphical representations and a captivating dialogue, the game plot presents the story of Tobias and how he turned into Professor Tibia after meeting Rob the squid during his expedition on a different planet. The game graphics and the narrative content are interspersed with six challenges, presented in six panels of the game plot. In these panels the teacher can define minigames or location-based challenges, and students must resolve them to discover who Professor Tibia used to be. During the game, if the answers are incorrect, the student can repeat the same challenge. The GLP, through its game plot, sparks student creativity and imagination, and eventually helps achieve sustained engagement with the learning content (helping to address challenge #2). Furthermore, each GLP offers a complete package of teaching, learning, and assessment elements (in an attempt to mitigate challenge #5). The Teacher and Student User Interfaces (UIs) are described next followed by further discussion on how the unique elements and features of the AT-GLP can help mitigate the key challenges identified in the literature.

Teacher User Interface

The Teacher UI is adapted for mobile devices and provides self-explanatory layouts allowing teachers to view active lesson plans and recent activity, whilst observing the progress of their students and groups. Upon authentication, the teacher can access several components (Figure 1) such as: the Lesson Manager (to create new GLPs or view the list of gamified lesson plans created by the teacher, as well as non-authored GLPs which are defined as public); the Classroom (which includes the list of students added by the teacher on the platform and the groups defined); the Calendar (with a list of notifications

relevant to all the activities designed on the platform); and the Forum (this component can be used to facilitate the communication between teachers and students). The teacher can define the structure of the GLP in the Lesson Manager page. The form is easy to use and is adapted according to the specifics of each device, offering instructions on how to fill in the fields, such as plan name, description, domain, topic, age group, year, learning objectives and competences. To help the teacher in supporting the plan competencies, the platform provides a list of three predefined competencies, leaving the definition of the learning objectives to the teacher. Also, if the teacher wants to create a collaborative GLP, which other teachers can use or customise, the platform offers the possibility to set the GLP as public. The final step involves selecting the game plot. The platform has fifteen build-in game plots with adapted narrative content and modern graphical representations, aiming to attract the player's attention. To facilitate the creation of the learning content, the platform is adapted for mobile devices (e.g. drag-and-drop capability).

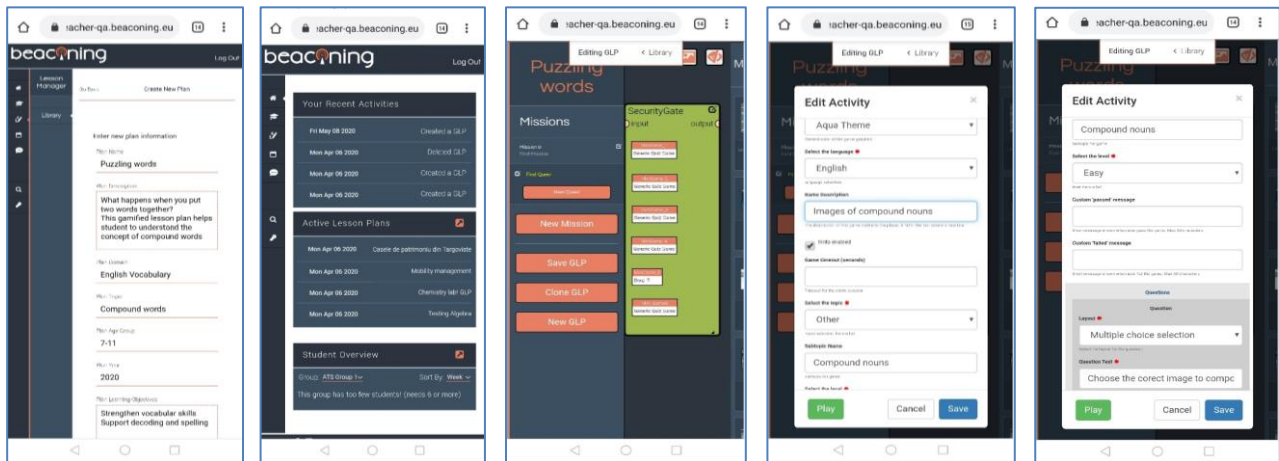


Figure 1. Teacher UI – Authoring Tool for Gamified Lesson Paths

The teacher can select different minigames for a particular GLP which form the layout of the learning content. The Puzzling Words GLP includes six challenges and two minigames: Generic Quiz and Drag It. The fifteen minigames readily available in the platform can be utilised to create a dynamic lesson plan. Through the AT-GLP the teacher can adapt the content and the lesson paths can be tailored to the needs and requirements of individual students or groups of students, hence improving learner inclusivity and adaptability (challenge #3). The integration of the learning content into the structure of the GLP is straightforward since the Authoring Tool follows predefined templates, whose structure is based on the definition of questions and answers. In addition, each template has predefined functionalities such as the time allotted to answer a question, the provision of clues, or the possibility to pause the game for a few seconds. Finally, the teacher can proceed with assigning the lesson plan and certainly, assessment. From the Lesson Manager page, the teacher can choose the GLP and assign it to an individual student or group of students. On the Classroom page, the teacher can access the page of a student and monitor student activity regarding a specific GLP. This facilitates monitoring and, most importantly, gives the teacher the opportunity to assess student learning (challenge #5).

The AT-GLP takes into account key educational aspects of gamified mobile learning (challenge #4) and leverages both the role of feedback and the careful selection of assessment strategies which must be aligned with the intended learning outcomes (challenge #5). The goal is to enable an effectual partition of learning content, and of assessment units, according to certain criteria deriving from data collected on learners, while supporting motivation (challenge #2) and boosting performance (Beaconing, 2019). The storyline of a GLP integrates challenging yet intriguing and entertaining tasks that players must solve to access the next level of the GLP. The role of these intriguing tasks is to captivate the students' interest and enthusiasm provoking them to access the learning content or to play the minigames which are integrated in the GLP (challenge #4). Through playing, the tool supports teachers by providing resources that can be used to assess the student knowledge acquired through those tasks, while the minigames integrated within a GLP can employ various reward mechanisms (challenge #5). A teacher can create a new storyline or customise an existing one to fit a specific subject. The minigames that can be integrated into a GLP implement basic mechanics to avoid generating a game-based environment which is too complex. Finally, the AT-GLP can be used to create GLPs for various disciplines.

Student User Interface

The BEACONING platform offers an engaging and accessible Student UI, adapted for both desktop and mobile devices. In the mobile interface, the students can view the lesson plans assigned to them or to the working group(s) they belong to, receive notifications displayed in the Calendar when they have new lesson plans assigned, and check the progress for each GLP by accessing the Dashboard component (Figure 2). Students can access the lesson plan anytime to improve their results and their individual records. Starting from the gamified lesson plan, the example below illustrates how the game flow is presented to the student, according to a series of steps. First, the student must be authenticated on the platform with the credentials provided by the teacher (username and password). From the launch page, the student must select Play to access the gamified lesson list. In this list, the students can view all the lesson plans assigned to them and play a new or an ongoing gamified lesson plan. By accessing the Dashboard button of the lesson plan, the student can track the progression of the Puzzling Words GLP, while in the Calendar module the student is notified when a new lesson is assigned or if a GLP

has new or modified activities. For the Puzzling Words lesson plan, once the Play button is pressed, the student is transferred into an immersive world, presented by the narration of the game plot – Professor Tibia (Figure 3).

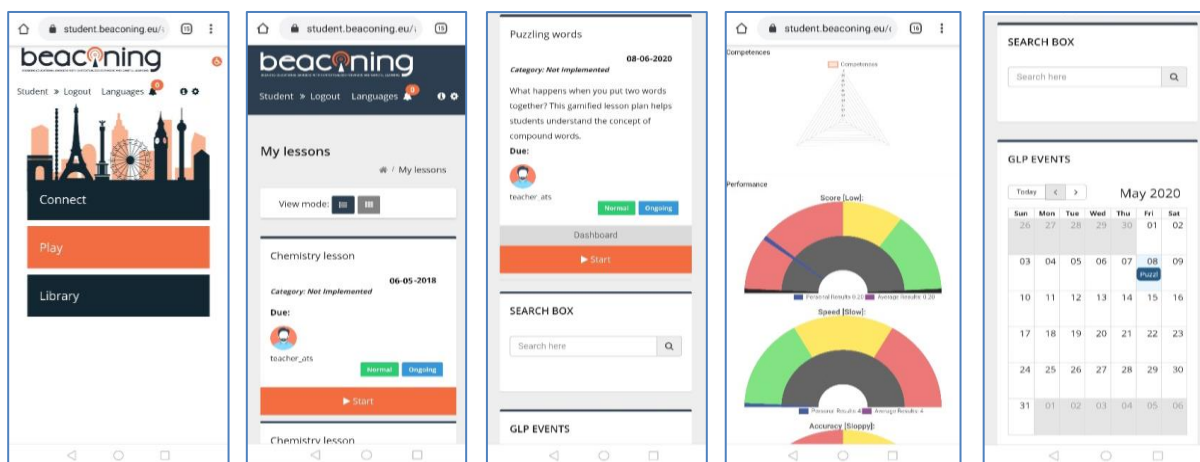


Figure 2. Student UI – List of assigned GLPs, Dashboard, Calendar notifications

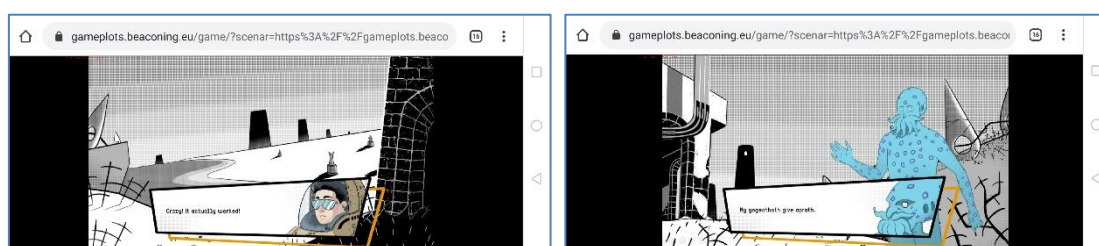


Figure 3. Game plot narratives

The student must complete all six challenges and minigames to complete the particular GLP. A minigame is added after every challenge to assess student learning. For the Puzzling Words GLP two minigame structures have been used: Generic Quiz and Drag It (Figure 4). The content of these minigames can be customised by the teacher to meet specific learning objectives. Before accessing each minigame, sequences from the game plot narrative are presented. At the end of the game play, the student can view a summary of the results. After completing all the minigames, the student is redirected to the main page.

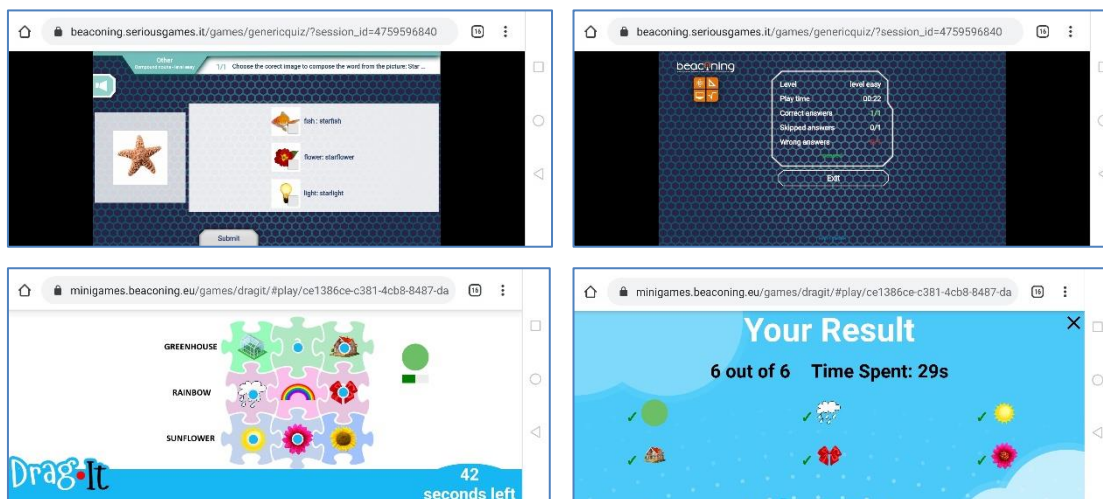


Figure 4. Game play for Generic Quiz and Drag It

The AT-GLP offers embedded learning activities adapted to the needs of individual students, providing deep engagement through their narrative game plots and minigames, hence helping to address learner engagement and learner inclusivity (challenges #2 and #3, respectively). More specifically, with regards to engagement (challenge #2), the AT-GLP employs narrative scenarios as primary sources of engagement. By intriguing student curiosity, the game plot motivates students to complete the challenges in the GLPs.

Lessons Learnt, Limitations and Suggestions for Improvement

GLPs created using the tool can be played both in the classroom and remotely. In a mobile learning context, the inherent challenges of mobile games-based learning, including mobility itself, and the technological constraints related specifically to mobile devices (challenges #1 and #6, respectively) are unavoidably present and these had to be considered while using

the AT-GLP. To achieve a rewarding experience, GLPs must be tailored taking into account key technical challenges, such as limited Internet connection, limited battery life, and limited availability of smart devices amongst others (challenge #6). Such challenges could be addressed by creating smaller GLPs that do not require too much time to be completed. Empirical studies (e.g. Hauge et al., 2017; Hauge, Ștefan, and Ștefan, 2017) have shown that the AT-GLP can significantly reduce the time, effort, and budget required to create a gamified learning experience.

With regards to inclusivity, adaptability, and personalisation (challenge #3), even though the tool has many useful features supporting inclusivity (i.e. a learning analytics component is integrated into the tool, the minigames can be customised, subject-specific content can be added to assess student knowledge, and the tool allows the teacher to tailor the content to the needs of individual students or group of students), adaptation is not carried out automatically. Furthermore, while teachers can customise existing storylines or creating new ones, no further personalisation features are available. Another limitation is that the current version of the AT-GLP does not support synchronous communication between tutors and students. Even if this creates a more game-like environment, it might affect the learning experience as students cannot communicate with their tutors as they progress through a GLP. Therefore, the lack of physical presence needs to be reconsidered so that students are better supported when playing without face-to-face contact with their teachers (challenge #1). In addition, although the minigames that can be integrated within a GLP can employ various reward mechanisms (challenge #5), currently, the AT-GLP does not implement an overall reward system that centralises the player performance across all the minigames that are part of a GLP.

The lessons learned from the application of AT-GLP in the content of foreign language learning have also illuminated several suggestions for improvement. As an improvement to the existing functionalities, the platform should offer the possibility to define other competencies, besides those build into the GLP. Another improvement would be to make the tool more dynamic and user centred. For instance, the platform should offer the possibility to create new game plots or to edit the existing ones, although this might require extra work on behalf of the teacher. To help the teacher in this process and to shorten the time dedicated to create a dynamic GLP, the platform could provide a set of graphic elements and characters, thus giving the teacher the autonomy to choose the desired graphic elements from a predefined set, and create an original, innovative story starting from these elements. To be available and easy to use on mobile devices, this functionality should support drag and drop actions, like the one employed for setting up the minigames.

CONCLUSIONS

In this paper we have explored the challenges inherent in gamification, specifically in relation to mobile games-based learning. The literature review revealed several challenges associated with gamification in mobile learning contexts and these are grouped under six broad themes. Following the literature review, we have presented the Authoring Tool for Gamified Lesson Paths (AT-GLP), described the application of the tool in the context of language learning, and discussed how the tool helps address some of the challenges identified in the literature. The AT-GLP is the core component of the BEACONING platform and was developed by incorporating the evident benefits of applying gamification in education, while also aiming to address prominent challenges. Despite the continuous development of mobile technologies, research findings regarding the effectiveness of gamification in engaging learners and improving the learning outcomes remain inconclusive. Furthermore, while there is increasing empirical evidence on the educational benefits of games-based learning, research on the challenges facing instructors and students is insufficient. Ramirez and Squire (2014) suggest that “gamification principles aren’t inherently good or bad. Rather, we can examine the consequences of their use and determine their value. As designers and learning scientists who create learning systems with important consequences for learners, we treat issues around gamification techniques as largely empirical questions: How are they working? Whose interests are being served and legitimated? Are they engaging and life enhancing for participants? How might we improve these structures so as to make them more just or equitable?” (p. 631). This calls for more empirical research investigating the value and practical implications of gamified pedagogical approaches across different disciplines and contexts, contemplating diverse learning styles and engagement profiles. Further empirical research will help address these questions, find ways to mitigate the challenges, and leverage the impact of mobile gamified learning on learner engagement.

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