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Endowing a Game-Based Learning Hub for Augmenting Teaching and Learning: Design, Constellations and Perceptions from a Teachers Perspective

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Abstract: Game-based learning is viewed as an immersive and pedagogically rich approach to enhancing teaching and learning in schools. However, teachers may feel overwhelmed from the dispersed, disorganised and invalidated plethora of game-based resources circulated over the Web that needs to be collected, reviewed and repurposed for designing and orchestrating game-based learning. This paper presents the design requirements of a game-based learning platform that may help teachers to find, retrieve, re-use and share game-based learning along with opportunities of augmenting teachers' creative potential and professional development. The paper also contemplates on qualitative findings of a small-scale study (n=18) on teachers' different perceptions of game-based learning and constellations of employing a digital platform for increasing awareness and practice in the classroom. An empirically-based framework is developed that maps perceptions to actual practice. The findings may contribute to developing discourse on processes, practices and strategies that teachers would employ, which in turn would inform the design of GBL systems dedicated to support teachers in their effort to use game-based learning most relevant to them.

Keywords: perceptions of game-based learning, approaches to game-based learning, game-based platform, schools, game resources

1. Introduction

A raison d'être for designing, planning and orchestrating Game-Based Learning (GBL) is in its inherent potential to impact student's learning by providing motivating and engaging learning experiences (e.g. Gee, 2004). There is consensus that GBL integrates and combines constructivist learning theories with game-like elements as means to provide self-regulated, goal-centred, creative and situated learning (Partovi & Razavi, 2019; Plass et al., 2015). While research 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 semiotic domains (e.g. Gee, 2004) 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 encourage students not to necessarily learn how to absorb and transmit content, but most essentially how to understand the process of learning through designing, playing and making (Squire, 2006).

Despite frugal debates in meanings between GBL, serious games and gamification (e.g. Wiggins, 2016; Subhash & Cudney, 2018; Landers, 2014) we perceive GBL as an umbrella term to denote a student-centred 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 as tangible digital products, may constitute a specific activity designed or re-used/repurposed encompassing a broader GBL strategy. In ditto, as part of a wider GBL activity, gamification may be proliferated as a route to transform specific learning design elements (e.g. assessment, feedback, progression) to game-like instances via scores, badges, and leaderboards at its simplest instantiation. More sophisticated gamification designs may include escape rooms (e.g. Brown et al., 2019) or gamifying the process of making, building and crafting using playful technologies such as robotic kits, sensors and 3D printers (e.g. Nacher et al., 2016).

The aim of this paper is twofold: Firstly, it attempts to present the design requirements of a GBL hub prototype as a repository for finding, retrieving and sharing GBL resources and secondly, it presents the results from a small-scale study (n=18) on teachers' perceptions and beliefs of GBL and associated attitudes, feelings and dispositions on using a GBL platform that would represent varied and relational actions grounded on, and driven by, underlying GBL perceptions. The findings of the study will inform the design of the GBL hub in terms of the specific type of GBL content to be made available mapping teachers' experiences of and approaches to using GBL. The paper starts by briefly presenting evidence on teachers' perceptions and uptake of GBL and then it contemplates on the design of the GBL hub. It continues by elaborating on the research design and presentation of findings along with a discussion and plans for future research.

2. Teachers' perceptions of teaching and learning using GBL

There is ample evidence from several commentators supporting that attempts to integrate technology-based interventions and associated digital pedagogies in teaching and learning has been challenging mainly because teachers' perceptions of and approaches to using learning technologies and digital pedagogies are not investigated systematically and comprehensively (e.g. Ucus, 2015; Albirini, 2006). It seems logical to claim therefore 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 and make related decisions in their 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. Huizenga et al., 2017; Stieler-Hunt & Jones, 2017) and elucidating on enablers and constraints (e.g. Malaquias et al., 2018; Michael & Chen, 2006) to teachers' acceptance of GBL (e.g. Jong, 2016; Bourgonjon et al., 2013).

In this study, we were interested in investigating teachers' perceptions and beliefs of teaching using GBL as a predominant factor that may influence the uptake of a digital repository for finding, retrieving and sharing GBL content and resources. Bourgonjon et al., (2013) contested 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 to interviews and qualitative studies. The former type of studies investigate level of effectiveness, acceptance or negation of GBL in relation to an increase or decrease on student's cognitive performance and learning outcomes whilst the latter set of studies explore the qualitatively different ways teachers' experience the use of GBL spanning from optimism and scepticism to embedding GBL to the school curriculum, designing GBL based on students' needs and supporting access to GBL resources (e.g. Dickey, 2015; Ucus, 2015). The aim of this study was to explore views of GBL as means to inform disposition on finding, accessing and sharing GBL content, resources and strategies.

3. Design requirements of the GBL hub

The design of the GBL hub is premised on features that would prompt teachers to easily find up-to-date and organised content with clear visualisations on the subject topic, level of students and making explicit the period required for teachers to design and deliver the app as well as the time necessary for students to complete a GBL activity. An iterative flow process of *imagining, creating*, *playing, sharing and reflecting* (e.g. Resnick, 2017) was adapted, as shown in figure 1, to act as the driving force behind delineating capabilities and skills necessary to learn and work within a creative society. We have embraced this notion of instigating creative processes as means to help teachers to use the retrieved GBL content for designing and creating GBL activities and begin to develop as creative thinkers. Creativity therefore is the sine qua non feature of the platform because as teachers start to develop their thinking on how to design and orchestrate GBL through finding, using, sharing and reflecting on GBL they engage with all aspects of the creative process.

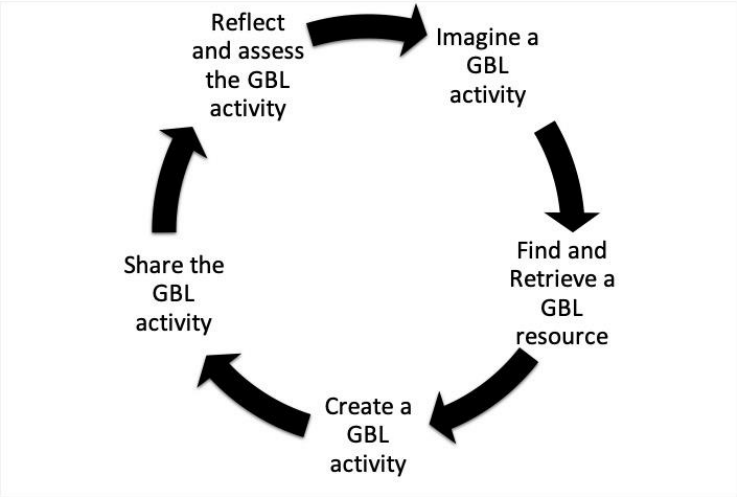


Figure 1: A cyclical flow for creatively using the GBL platform

Teachers start by *imagining* or by *developing an idea* on a GBL activity that they envisage to be planned, designed and orchestrated for a subject topic. They start looking on the GBL platform for *finding* and *retrieving* GBL resources that can use to inform their teaching practice. Then, they are ready to *create* a GBL activity by constantly experimenting with the resources found for turning their ideas and the retrieved GBL resources to actual activities to be orchestrated by students. When the activity is created teachers *share* it with other peers for re-using / repurposing the design and content of the activity. Teachers then *reflect* on the resources found and what it would have made the design of the activity more efficient and playful.

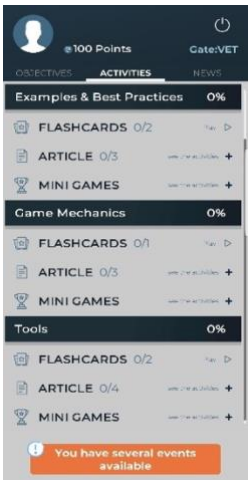
3.1 GBL content

Following recommendations from Becker (2007) and Phillips (2015) the GBL resources are easily searched and found organised into categories for teachers to identify the subject topic, the level of study and the duration of the proposed GBL activity / resource. Each resource has certain properties visualised and represented to the user such as a comprehensive description of the resource, an icon-based type to distinguish different resource types and suggestions on how to use, integrate and adapt them. We have identified four categories of different GBL resource types: (1) GBL examples, tools and best practices (e.g. lesson plans, game designs, serious digital games, games authoring environments, (2) standalone game mechanics: (e.g. feedback and progression mechanics, rules, tutorials, dialogue mechanics, scoring, rewards), (3) gamification processes (e.g. gamification examples like how to gamify assessment through points, badges and leader boards, how to enhance content knowledge in physics through an escape game, how to visualise the basic elements of a Galileo telescope through game cards) and (4) research & news (e.g. research publications, projects and GBL news from the industry).

3.2 GBL hub interface

A mobile application along with a web version of the mobile app will be offered for users to accommodate a larger screen estate making it easier to interact with content and play the games. A web database stores user-generated content displayed both from the mobile app and web portal. The mobile app is available on iOS, Android and Web through WebGL. A toolbox is rendered to offer GBL software such as mini games, flashcards, and gamification widgets like leader-boards. The interface of the GBL prototype is consisted of numerous UI views to form layers of UI objects consisted of three main tabs (objectives, activities and news). The objectives tab displays algorithm generated GBL recommendations and the points to be earned once objectives are completed. The activities tab has three sub-categories (examples & best practices, game mechanics and tools). In all sub-categories the user can tap on flashcards, articles or mini games to interact with associated content. In the news tabs, the user can learn about current trends on GBL from various media including videos, articles and keynotes (see figure 2).

This section offers a selection of recommended contents for every user thanks to an algorithm.



This section gives you access to all the contents (video clips, games, flashcards, articles, etc.). It also shows the level of progression for every theme.

This section presents the last articles, news or video clips published.

Figure 2: Early GBL hub interface version with objectives, activities and news as main categories

Notifications update users on new lesson plans, games, earned badges, and objectives as it becomes available on the platform. Embedded mini games such as flashcards for assessing content knowledge and capabilities will become available as the platform goes live. Other mini games may be designed to test memory, vocabulary and knowledge on GBL tools, processes and strategies to be implemented in the classroom.

4. Research design

The aim of this small-scale study was to investigate how teachers perceive GBL as a way to make explicit beliefs, feelings and purposes of using the envisaged GBL platform for accessing, finding and sharing resources and content. The research questions that sought to address this aim were:

- What are teachers' perceptions of teaching using GBL?
- How teachers' perceptions of GBL impact approaches to using a digital hub as means to inform practice?

Eighteen secondary education teachers were recruited for this study. In order to achieve variation in the experiences we have recruited teachers that taught different subjects who demonstrated diverse experience in using GBL. Specifically, 5 were teaching mathematics, 3 physics, 2 biology, 5 languages, 2 history and 1 sociology. 6 were using GBL currently in some form in their practice and 14 were not, but they were keen on using GBL as means to enhance their teaching. 10 teachers were females and 8 were males and were all working in schools exhibiting varied teaching experience (1-20 years). 6 participants were aware of the term GBL as an instructional strategy that may encompass the use of games and gamification in pedagogically rich ways whilst 14 participants seem to be nebulous in the distinction between GBL, games and gamification. Participants were drawn from a wide geographical range from countries such as Germany (n=6), Denmark (n=6) and Romania (n=6). This ensured that a range of contexts and influences would be placed in the background of the experience.

The data collection process started by encouraging participants to complete a questionnaire as a data-driven method for delimiting perceptions of GBL in their teaching context. Participants had 40 minutes to complete the questionnaire. Questions were semi-structured to allow for deep articulations and meaningful inferences between and within the GBL dimensions discerned. By asking teachers questions such as "What GBL means to you?" and then further probing with "in what ways GBL may improve the design and delivery of teaching?" would delve into their conceptions of GBL whilst questions such as "how would you perceive a platform for accessing and retrieving GBL content?" would discern relationships between espoused theories and theories in use.

The data analysis strategy was guided through a data-driven process as means to discern meanings and relationships that constitute the different perceptions of and approaches to GBL. The software analysis package Dedoose was used for coding, rendering relationships and identifying themes and sub-themes. As such, the analysis was an inductive approach that delineated associated inferences and meanings from the data. To achieve consistency and trustworthiness we carried out the analysis in two stages: during the first stage the researchers individually identified and coded the data for identifying preliminary themes and then, in the second stage, the researchers collectively went through the data and the preliminary themes for constituting the final datasets. A fusion between descriptive (e.g. illuminate themes) and interpretive (deeper enquiry of meaning) was followed to ensure rigorous analysis procedures.

5. Results

In what follows we present the results of the analysis on teachers' perceptions of GBL and the varied constellations and meanings of using the GBL hub for informing practice. Teacher identifiers (T1-T18) were employed to ensure anonymity and to indicate responses from the teachers.

5.1 Teachers' perceptions of GBL

Understandings, experiences and meanings of game-based learning sought to reflect teachers' unique ways of perceiving and using game-based learning in their own teaching practice. Game-based learning therefore was experienced as:

Theme A: Helping students to register and retain knowledge into memory: It was perceived that game-based learning can help students memorise and retain knowledge and content-knowledge in more engaging ways: "*Students can remember things better. For example, monopoly is a game that can help students memorise and retain knowledge"* (Teacher 3). Quizzes and memory games were perceived as types of games that may help students to retain concepts and facts: *"Quizzes and memory games used in math class – used for evaluating the course modules and the students"* (Teacher 10).

Theme B: Helping students to gain improved understanding of the topic: In this theme, game-based learning was conceived as using GBL for *"gaining improved understandings of certain learning situations"* (Teacher 1), *"Breaking up from pure theory, not just conveying knowledge"* (Teacher 2). Applications of GBL interventions included the use of 'flashcards' for helping students to understand how theoretical concepts apply to practice. *"It can help you understand the material you are working with"* (Teacher 9). Understanding of concepts felt that can be instigated through applying theory via playing a mini-game: *"I mainly use games as comprehension exercises – I first go through the theory, and then the students can play through it instead of doing a boring theory assessment"* (Teacher 10).

Theme C: Attaining an in-game learning goal: Game-based learning was correlated with a learning outcome or goal that the student / player needed to achieve. A trial and error process was used for assessing whether the in-game goal has been addressed especially for ill-defined problems. *"Forming opinions"* (Teacher 2) and aligning in-game objectives felt as important for encouraging the design of in-game learning goals tied to in-game learning activities. Achieving in-game learning goals was also increasingly correlated with being an autonomous learner and *"assessing themselves and making success [or failure] visible"* (Teacher 5). However, it was felt that there is no much time for teachers to attach a learning goal into an existing game due to teaching workload: *"Lack of time (for preparation and implementation of game ideas) is the biggest challenge"* (Teacher 3).

Theme D: Developing a sense of constructive competition: Game-based learning was seen as a medium for competitive learning processes that would create feelings of self-esteem, self-motivation and self-development. Using game rules and *"a rough structure within a games competition"* (Teacher 6) students could potentially exert their best learning performance. Learning is sought to be realized through peer-work: *"groups correct each other after group-work with measurably better results because of game competition"* (Teacher 6). Constructive competition was also perceived as *"linking student's actions"* (Teacher 2) with direct comparisons of their performance in relation to how other students have performed. Role-playing games were viewed as a genre that foster competition as *"students compete based on the skills assigned to their roles"* (Teacher 4). Competition

may also create conflict and this is something that it is not desirable from the teacher's perspective and could be replaced by reflection and critical thinking: *"The challenge with games is that it often become a competition, which I have mixed feelings about, and I like it, but it can also intimidate some students. I would like to use games that trigger reflection and analytical thinking than competitiveness"* (Teacher 14).

5.2 Teachers' approaches to using a GBL hub

Teachers had diverse views on how the GBL hub would be a supportive tool for developing their teaching practice. In particular, teachers sought to understand the GBL hub as:

Theme A: searching, accessing and organising GBL resources: An essential aspect of the platform is to be able to provide gamified learning content effortless: *"Finding a game presenting the facts of World War 2 easily without having to search for a long time"* (Teacher 2). "*Such platform has the potential to save me a lot of time and energy taken up in the process of looking for gamified slides on my math lesson on the Web"* (Teacher 7). Being able to convert analogue to digital content was also key for teachers to share gamified content that they use in class with others via the platform: *"simplification of content conversion (from analogue to digital) would be important"* (Teacher 3). Search function, simple syntax, content ratings, best top 3 resources, favorites and a bookmark section was also key for users to navigate and search: *" Ideas explained briefly time indication, intuitive, simple, search function, results concerning all subjects for example per school year or subject, specification of the age group"* (Teacher 4).

Theme B: Discovering GBL resources for creative use: lesson plans, game design templates, game mechanics discovered for inspiration in creating GBL activities new to the teacher. *"A GBL design template or a feedback mechanic would help me to come-up with a new idea I haven't tried before"* (Teacher 1). Through curious exploration and investigation of diverse GBL content would help teachers to reach their full creative potential: *"I would expect that exploring and experimenting with different types of GBL designs, games or even small gamified snippets so I can playtest and tinker would help me to identify and expand my creative potential"* (Teacher 17). Discovering GBL resources felt as a "Eureka" moment fueling the start of a creative journey: *"I would feel like being hit by a lightning bolt when I meant to discover this card game for multimodal teaching; I could tweak it for my students to learn about English vocabulary"* (Teacher 14).

Theme C: Creating communities of GBL: A community-based structure for supporting teachers to learn, share and provide / receive feedback for using game-based learning resembling processes and practices defined from and approved by the community: *"possibility for collaboration, communication, incentives to give feedback and ratings as a reward system and for assessing resources made by other [teachers]"* (Teacher 2). Getting reviews and comments on gamified content already used is a core aspect of creating a community: *"Reviews from others, so that it's easy to get an overview of your own designs, what level it's relevant and a checklist of student skills for them to be able to play the game"* (Teacher 10). Creating a GBL community was interestingly perceived as nurturing creativity through discovering, using and sharing resources and feedback on GBL by other teachers in the community: *"A GBL community is all about encouraging, nurturing and supporting new ideas, designs, providing feedback, improving together a design for it to flourish"* (Teacher 13).

6. Discussion and conclusions

Teachers' perceptions of GBL were varied from retaining knowledge into memory and helping students to understand the topic to addressing a learning goal and developing constructive competition. Experiencing GBL for retaining knowledge into memory is characterised as a content based GBL learning intervention that teachers employ for transmitting information to students. Principally the purpose of traditional content, such as reading books and slides, is being emulated by GBL content. In the second theme, GBL is experienced as a way of helping students to apply theory into practice. Practical games that students play and interact with aid their efforts to understand how theory is being used to solve a practical problem (e.g. Wouters et al., 2013; Liu et al., 2014). In the third theme, GBL is tied to a learning outcome or goal that the student needs to attain. Students are developing trial and error processes, playing as many times as needed to achieve learning goals, especially for complex and ill-defined problems that need to be aligned within. In the fourth theme, GBL is perceived as a way

for triggering constructive competition in the sense that competition is a mechanism for encouraging collaboration, meaningful learning and creativity.

Teachers' approaches to using a GBL hub spanned from searching content and discovering GBL for creative use to creating GBL communities. Searching and organising content was as essential aspect that would encourage teachers to easily access GBL and find resources appropriate to their own needs. Discovering GBL resources for creative use would encourage teachers to develop ideas and ascertain their creative potential (e.g. Urus 2015; Resnick, 2017). In theme 3, teachers experienced the use of a GBL hub as a space for building GBL communities to support development in GBL practice (e.g. Romero and Barma, 2015). GBL practice is cultivated though sharing resources and through reflecting on GBL collectively leading to developed understandings of how GBL resources found on the platform could enhance practice.

In Table 1 we attempt to map teachers' perceptions of GBL with approaches to using a GBL hub as means to understand impact on actual practice. In theme A, the focus is on using GBL for knowledge retention, therefore searching and organising GBL per content type would most likely allow teachers to access GBL that ensembles their needs. To support the discovery of GBL content for creative use teachers may retrieve content-based games and gamified assignments that would inspire how to represent and visualise content creatively. GBL communities with a main topic around different ways of representing, visualising and assessing GBL content may be formed. In theme B, the focus is on understanding the topic hence searching for applied-based GBL and context-aware games would enable use of GBL for complex meanings. Discovery of GBL resources for creative use may encompass repurposing lesson plans and gamified simulations with problem-based scenarios. Community development would convey GBL aspects around applying theory into practice. In theme C, associating learning goals in GBL is in the foreground of participants' experience. Searching for gamifying learning outcomes would enable teachers to assign GBL learning goals. Discovering GBL for creative use may be in the form of mapping goals to GBL templates. Communities around how to design and represent goals in GBL would assist in the design of goal metrics. In theme D, the focus is on constructive competition as a process of instigating progress and collaborative mechanisms for learning development. Searching for competitive GBL would highlight the competitive and collaborative elements of the perception. Discovering GBL content for creative use could be around game design collaboration templates. Community building for supporting GBL would help on designing creative GBL for promoting competition and collaboration.

Table 1: Mapping perceptions of GBL with approaches to using the GBL hub

	A: Searching for GBL content	**B: Discovering GBL for creative use**	**C: Creating GBL communities**
A: Registering and retaining knowledge	*Memory games, non-interactive content-based games, gamified slides, books and assignments*	*Content-based games, game designs that focus on content, gamification processes for assessing acquired information*	*Communities around broadcasting, and visualising GBL information and knowledge*
B: Understanding the topic	*Applied-based GBL, context-aware games, gamifying a field trip resource*	*Gamified simulations, mobile games, GBL lesson plans performed outside the classroom*	*Communities around applying theory into practice via GBL content*
C: Attaining a learning goal	*Trial and error games and gamifying learning outcomes, gamifying grades, virtual rewards*	*Games with scoring elements, victory and loosing conditions; role-playing scenarios, narration mechanics*	*Communities around designing in-game learning goals to GBL, reusing / sharing successful GBL goals*
D: Developing constructive competition	*Competition-based GBLs, action games, co-op games, scoring & leader-boards, timer mechanics*	*Creativity-based GBL, game design templates, game engines, collaborative & mechanics, gamified peer-assessment*	*Communities around collaborative GBL teaching. Visual ratings and textual feedback for assessing GBL*

The results from this study revealed teachers' perceptions of GBL and the impact on using a hub for searching and discovering GBL for creative use, and for creating GBL communities of practice enabling the categorisation of GBL content to associated perceptions of GBL. This mapping between teachers' perceptions of GBL and approaches to using a GBL hub would encourage the design and categorisation of GBL content to align with teachers' actual practice most meaningful and relevant to them. An interesting study would be to build on these preliminary findings and identify perceptions and dimensions that would be inclusive and hierarchically structured delineating a more developmental set of GBL perceptions and approaches along with their influences. Limitations arise from our study in terms of its context-specific nature that may not be generalisable to other contexts. However, in that it revealed, teachers' perceptions of GBL are instrumental in better understanding approaches to using GBL which in turn would inform the design of GBL systems and resources.

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