

Developing a Platform for using Game-Based Learning in Vocational Education and Training

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Author post-print (accepted) deposited by Coventry University's Repository

Original citation & hyperlink:

North, B, Diab, M, Lamas, P, Zarak, J, Philippe, S, Muller, J & Fischer, H 2021, Developing a Platform for using Game-Based Learning in Vocational Education and Training. in 2021 IEEE Global Engineering Education Conference (EDUCON). IEEE, pp. 1345 - 1352, 2021 IEEE Global Engineering Education Conference , Vienna, Austria, 21/04/21.

<https://dx.doi.org/10.1109/EDUCON46332.2021.9454124>

DOI 10.1109/EDUCON46332.2021.9454124

ISBN 978-1-7281-8478-4

Publisher: IEEE

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Developing a Platform for using Game-Based Learning in Vocational Education and Training

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Abstract—The importance of Game-Based Learning (GBL) for student learning is increasingly recognized as beneficial for engagement, creativity and motivation. While further research is needed to explore the multi-faceted tenets of GBL, vocational education teachers may experience difficulties in finding appropriate and relevant materials as well as applying GBL methods in their classroom. This paper presents the development of a platform that VET teachers can use to find, create and share GBL teaching resources. The Erasmus+ project GATE:VET is creating a platform, consisting of an online wiki and a mobile application, that supports educational professionals to understand theoretical and practical aspects of GBL, with the goal of enabling these teachers to design and implement GBL activities in their practice. This paper highlights some of the challenges and strategies for solving these issues when consolidating varied requirements into one platform to create an accessible, user-friendly and relevant point of departure for using GBL, with emphasis on the appropriate level of complexity when describing the theory of GBL and linking it to practical examples.

Keywords—game-based learning, serious games, gamification, vocational education and training, learning experience, learning platform development

I. INTRODUCTION

The effectiveness of Game-Based Learning (GBL) on student learning across an array of intended learning outcomes including motivation and creativity has been studied extensively (e.g. [1], [2], [3], [4]). The overarching factor that contributes to the propagation of motivation seems to be the process of playing. Rastegarpour & Marashi [5] sought to investigate the effects of GBL on chemistry learning and highlighted the instrumental role of play and the active engagement of students with gameplay as opposed to a more passive learning activity observed in the classroom. Grimley et al. [6] investigated whether learning through a game can improve student learning compared to a lecture approach. Increased feelings of being active, involvement and a perception of challenge were reported when interacting with the game leading to higher engagement for students. In a study conducted by [7], creativity and creative thinking were improved using a game. Disciplined imagination as being

related to imaginative creations, risk-taking and participating in challenging tasks seemed to be amplified through game play. There seems to be consensus (e.g. [2], [4], [5]) on how GBL supports and potentially improves awareness and knowledge on certain subject areas contributing to learning effectiveness.

Guillén-Nieto & Aleson-Carbonell [8] identified factors that influenced the learning effectiveness through the use of serious games. Learning effects on students' ways of communicating with peers and teachers were identified along with improvements in understanding content and transfer of learning skills. Game design, as a feature of some GBL activities and as an innate process of creation and creative thinking, may improve students' problem-solving skills on two levels; teachers can provide meaningful in-game feedback and also engage their students in a GBL activity that helps them to develop coding skills. Akcaoglu & Koehler [9] asserted that the process of designing games resulted in substantial cognitive changes in students' problem-solving capabilities.

The aim of this paper is to present a wiki and a mobile app, which were developed in the Erasmus+ project GATE:VET to help educators to access, use, re-use and share GBL-related content and resources. To set the context of the paper, teachers' perceptions and competencies of teaching and learning using GBL are laid out; then the GATE:VET project is introduced before the design, interface and contents of the two online platforms are described. Further, this paper presents a small-scale usability evaluation of the wiki to determine the user-friendliness of the platform.

II. TEACHERS' PERCEPTIONS OF TEACHING AND LEARNING USING GBL

There are many research findings from several commentators supporting the view that attempts to integrate technology-based interventions and associated digital pedagogies into teaching and learning are challenging, mainly because teachers' perceptions and approaches to the use of learning technologies and digital pedagogy have not been systematically and comprehensively investigated (e.g. [10],

[11]). It seems therefore logical to claim that the empirical process of eliciting teachers' experiences of GBL is central for understanding 'how' and 'why' teachers perceive, select, implement and share GBL content, resources and best practices and make related decisions in their practice. It is also axiomatic to claim that the way in which teachers experience teaching using GBL can influence students' beliefs about learning with GBL, with consequences for later learning design and practice. Studies that investigated teachers' ways of experiencing GBL for teaching and learning have focused on certain aspects from conceptions of designing, orchestrating and augmenting teaching with the use of GBL (e.g. [12], [13]) and education on enablers and constraints [14] to teachers' acceptance of GBL [15].

The paper presented here elucidates on a platform for teachers to find, access and share GBL resources as means to improve perceptions of and approaches to GBL in teaching and learning. Bourgonjon et al. [16] argue that teachers' perceptions of using GBL have been studied using a number of different data collection and analysis instruments and methods, from questionnaires and quasi-experimental research designs to interviews and qualitative studies. While the former investigate the level of effectiveness, acceptance or negation of GBL in relation to an increase or decrease on students' cognitive performance and learning outcomes, the latter explore the qualitatively different ways teachers' experience the use of GBL as means to propagate a framework that may inform GBL design and delivery across different subjects and disciplines.

Teachers' views on using GBL indeed vary, some teachers consider GBL a valuable asset for enhancing traditional teaching but overwhelming in terms of designing and orchestrating GBL activities that are based on sound theoretical and applied GBL practices and norms (e.g. [15], [16]); others view it with incredulity and do not believe it added value to the teaching and learning process. Such conceptions may affect approaches to and preferences on using GBL that would in turn influence student learning. It seems that teachers may feel overwhelmed by the plethora of GBL elements, strategies and tools that they need to comprehend and apply in their practice. To provide more clarity and to ensure that teachers can make informed decisions about which facets of GBL are most appropriate for their own teaching context, it is necessary to foreground beliefs, practices and processes to support teachers. Fostering teachers' self-awareness of their own practice is a predominant factor in developing the competencies and skills needed to find, access and meaningfully evaluate GBL resources.

A *raison d'être* for designing, planning and orchestrating GBL activities is their inherent potential to impact students' learning by providing motivating and engaging learning experiences [17]. While academic investigations into the design and use of GBL as a pedagogical approach commenced in the early 2000s, there were assumptions that GBL may be viewed as a distinct breed of the semiotic domains [17] that afford students to employ different multimodal ensembles or as a design experience from which students are learning to think creatively. Such design experiences may not necessarily encourage students to learn how to absorb and transmit content, but most essentially how to understand the process of learning through designing, playing and making.

Despite frugal debates on meaning between GBL, serious games and gamification (e.g. [18], [19]), GBL here is understood as an umbrella term to denote a student-centered and creativity-orientated strategy, collaborative and social in its foundation, that amalgamates constructivist learning theory and game elements embracing spaces for practicing creative thinking, inquiry and resilience. Serious games and games design, as tangible digital products, may constitute a specific activity designed or re-used/repurposed encompassing a broader GBL strategy. Gamification as part of a wider GBL activity can similarly be propagated as a way to transform specific learning design elements (e.g. assessment, feedback, progression) to game-like instances via scores, badges and leader-boards in its simplest instantiation.

III. COMPETENCIES FOR GBL

Against the background of structural change and the changing demands of new generations, such as the "digital natives" or "Generation Y", there is a need (also in terms of learning content) to create new attractive learning instruments and innovative approaches that support the acquisition of competencies. In the field of Vocational Education and Training (VET), the demand for the provision of learning and educational content is also changing as rapidly as the technological progress of recent years [20]. As written in [21], it is now necessary to transfer the competences of the 21st century into a new learning culture and thus also into schools and universities to strengthen pupils' competences in the future. Among other things, this can be promoted by teaching with digital media and by using concepts such as GBL and gamification.

Game-based solutions for knowledge acquisition are moving into the focus of educational and economic efforts [22]. GBL creates new learning requirements and at the same time supports learning processes to open up new ways and forms of acquiring skills and abilities (e.g. [23], [24]). This would not only result in new occupational profiles, but also in new areas of competence. Consequently, concepts such as "21st century skills" or "Future Work Skills" also have a formative influence on future life and work. Among the core competences of the 21st century are skills such as learning and innovation skills (i.e. critical thinking, creativity, flexibility and independent working), but also virtual and personal communication and collaboration as well as competent handling of media, technologies, data and information [25]. In relation to GBL, however, there are few studies on how GBL can influence the development of students' skills. As shown in a literature review by [26], many academic papers reported the influence of games on the development of 21st century skills, with the majority focusing on critical thinking skills.

Through GBL, new requirements in the educational sector can be created and at the same time support for learning processes can be offered. Teachers face the challenge of designing creative game scenarios that at the same time integrate relevant learning objectives. Specific skills are required to convey learning content in a playful way, which is supposed to do both - maintain the motivation of pupils and promote their learning process. In order to determine which skills educators need to use gamification, an empirical study was conducted from May to August 2019 [27]. The aim of the study was the creation of an exemplary competency profile that educators need to implement GBL scenarios. The following question formed the basis of this study: *What skills do educators need to develop and implement*

GBL/gamification? In order to answer this overarching research question, six guideline-based expert interviews and a subsequent short questionnaire were conducted. Teachers in the higher education sector with experience in developing and implementing GBL scenarios and researchers with a scientific focus on GBL development were interviewed. All of these experts were able to take at least one of the following perspectives based on their experience:

- teaching perspective, i.e. experience in using game scenarios in classroom;
- developer's perspective, i.e. experience in the development of GBL applications (e.g. serious games);
- researcher's perspective, i.e. experience in researching and evaluating GBL applications.

The interviews were transcribed and evaluated using qualitative content analysis [see 28]. In an expert discussion with three GBL experts from the research cluster for digital learning and gaming cultures (Technical University of Dresden), the identified qualification requirements of future teachers who want to implement GBL practices were condensed into four fields of competence. These four fields of competence and the associated skills and knowledge requirements outline the competencies required for the gamification of the classroom.

A. Openness, Readiness for Change

- ability to understand change as a learning situation and to act accordingly
- being open to adapt to new forms of teaching and learning
- replacing old learning formats
- ability to leave room for new reference points
- adapt their actions to the changes
- acquiring the resources necessary for change
- learning new tasks and dealing with new technologies

B. Creativity

- ability to develop good and preferably novel solutions to problems
- readiness to innovate
- creation of something new and original

C. Comprehensive/Holistic Thinking

- ability to incorporate other aspects into their own objectives
- decision-making on the basis of sound knowledge
- comprehensive perspective
- overview of the entire concept
- consideration of diverse interdependencies and other persons involved

D. Expertise and Interdisciplinary Knowledge

- specific knowledge about learning and games, and the ability to apply this knowledge
- know different types of learners and players

- knowledge about the characteristics of game (game mechanics, flow experience, game elements)
- consider different forms of learning (situated, action-oriented learning)
- integration of different constructs and concepts for learning transfer (learning and motivation theories)
- media didactic knowledge

These provide an initial overview over the skills and fundamental aspects that are required to develop the competences teachers need to implement GBL practices.

IV. INTRODUCING GATE:VET

The primary objective of the GATE:VET project is the planning, development and provision of a qualification and communication platform consisting of a wiki and a mobile application on which various game elements, best practices and instructions on GBL are made available to teachers in VET for their teaching activities. In developing the platform, particular attention is paid to user-friendliness, expandability and user experience in order to provide teachers with a practical and accessible tool for preparing their lessons. The main incentive for teachers is the provision of easily transferable, motivating and versatile teaching materials in an accessible way. The creation of platform content is supported by an online community for VET teachers interested in GBL; it can be maintained independently and autonomously by this community of teachers even after the end of the project.

To ensure that the platform is developed in line with the needs of the target groups, VET Teachers from the partner institutions are involved in the development process at various stages of the project. For example, online multiplier workshops are planned in which teachers can test the wiki and provide critical feedback on the platform. At the end of the project, users of the platform(s) can create, share, use and evaluate content themselves. This is intended to ensure the sustainability of the project results in addition to peer learning.

Moreover, a training-of-trainers curriculum is being developed to enable teachers to use GBL in class and to train multipliers. In addition to basic concepts and models, they will also learn how to use both platforms and adapt the examples to their teaching practice. In the training-of-trainers, a set of gamified activities is implemented and intended to guide the user to explore and/or review the knowledge displayed in the wiki and app. In addition to glossary terms and educational sheets, micro-learning units created in the app complement the content and the way the curriculum is taught. App activities include flashcards and mini-games. This set of activities is part of the training-of-trainers and supports learning activities to build a blended learning program.

A. Design of online platforms

The target group of the platforms are VET teachers interested in implementing GBL activities in their teaching practice. In this context, the primary purpose of the platforms is to increase the general awareness of teachers regarding GBL, to provide them with methodological tools and frameworks as well as with use cases and good practice examples.

Based on the project objectives, the first step was to determine the requirements for the platform. These were defined in workshops and by interviewing teachers from

(vocational) schools (18 in total, nine teachers without and nine with extensive experience in the use of GBL). In conjunction to their individual understanding of the concept of GBL, the teachers were asked how such a platform could support them in integrating game elements into their lessons. It was found that the teachers interviewed associated quite different goals and functions with GBL and, accordingly, the desired use and strategy of such a platform varied. Nevertheless, the main aim of the teachers surveyed was to increase the motivation of students by conveying the learning material in a fun way. In addition, these teachers believed GBL could help, among other things, to consolidate knowledge, gain a deeper understanding of a topic, develop creativity and develop a sense of constructive competition.

The desired functionalities of such a platform are therefore broadly diversified. Yet, a majority of interviewees stated that the platform should be easy to use in terms of finding and retrieving content and that the examples and games presented should be sorted by subject, among other things. Contrary to this preference and with the goal to accommodate the more occupation-specific subjects in VET teaching, which usually transcend disciplinary boundaries; no subject-specific categories were adopted for the platforms. The deliberate omission of subject-specific categories is intended to strengthen the platforms' capacity to promote critical and creative thinking. In this way, teachers cannot simply copy or reproduce activities; they have to adapt the content to their needs while processing some of the theoretical aspects of GBL. At the same time, users are given the opportunity to build a community, in which they can interact and exchange ideas on implementing GBL practices. Game ideas could be (further) developed interactively and teachers could network easily, both with colleagues at their own schools as well as with peers from other educational institutions. A mere collection of subject-specific game ideas would not be suitable for this aim. The project partners have therefore developed a number of descriptive filters that help to sort the content according to different aspects. The focus is not on subject-specific factors, but on learning goals, learning approaches and forms of pedagogical action, among other things. While the overall design of the GATE:VET platform aims to accommodate primarily the needs of vocational teachers, it includes content that may assist teachers at all educational levels in implementing GBL activities. The different platform requirements are technically implemented in two different ways: an online knowledge database in the form of a wiki and a mobile application.

1) The wiki

The first component of the digital platform is a website (see Fig. 1). It can be reached via a web browser and is designed in a wiki format, suited for:

- longer entries, as compared to the 'micro' format of the mobile app;
- contributions by users in the form of creating new or editing existing content;
- exchange of ideas and peer learning;
- parallel learning about GBL theory and practice through linkages between glossary and educational sheets;
- content searches with multiple filters.

GATE:VET Wiki

Learning should be fun and the use of game-based learning activities in the classroom can be easy. Games can enhance the learning experience and playing can function as an active learning activity. Students are more motivated to learn when their creativity is stimulated. It is great to include some gamified materials and activities in your teaching practice, but it is sometimes difficult to find suitable materials. You may have asked yourself questions like: What's with all the terms and theories? Do I have the time to get my head around this?

We believe you can definitely get your head around this and it requires less time than you would think. With our project GATE:VET (an Erasmus+ Strategic Partnership) we want to help teachers at vocational schools expand their methodological repertoire. We want to show you how you can enrich your classes – from introducing basic gamified learning activities into your everyday practice to developing elaborate serious games, whichever way suits you best.

There are two main ways you can use the wiki:

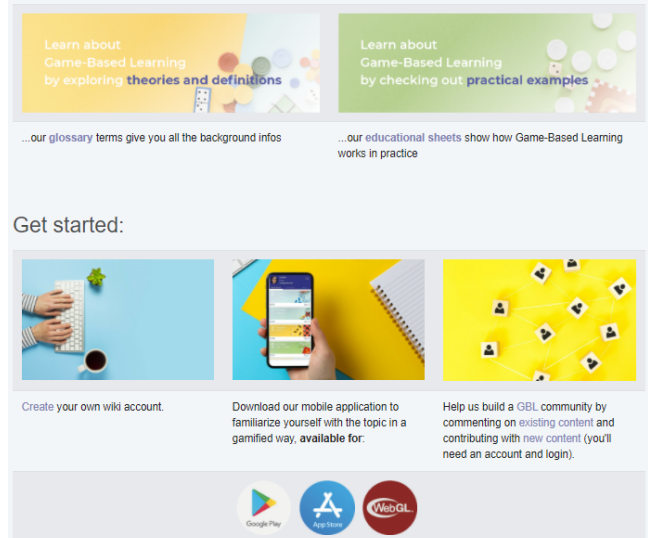


Fig. 1. Wiki homepage

At the moment, the wiki comprises over 50 educational sheets and over 70 glossary terms. All entries are organized in various searchable categories; images, links and additional files (i.e. resources) can be added to every wiki entry.

2) The mobile application

The second component of the digital platform is a mobile application. This application is gamified and based on a micro learning approach. Micro learning is described as “a didactic concept and approach that uses digital media to provide limited, coherent and autonomous content for short learning activities” [29]. It is organized as a toolbox comprising short articles to provide content as well as mini-games, flash cards and quizzes to train the users in GBL skills (see Fig. 2).

The application is aimed at driving engagement of the user through several features:

- The format is gamified, to stimulate the interest of users;
- The activities are diversified, to maintain the engagement of the users;
- The activities require minimal time, to facilitate their completion when users want or are able to;
- The progression is monitored with the leader board, figuring points, badges and awards collected by the users (see Fig. 2).

The training program offers a combination of learning resources that covers several pedagogical objectives relating to GBL:

- articles of 1,500 characters maximum, which may include images and videos;

- flashcards, mini games and quizzes, which relate to the educational sheet or glossary contents and may be used as gamified training resources on different topics (see Fig. 3).

Push notifications regularly invite the users to complete activities and explore the contents. Furthermore, a search tool (using a search bar based on predefined tags), a rating tool (using a 5-stars rating option) and a bookmark tool (to save content) will facilitate exploration of the content. The user should thus increase knowledge about GBL.

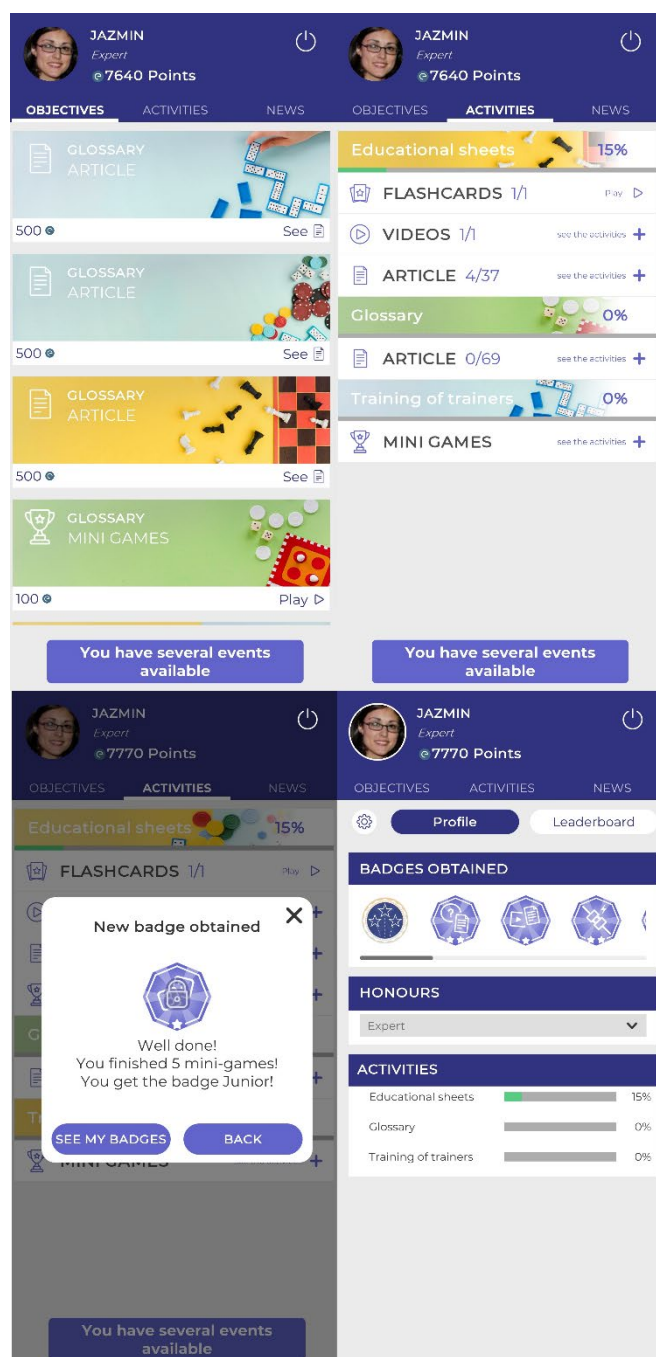


Fig. 2. Mobile app screens showing (from top left to bottom right): the daily objectives assigned to the user; the list of activities available and achievement; a new badge collected; the user's collected badges.

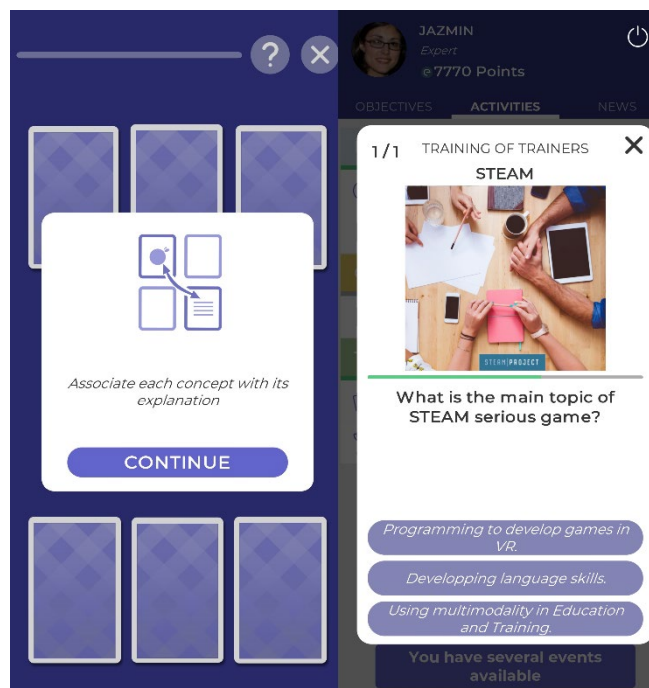


Fig. 3. Mobile app screens showing examples of: the mini-game Memory; a mini quiz.

3) Articulation between the components

To make the most of the two platforms and facilitate navigation of the users between both components, the educational sheets within the mobile app will contain links to the platform's wiki. Users will be invited to go to the wiki to get more information about a particular topic. The mobile app will be available as WebGL via a web-browser.

The wiki and the app will both be part of the training-of-trainers workshop, a blended learning program dedicated to educating multipliers who will share our platforms for developing GBL knowledge and skills with their colleagues and within their networks. The mobile app and the wiki will be used as a digital support to the learning activities of the training-of-trainers workshop.

With the help of the app, users can playfully explore GBL contents free of charge in the form of micro-learning units and practice their knowledge. To take greater account of the planned establishment of a community, communication tools such as rating tools (app) and cooperative work (wiki) are particularly important functions of the platform(s).

B. GBL content

During the course of the project, the participating partner institutions create a rich collection of basic terms (i.e. 'glossary'), game ideas and best practices (i.e. 'educational sheets') in the wiki and app. These situation- and context-related best practices contain instructions for implementation and link to similar practical examples. In addition, the collection of basic terms and concepts of GBL on the platforms enables users to acquire in-depth background knowledge. The solid knowledge of GBL and the applied practical examples will enable teachers to transfer their newly acquired knowledge into their own teaching settings. This is what sets GATE:VET apart from other databases which often exclusively present learning games or build up teacher communities.

1) Glossary

The glossary comprises the definitions of many key concepts and theories used in GBL. It has been created to help teachers understand some of the descriptions for and approaches used in GBL activities. Those terms are also used to describe and categorize the educational sheets. Glossary terms are organized in eight subsections: game features, game genre / type of game activity, key term, learning approach, learning mode, link collection, theory, and tool.

Entries in this section are usually shorter (limited to 1,500 characters in the mobile app), with the aim of providing useful and brief explanations of relevant terminology to wiki and app users. Third party resources can be embedded in glossary entries (e.g. integrated videos or links toward external resources). Fig. 4 provides an example.

2) Educational sheets

The educational sheets provide practical examples of GBL activities to illustrate the application of gamified content in the classroom. Users can use the search function to filter contents through eight different category groups: age group, duration of the game play, game features, learner group size, learning approach, learning mode, pedagogical goal, and usage rights. As various categories will apply to each educational sheet (as entered by the respective wiki entry author), there is also the option of searching contents with multiple filters. Consequently, teachers can individualize their search for suitable content, e.g. look specifically for educational sheets in a certain age group, for a particular learner group size and with one or multiple learning approaches. The project deliberately excluded the option of filtering content according to subject-specific categories in order to reinforce the platforms' capacity to foster creative and critical thinking. When adapting content to their own individual purposes, teachers need to deal with aspects of GBL theory to a certain degree, rather than simply copying or reproducing activities.

The format is similar to the glossary section. In addition, the educational sheets contain a list of relevant categories that help teachers to filter the proposed activities in accordance with specific teaching or classroom requirements (see Fig. 5).

V. EVALUATION

The first of two planned multiplier events was held in November 2020. While initially intended as a face-to-face event in October, due to temporary travel restrictions, the event was changed into a fully online format. In view of the situation and difficulties in finding enough local participants, the event was postponed to November to allow for proper planning. The main goal of the multiplier event was the introduction of the wiki to members of the target group, who were given an opportunity to try out the platform and share first impressions of the developing user community.



Fig. 4. Wiki, example of a glossary term, including links to other content in the wiki.

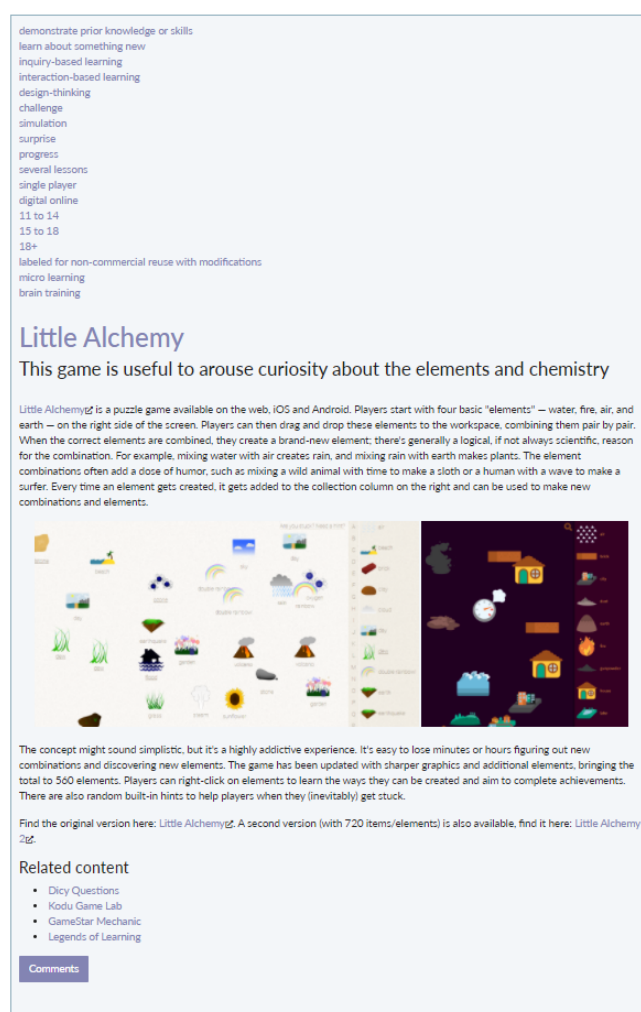


Fig. 5. Wiki, example of an educational sheet with categories, internal and external links, and related content.

The event was planned as an interactive workshop that would give participants time to explore as well as a space for exchange of experiences and ideas. While initially 21, mostly local Danish, VET teachers signed up for the event, only 11 of them participated on the day. In three short presentations the project partners introduced GBL in general, the GATE:VET project and its outputs, i.e. the wiki and the app to VET teachers. In facilitated, interactive breakout workshops, participants exchanged their experiences with implementing GBL activities in their practice, explored the functionalities and contents of the wiki and provided feedback on the wiki and app. While the event provided feedback on the ongoing development of the project results, the organization of an online event with a strong interactive component and a group of participants who do not know each other proved to be a challenging task at times, especially concerning the active participation of workshop attendees.

Some participant feedback was already collected during the workshops in the form of comments, small interactive exercises and a brief online questionnaire (on the wiki only). There was a mix of closed and open-ended questions, with open-ended questions following closed questions allowing respondents to elaborate on their answer. Examples include:

Do you like using game-based learning activities in your practice?

Please tell us which parts of the wiki you'd most likely use (please tick all that apply).

Please rate the following statement: The educational sheets seem to provide all details needed to prepare lessons with their help.

Do you generally use a lot of online teaching resources?

Do you generally like to share teaching resources (that you have created or modified) with colleagues?

Open-ended questions (also as follow-up) were:

If there was one thing you could change in the wiki - what would it be?

We'd love to hear more about your response to the previous question.

The participating teachers rated themselves as having fairly well-developed digital skills and expressed little skepticism about finding and using online materials. The majority of them favor the use of GBL activities or playful elements in their teaching practice; although some did not consider this sort of activity useful in all contexts. Only two of the eight participants who took the online questionnaire voiced uncertainty about the application of GBL practices. Overall, the teachers' responses were positive and included comments, such as:

I think you should find a way to push your platform to schools and spread the word. It is clear to see that a lot of work has gone in to creating the website. I will definitely share it with my colleagues, or

Great idea with a common platform for teachers! It takes off some of the workload.

The majority of participants would use the wiki to find inspiration for their classes and resources for their teaching practice. However, at least five teachers commented on the visual design of the wiki, stating it seemed "really dated" and "very plain". While three expressed an interest in creating own contents and share ideas with the community, none expressed any interest in the other community building aspects of the wiki (i.e. commenting on or editing other users' entries). Furthermore, few teachers indicated an interest in learning more about more theoretical aspects of GBL and gamification. Most teachers see the greatest value of the wiki in the collection of resources and believe that the use of these practical examples gives them sufficient knowledge about GBL and gamification, as the following comment illustrates:

I don't really read the glossary terms because I think looking for sheets and seeing games is more relevant to learn how it works.

The feedback for the app was also largely positive. Since the multiplier mainly concentrated on gathering feedback on the wiki and the participants were only briefly introduced to the app, the collected impressions were less detailed compared to those of the wiki. In general, the appealing visual design and user-friendliness of the app were very well received by the participants.

VI. CONCLUSION

This paper presents the development of a platform for finding, creating and sharing GBL resources. In developing

the platforms and assessing the needs of education professionals in the higher education and VET sector, different and at times contrasting perspectives were identified. While university level educators, who are often much more involved in game theory research, seem to put a much greater focus on learning about the theory of GBL as a significant qualification requirement of teachers who want to implement GBL practices [26], vocational teachers are primarily interested in learning from practical examples, as our platform requirements analysis and multiplier event evaluation has shown. It is a delicate balancing act to reconcile these two positions, with implications for the ways in which effective VET teacher training methods should be devised. On the one hand, an overly theoretical approach could pose the risk of creating an over-complication that may discourage some teachers with less capacity (and perhaps also less time) to deal with GBL theory and obscure some of the less problematic aspects or processes of gamifying learning materials. On the other hand, attempting to approach a new teaching matter solely through practical examples could be problematic in that the potential benefits of a more detailed and theoretic understanding of GBL may be neglected and teaching capacity may not be fully realized.

The wiki and app, which were developed within the GATE:VET project, operate exactly within and feed from the remit of balancing GBL theory with practice as means to ground theoretical considerations to actual GBL applications necessary for a GBL resource to be comprehended holistically and consciously. To this end, the wiki and app provide the necessary context for teachers with a variety of practical examples (wiki educational sheets) and at the same time allow teachers to delve deeper into the topic of GBL (wiki glossary). They also offer a very accessible introduction to the theory of GBL, where the material can be learned in a gamified way (app). The platform can therefore help education professionals to understand theoretical and practical aspects of GBL in the way that works best for them. The platform has the capacity to resolve some of the difficulties that many teachers face when designing and implementing GBL activities in their practice. The platforms not only provide guidance on how to instantiate suitable GBL content and apply it in real classroom situations, but also function as a hub for teachers to access and share content openly and free of charge. Accordingly, another overarching purpose of creating a digital platform for GBL is to enable education professionals to easily browse and share GBL content and resources; and to create GBL teacher communities that can shape GBL activities, discuss and solve design-based and content-related problems in embedding GBL in their teaching practice. This leads to the formation of a mechanism that uses a community-based approach to create awareness of GBL and the practice of GBL in different teaching contexts.

More comprehensive results on the actual use of the platform will be provided in future research iterations to be developed in due course. A more comprehensive evaluation study will be conducted to explore further teachers' experiences in using the platform.

ACKNOWLEDGEMENT

This work has been supported by the European Commission's Erasmus+ programme, under Grant No. 2019-1- DE02-KA202-006559 GATE:VET.

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