

# A Framework for Analogue Game-modification Learning

## Guidelines to Lower Barriers for Games in Education

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### ABSTRACT

Academic interest in games as learning and teaching tools has directed much scholarly work towards gaining a better understanding of game-based learning and analyzing the experiences of both the educators and the learners. Our knowledge of the effective use of games as integral parts of educational approaches has increased, yet game-based learning has not displaced the instructional practice of teacher presentation to a significant extent, particularly in formal post-primary education. This paper will outline how games are generally used for educational purposes and describe reasons that hinder the wider adoption of game-based learning methodologies. Analogue game-modification learning (aGML) will be described as offering potential solutions to these hindrances through a framework that serves as a set of guidelines for efficient implementation.

### CCS CONCEPTS

• Applied computing; • Education; • Interactive learning environments;

### KEYWORDS

Learning games, game-based learning, participatory game design, game modification

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## 1 INTRODUCTION

The educational impact of games has been a subject of much scholarly work, particularly since the emergence of game studies as an academic field. Numerous researchers have analysed the experience of educators with these methodologies [3, 5, 6, 8, 10, 18, 21, 25, 29, 31, 41, 42]. Although results differ, the consensus is generally positive regarding improvements in student engagement and learning outcomes. The activities and artefacts generally understood as "games" [36] typically invite interaction and can provide students with compelling learning opportunities, replacing the passive mode they experience with the instructional practice of teacher presentation.

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Games can also serve as a framework for meaningful context [9], providing students with an opportunity to experience the taught material in a relatable situation. The specifics of how games are applied to an educational setting vary. Figure 1 visualises a categorisation of game-based learning based on Becker [4], adapted for the purposes of this paper. At the top level is game-based learning (GBL) - "the process and practice of learning using games" [4], used as an all-encompassing term for this methodology. It is then subdivided into games for learning (G4L), and game-design learning (GDL). Game-modification learning (GML) is situated as a sub-category of GDL and is itself further broken down into digital (dGML) and analogue (aGML) implementations.

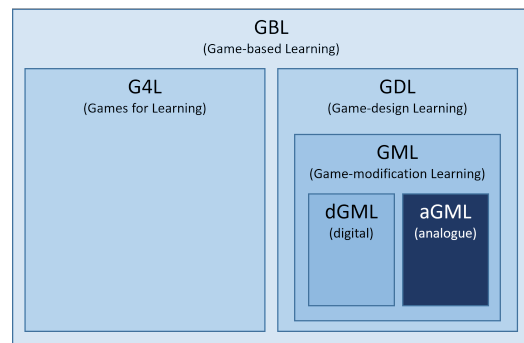


Figure 1: Categorisation of GBL methodologies, based on Becker [4]

Sections 2 to 4 of this paper will describe game-based learning practices in general terms to situate the suggested methodology of game-modification learning within the broader context. Section 5 briefly highlights the benefits of using non-digital (analogue) tabletop games and provides examples. Section 6 presents an overview of hindrances to the use of games in educational contexts, followed by a description of the suggested aGML framework in section 7 to suggest how the identified barriers could be addressed. Section 8 discusses the known limitations of the presented work, as well as suggested future work to enhance and extend its findings.

## 2 G4L – GAMES FOR LEARNING

The approach of using specifically designed "serious games" - games designed for purposes other than, or in addition to, pure entertainment [4] - is intended to provide tools and material for educators to use as a supplement to their usual lecture format. The application of games as learning tools changes the learning environment from both the students' and the educators' perspectives. This means these tools must be designed with particular functions in mind, based on an educational theoretical foundation and an instructional

methodology. It also means that educators, as the people implementing these tools, should receive proper training in their use. Cheng et al. [13] have reviewed 53 empirical studies on using serious games (in science education, specifically) and have analysed the practices involved according to several dimensions. Serious games appear more often to be used to create a learning environment rather than as instructional tools, and constructivist perspectives [40] often are important theoretical foundations for these games to facilitate engaged learning.

In addition to their functional requirements, games meant to assist in teaching and learning ideally should also be “good”. What is or is not good about a game depends, of course, on many factors, not least of all on individual subjective preferences. The fact remains that the aesthetics of a game influence how it is experienced, and this goes beyond the mere surface-level art design or gameplay graphics. In this sense, the aesthetics of a game constitute its ability to facilitate experiences like expression, discovery, or challenge - in other words, the components of a game that make it “fun” [26].

Educational games face the same challenges as “regular” games - they may simply not be very engaging or possibly miss their design goal by just not being particularly “educational”. Additionally, some games may be designed based on more behaviouristic ideas, thereby failing to embrace more learner-centred or experiential pedagogies, or supporting passive learning processes without taking advantage of learners’ creativity [37]. Designing a game based on behaviouristic principles of stimulus and response, such as quiz games, or narrative games that challenge players with essentially extradiegetic puzzles, may, in many circumstances, be more feasible than designing constructivist games that meaningfully integrate the educational goals with their gameplay to create active learning environments. Ideally, the process requires a designer (or team of designers) with experience in game design, educational theories, and instructional design. However, even if that is the case, the teachers who eventually use the artefact in their classroom are presented with a finished product on which they likely have had no input. In some cases, teachers may even have to spend time and effort to address wrong or inaccurate information contained within learning games - although savvy educators can transform these mistakes into teachable moments [20].

### 3 GDL – GAME-DESIGN LEARNING

GDL aligns very much with the aim of GBL as a more learner-centred approach to education and could represent a means of addressing some of the potential shortcomings of educational games. Designing and implementing game mechanics that support particular learning goals, as well as creating the content that makes up the theme or narrative of a game, expects that the designers have a detailed understanding of the material or topic to be taught. Arguably, the most significant benefit of an educational game is experienced by the designers, as they spend a great deal of time on the content of such games, their representation to the players, and the instructional techniques to be applied as part of the gameplay [28]. Designing a product that aims to inform or educate requires knowledge of the topic that serves as the basis for the artefact, an understanding of any processes involved and their interrelations, and the cognitive and operational requirements of

the intended audience. In other words, the designers must have a thorough knowledge of the content and sufficient control over how they want to communicate it [21].

Although it is necessary to differentiate between education and personal transformation, the requirements and effects discussed above are relevant and beneficial to both. Therefore, the idea translates into the practice of design - rather than playing - of games as a teaching and learning technique, to which there are at least four benefits. Firstly, learners are potentially more motivated and actively engaged as producers of an educational game rather than simply consumers. Designing games is an intrinsically meaningful task as the resulting games are personally meaningful artefacts [30]. Secondly, learners receive the increased benefit of going through the design process of the educational game and all its related tasks. Not only does this require a thorough understanding of the taught material, as discussed above, but they also need to apply design thinking and problem-solving skills, which are higher-order cognitive skills [23]. Thirdly, the responsibility and challenge of making the game engaging, enjoyable, and educational is shifted mainly to the learner. In fact, with this methodology, those attributes are no longer required for the game to be used in a successful implementation of GBL. The process of designing and making the game artefact represents in itself a constructionist-type learning activity - a construction of knowledge “[...] through building a complex product for use by others.” [28]. This is true even if the resulting game uses behaviouristic mechanics in its attempt to teach the material to the players, or is altogether ineffective in engaging them. Lastly, professionally developed educational games are generally limited to the knowledge domains for which they have been created. In contrast, a framework for creating games for learning provides educators with a tool they can potentially apply to any subject and level.

The use of GDL was pioneered predominantly by Yasmin B. Kafai, based partly on educational approaches developed by Jean Piaget [35] and later Seymour Papert [34]. The methodology borrows heavily from the constructivist view of education; more specifically, GDL embraces a constructionist theory of education. Constructionism is so named because it is informed by constructivist theories of psychology and involves the learners’ construction of a meaningful product. The last decade has seen a proverbial explosion of so-called makerspaces in educational settings, substantiating this idea of constructing to learn. Similarly, game jams - relatively short, team-based game design events - have become very popular in various contexts, including education. They are adaptable in their methodology and serve as effective and motivating pedagogical tools [3]. Meishar-Tal and Kesler [32] have conducted research among students with learning difficulties using a game generator. They aimed to investigate the improvement of thinking and learning skills not necessarily related to a specific school subject. They have seen beneficial impacts with the use of game design and addressed a gap in the literature concerning the applicability of this pedagogical technique to low-achieving students.

Digital technologies appear well suited for GDL projects, which may be reflected in the types of knowledge domains for which they are used. Hayes and Games [23] identify four approaches to GDL that differ in their educational objectives. Three are related to

acquiring programming skills, attracting female students to computer science or technical fields (STEM subjects), and understanding game design principles. Only one category covers GDL projects that concern themselves with enhancing students' learning in other non-technical academic domains. Kafai's [28] project, for example, covered using a programming language, computational thinking, and an understanding of the mathematical concept of fractions.

#### 4 GML – GAME-MODIFICATION LEARNING

As discussed, game design is a high-level thinking skill that needs to be learned and practised and, as such, comes with a learning curve. This can be discouraging for inexperienced learners tasked with designing an entire game from scratch while tackling new curriculum content simultaneously. Adapting existing games rather than designing new games can simplify and shorten the game design process. Many problems encountered and decisions made throughout the game's design could be removed by only redesigning portions of it while leaving large parts in their original form. In other words, by having a 'playable prototype' (i.e. the original game) with subsystems that are already working together, the process of manipulating these subsystems to achieve desired outcomes becomes less daunting [12]. Game design as 'redesign' - or modification - would potentially be considerably simpler for novice designers and far less time-consuming to fit within the time frame allotted to a curriculum unit.

Many modern digital games employ the use of a game engine for their main content, with a separate set of modification tools to facilitate player-generated content or alteration of game mechanics [23]. Students taking part in GML projects can start their design process by playing a game that provides these options and first learn to appreciate the game as a designed artefact, then reflect upon and discuss its mechanics in relation to the curriculum content they are meant to illustrate. They can then identify any shortcomings the game processes may exhibit and attempt to adjust these based on their understanding, at first in theory but the modification - or 'modding' - tools discussed above. For example, the Civilization series of games has been popular among educators for its depiction of history and various concepts of nation-building and conflict and the role of technological advancements [23]. Its latest release, Sid Meyer's Civilization VI [19], has facilitated (at the time of writing) thousands of user-generated gameplay changes as well as hundreds of custom scenarios by the Steam Community [45] illustrating various historical and geographical settings.

Another approach to adapt a game for educational purposes is to change the way it is played on a user level - in other words, instead of changing how the game functions, players change the way they engage with it. For example, as part of their investigation into the use of games in humanities subjects, Caldwell et al. [9] have studied Latin students engaging with the game Rome: Total War [15] as a group, assuming the function of the governing senate. As 'senators', students would "[...] advise, argue, and orate as they had learnt from historical texts."

#### 5 GOING OFFLINE – A CASE FOR NON-DIGITAL GAMES

A likely hurdle towards more widespread adoption of GDL appears to be the requirement for participants to be reasonably skilled in computer programming or possess the knowledge to use a suitable game-making tool effectively. While many of these tools have been advertised for their user-friendliness and shallow learning curve, there is still the need for some time to get accustomed to their use [12]. However, an alternative can be the use of non-digital tabletop games. Especially modern board games are often designed to simulate very complex real-world systems and are adaptable, making them suitable for shorter GDL exercises [1, 12, 38]. Board games are generally played in person by small groups, following a set of codified rules, using physical components such as tokens or cards, and a board or playing surface on which they are played. They are versatile and capable of addressing several topics, which can be presented in an engaging manner and simulated through intricate game mechanics. As they are essentially made of paper, replacement components can be hand-made, and rules can simply be changed without using special 'modding' tools. Savvani and Liapis [37] have used a GML approach in EFL classes (English as a foreign language) to combat the shortcomings of GBL identified above. Using participatory (re-)design of commercial board games, they took groups of students aged 10-13 through a multiple-stage process and created educational artefacts from popular games such as Taboo and Pandemic. The game CO2 was used by Castronova and Knowles [12] in a study by changing the rules to emphasise the problems policymakers face when attempting to bring about meaningful change. Cortés et al. [14] have attempted to tap into the learning potential of 'designerly thinking' through their approach of playing and fixing ('playfixing'). For already discussed reasons of reducing the demands on students' cognitive resources, the process of designing an entire game is replaced by playing and analysing a game, followed by suggesting and implementing changes to fix a game's 'flaws'. The definition of these flaws could be defined relative to a game's lack of educational quality by misrepresenting or oversimplifying facts related to the taught material.

#### 6 BARRIERS TO ENTRY

Given the amount of interest and research directed towards GBL, it still appears to be a very underused approach to teaching and learning, especially in formal education or as part of official curricula [8, 25]. GDL is usually implemented as an after-school option, summer camp project, or other extracurricular effort; see, for example, Kafai's project of creating a game over a six-month period [28] or Ke's [30] six-week project about design-based learning in mathematics. Although these projects further the community's understanding, they rarely lead to any significant change in educational practice [6]. Fortunately, much research has been conducted that analyses and describes barriers to entry and provides insight into the issues that need to be addressed, as well as guidance towards designing mitigation strategies. For example, Aurava et al. [3] investigated teachers' opinions concerning game jams as pedagogical projects, making their insights very relevant to the application of GDL in general. Other researchers have investigated teachers' opinions and attitudes towards games as learning or teaching tools

[5, 10, 25, 29], attempting to assess which internal and external factors influence their willingness to adopt or attempt GBL. Work has also been done to assess what barriers there are to the acceptance of GBL, which of course, also relates to adoption and success rates [8, 18, 22]. Lastly, Williamson [42] surveyed over 1600 teachers in the UK and found that a large proportion of them mention the same issues, many of which align with the findings of other studies above.

To pinpoint common barriers to GBL – as well as GDL as a sub-category of GBL - individual issues were extracted from the studies listed above. Focus was placed on issues that a specifically designed framework could feasibly address, rather than larger systemic problems. Issues were then categorized, and the categories sorted in order of priority based on the number of studies that identified an issue belonging to a particular category as problematic. From analysis of the literature, five categories were identified. The third of these, in order of significance, is a lack of access or problems with IT infrastructure. However, as the approach suggested by this paper employs the use of specifically non-digital games such as board games, these issues will not be discussed further. This leaves four categories, in order of priority:

- Lack of GBL expertise.
- Lack of implementation support and documentation.
- Inflexibility of schedule/curriculum
- Preparation time requirement

### 6.1 Lack of Game-based Learning Expertise

Almost all reviewed studies mentioned one or more problems related to teachers' lack of experience with GBL approaches and a general lack of knowledge about available games and how they can be implemented in a learning setting. On one hand, they experience difficulty finding suitable games which align with their learning objectives and have enough relevance to their school's curriculum, but they are also not very aware of how these games could be integrated into their instructional techniques [5, 6, 31, 41, 42]. This lack of expertise also causes concern about class management issues, such as making students understand what is asked of them or managing their attention [10, 41, 42]. To some degree, the lack of experience may be viewed as more of a symptom than a cause. The need for the provision of GBL-related initial teacher training (ITT) and continuous professional development (CPD) is essential and should be highlighted [42], but ultimately teachers can only gain more experience through implementing their own GBL projects firsthand. Addressing the following concerns should be seen as a prerequisite to this.

### 6.2 Lack of Support and Documentation

As the second most common category, this relates to the lack of support teachers would be able to receive from their school administration and colleagues [18, 22], but also to the inflexibility of generally very conservative educational systems [41]. Even those willing to attempt the challenge of GBL 'on their own', as it were, find it difficult to obtain documentation and guidelines that could make this task more achievable [8, 29]. While some of the above issues indicate more deep-seated problems of a systemic nature that

will have to be ignored to stay within the scope of this paper, teachers can hardly be expected to go through significant lengths of time and effort during their normal lesson planning and preparation. Guidelines applicable to the needs of teachers - especially those with little GBL experience or knowledge - would have to be accessible and detailed, with step-by-step instructions ideally describing and explaining the implementations of specific games to specific portions of the curriculum [8]. The provided documentation should be designed to lower the entry barriers to a point where teachers can attempt a GBL project without (much) additional preparation and with minimal risk of failure. Once they accumulate positive experiences with games in their classrooms, their willingness to invest additional time and effort may increase.

### 6.3 Inflexibility of Schedules and Curricula

This category contains issues related to the planning of GBL activities around the schedule of teachers and students and the curricula of individual taught subjects. Often projects such as those discussed above were implemented as a form of extracurricular activity for several reasons. First of all, they require an amount of time that is difficult to fit within a typical lesson. This may be less of an issue for primary school teachers as, generally, a single person teaches most subjects to the same group of children. However, in post-primary education, this can create scheduling problems that affect learners, teachers, and access to facilities [3]. Additionally, teachers generally have to cover a rather extensive curriculum during a scholastic year, and any activity such as GBL that takes up significant time creates the risk of displacing content in the process [10]. A desirable solution to this issue is, of course, an increase in the flexibility of teachers' curriculum management, for which Williamson [42] cites several examples. Instead, in keeping with the bottom-up approach, GBL activities would likely only become feasible if they can be implemented within the constraints of the existing curriculum. For example, many subjects such as geography, science, or history cover topics that can include a form of project-based learning - presentations, essays, or group research activities. The adoption of GBL, and particularly GDL, may increase if it can be viable alternatives to these projects.

### 6.4 Preparation Time

As many GBL approaches require significant preparation time, which is often impractical for teachers due to existing time constraints, it may not be justifiable to invest a lot of time in a project that potentially only covers a very small portion of the material to be taught. Preparation time is limited; therefore, an increased time requirement to trial new techniques needs to be justified [3]. These issues are strongly related to the first category, lack of experience. A lack of (positive) experience would negatively impact teachers' willingness to invest the required time and effort. This category is last in the list, as it was not mentioned in as many studies as issues relating to the previous three categories. However, when it was mentioned, it was done so with emphasis [18, 29].

These issues are also tied to the lack of support and documentation. Frameworks for GBL/GDL practices can be relatively open and generic [1, 3, 14, 39], which is useful when one attempts to apply them to various games and differing situations. However, a more

prescriptive and specific guide concerned only with a few distinct games could describe their exact use for a list of predetermined learning goals within chosen subjects. A more specific framework would initially be less adaptable and flexible than its more general counterparts. However, once a suitable project has been identified, it would require the practitioners to consider far fewer variables, therefore fulfilling its designed purpose of significantly speeding up the implementation process.

## 7 THE AGML FRAMEWORK

The aGML framework is intended to provide potential solutions to the barriers mentioned in section 6, through facilitating the use of commercial non-digital tabletop games, particularly board and card games, as a basis for design activities meant to adapt the original game to a stated educational purpose. In addition, it is meant to help teachers or educational game designers to create and use GML activities in a variety of educational settings which are not necessarily tailored towards or particularly supportive of games as learning activities. In its current form, the framework was designed to be adaptable to a broad range of educational settings, but the described example was tailored towards an implementation in compulsory secondary education. As such, it is designed with the following goals in mind:

- Phases within the framework should be well documented and easy to follow for practitioners with little or no experience in GDL, or GBL in general.
- The framework should facilitate the creation of aGML projects that align with the existing learning goals of relevant curricula.
- aGML activities should be provided in the form of clear assignments of limited scope and reasonable time requirements that an educator can give to their learners as part of a project-based approach to a specific topic.
- The resulting aGML project should be explained with clear and comprehensive documentation that enables implementation without significant added effort or preparation time requirements.

The main learning activity is to be centred around the analysis and adaptation of a game, using play and design as ‘meta-cognitive activities’ and context for engaging with the taught material [17]. Playing the game is a requirement for understanding the game’s potential and determining a viable course of action for the design process. However, it does not in itself represent the game-based learning approach intended here. The resulting artefact’s suitability for educational applications should be a goal of the design activities but is not the primary requirement for a successful implementation. The focus lies in the constructionist approach of learning through creating a meaningful product.

The aGML framework borrows from Abbott’s [1] learning-objective-centred workflow. Abbott also uses and extends the so-called Learning Mechanics - Game Mechanics (LM-GM) model [2], which is meant to aid in the design of serious games by connecting learning goals to game mechanics. As the framework presented here is concerned specifically with analogue games, a more applicable approach might be that of Sousa and Dias [39], which takes into consideration the particular flows of modern board games, as

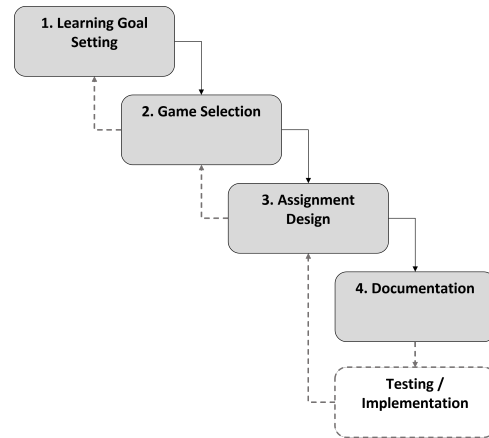


Figure 2: Outline of the aGML Framework

well as their materiality. For the purposes of the GML method, the activity of playing the game (before and after modifications) is not in itself a primary part of the learning process. Learning activities, as described in phase 3 of the framework, are based on the analysis and adaptation of the game artefact, meaning that a connection between learning mechanics and game mechanics - either in the original or modified form of the game - is not a requirement. However, it can be helpful to understand the mechanics used by a game, and how they relate to the learning goals and desired learning mechanics. Games that already contain desirable mechanics may be more easily adapted and provide better artefacts after modification, with a more significant potential to be used in other learning activities as G4L artefacts.

At a conceptual level, the aGML framework mimics lesson planning, which is a challenging and complex skill, and various approaches exist. The framework in its current iteration will be based on the generally most common - though heavily criticised - linear model [27] for two main reasons. Firstly, a thorough review and assessment of different approaches goes well beyond the scope of this paper. Secondly, while teachers may use different, more advanced, or fluid methodologies to plan their lessons, a more simplistic and uniform approach can aid in sharing and comparing projects created within the aGML framework, which would itself be a prerequisite for any self-supporting community of GML practitioners to be established. Individual teachers could then adapt projects to their teaching style and circumstances. The structure resulting from applying the aGML framework is not to be seen as a best practice but as a guideline for integrating GML into the curriculum. Figure 2 provides an overview of the aGML framework from the perspective of the teacher or instructional designer. Each phase is discussed in more detail in the below sections with an example.

### 7.1 Learning Goal Setting

The first phase in this process is to select which portion of the curriculum or syllabus is suitable to be taught by the proposed project. Several criteria need to be evaluated:

- Can the selected topic feasibly be taught - or is it, in fact, currently being taught - through a project-based approach?
- Is enough teaching time available to cover the selected topic through the proposed project?
- How much time can students be expected to work on assignments outside the classroom?

For example, teachers could consult their school's official syllabus of their taught subject to determine a likely topic for this purpose. Official curricula published by the relevant education authority can serve as a source, as they often specify in detail how much instruction time should be dedicated to a given topic, as well as a comprehensive set of learning outcomes. A clear understanding of the objectives allows the educator to draw up a list of learning mechanics they would generally use to teach the selected topic, which can aid in the subsequent two phases of game selection and assignment planning [3, 39].

As a theme for this example, the Second World War was selected from the learning goals for year 10 history students published by the History Department – Directorate for Learning and Assessment Programmes in Malta [43]:

- **Causes leading to the war:** Students are to know the reasons why the war started and understand why Malta was involved in this war; length: 2 lessons.
- **Causes leading to the Allied victory and consequences of the war:** Students are to understand why the Allies won this war; length: 1 lesson.

The syllabus also lists several specific points related to the above topics, which should be covered as part of the lessons. For the sake of brevity, they are not listed here, but they provide a valuable source of information for the design of the GML assignments.

## 7.2 Game Selection

Games selected during phase 2 should have a short enough play duration to avoid conflict with the time constraints of the curriculum [10], which needs to take into account the setup time required as well as the amount of time it takes for students to get to the relevant part of the game - in other words, ensure students get into contact with the physical components or game mechanics that they will need to adapt as part of the assignments defined in phase 3. While it may be helpful to select games that are already 'educational' to a certain degree by aligning thematically or mechanically with the taught subject [1, 12], it is not necessary. Many frameworks and guides concerned with board games will send the reader sooner or later to the website BoardGameGeek [44], which at the time of writing, offers detailed information on over 23000 board and card games. Games can be searched by their category (such as "educational games") or the game mechanics they use. A very helpful selection criterion provided by BoardGameGeek is a game's 'weight', rated on a scale of one to five, which represents the community rating of a game's complexity. It is advisable to select games with a weight of 'light' (1.00-1.99) or 'medium light' (2.00-2.99).

For the example here, Timeline [24] was selected as a game to provide context for the learning activities. According to the game's entry on BoardGameGeek, it has a very low complexity rating of 1.16 and an average playtime of fifteen minutes [46]. It can also be

played by a single individual - for example, as a demonstration by the educator - or in relatively large groups of up to eight people. Furthermore, the game consists only of a deck of cards, which makes the process of physically modifying it relatively simple by adding or removing cards from the game.

## 7.3 Assignment Design

Linear lesson planning often involves the definition of activities and tasks and blocks of time allotted to their completion [27]. For phase 3 of the aGML framework, this translates into defining the assignments to be completed by learners as part of the project. These are intended to guide students' learning activities by providing clear instructions and a defined scope. Assignments can be designed to be completed by individual learners, small groups, or the whole class (depending on size). It should be kept in mind that promoting collaborative learning is often a goal within GBL projects, as it should be for GML implementations whenever feasible [9]. To make sure the learners understand what is asked of them [10, 41, 42], assignments should follow these guidelines:

- Be self-contained: each assignment can be completed on its own and implemented in the game as a modification.
- Provide clear instructions as to what is expected of the students.
- Include an appropriate level of guidance.
- Leave enough freedom for personal expression.

Assignments can be of a varying level of complexity and difficulty, which would depend on several factors, such as the topic to be taught and the amount of time students can feasibly dedicate to work on them. All assignments should be preceded by an in-class play session of the game, allowing learners to gain an understanding of it as well as clearing up any misconception while there is a teacher or facilitator present. In addition, whenever possible there should be a debriefing session contained within the lesson plan to facilitate a sharing of experience between the participants and a "real" learning experience [16]. Ideally, debriefs represent an integral part of the assignment planning, where they could potentially also serve as an assessment method.

For the example here, three different assignments have been designed to illustrate three suggested levels of difficulty that can be used as a guideline. Level 1 - 'Re-skin' - represents a change in the game's theme, which is relatively simple for the suggested game. The original game of Timeline contains 55 cards depicting historical events from prehistoric times to the early 21st century. The students' task is to research significant events of the Second World War and create 55 cards to be used in the game instead of the originals. The level 2 assignment - 'Guided Modification' - is designed as a continuation of the previous activity. A new rule using a separate deck of 'Condition Cards' is explained to the students. These cards should contain societal, economic, and political circumstances related to the chosen events. They can either be causes or consequences of an event or are otherwise related. Ten random Condition Cards are placed face-up during gameplay, visible to all players. When a player places an event card in the timeline, they can also assign Condition Cards from the shared pool to the event, if applicable. Assignment 3 represents an example of the third level, 'Independent Modification'. This task is comprised of

General Information									
<b>Title</b>	World War 2 - Causes and Consequences								
<b>Time Frame</b>	<b>Year/Age</b>	<b>Class size</b>	<b>Main Subject Area</b>						
<b>School</b>	3 lessons	Year 10	n/a	History - World War 2					
<b>Home</b>	3 hours	13-14							
<b>Wider Curriculum / Learning Goals</b>	Describe causes leading to the war and causes and consequences of the Allied victory; Understand the past's implications on the present; Interpret information from a variety of sources; Understand and describe causes leading to historic events								
<b>Current Level of Understanding</b>	Students are able to research historic details and have a high level awareness of WW2								
<b>Project Structure</b>	Lesson 1: Introduction, assignment 1 as homework / Lesson 2: play and discuss homework results, assignment 2 or 3 as homework / Lesson 3: play (if applicable) and discuss homework results and conclusion								
Introduction									
<b>Game Title</b>	Timeline (2012)								
<b>Topic Overview</b>	Conduct a play session in small groups or led by the teacher with input from the class. Present a high-level overview of significant events during World War 2.								
Assignments									
<b>Title</b>	Assignment 1: Timeline - World War 2 Edition								
<b>Level</b>	1	<b>% of Grade</b>	50	<b>Type (I/SG/FG)</b>	SG	<b>School/Home</b>	Home	<b>Time</b>	1 hour
<b>Artefacts to be produced</b>	55 cards to be used for playing instead of the cards of the original game								
<b>Details</b>	in groups, students should research significant events of the war and create cards similar to those of the original game. Optionally, groups can be assigned to specific periods of the war, as well as relevant periods before and after, or create cards based on events in specific countries or regions.								
<b>Resources</b>	History text book, selected online resources								
<b>Assessment Strategy</b>	play and discuss during lesson 2; students to explain the significance of events they used for their cards								
<b>Title</b>	Assignment 2: Timeline Plus - Causes and Consequences								
<b>Level</b>	2	<b>% of Grade</b>	50	<b>Type (I/SG/FG)</b>	SG	<b>School/Home</b>	Home	<b>Time</b>	2 hours
<b>Artefacts to be produced</b>	30 "Condition Cards" to be used by the new game rule								
<b>Details</b>	New rule: 10 random condition cards are placed face-up visible to all players. When a player places an event card in the time line, they can also assign condition cards from the common pool to the event, if applicable, to score extra points. Used condition cards are then replenished from the deck. Task: Swap cards created during assignment 1 between the different groups; Students groups should conduct research and create cards that describe societal, economical, or political circumstances related to the events - these cards could represent causes or consequences, or otherwise related situations; <u>the instructor should ideally provide examples during the lesson</u>								
<b>Resources</b>	History text book, selected online resources								
<b>Assessment Strategy</b>	play and discuss during lesson 3; students to explain the reasoning for the condition cards they created								
<b>Title</b>	Assignment 3: Modifying Timeline for better learning								
<b>Level</b>	3	<b>% of Grade</b>	50	<b>Type (I/SG/FG)</b>	I	<b>School/Home</b>	Both	<b>Time</b>	2 hours
<b>Artefacts to be produced</b>	essay / report								
<b>Details</b>	During lesson 2, play the games created during assignment 1 in groups, then discuss (FG) the potential of the game to teach more than just dates and events; Homework (I): design and document changes to the game rules (and components) that can help it achieve additional learning goals; provide two examples of illustrating the modified rules								
<b>Resources</b>	History text book, selected online resources								
<b>Assessment Strategy</b>	discussion participation; assess essays against given tasks								
Conclusion									
<b>Summary / Notes</b>	In lesson 3, play games created during assignment 1 or 2, discuss events covered by the different groups' implementations; discuss parts of the curriculum that may have been missed								

Figure 3: Example lesson plan based on the game Timeline used as context for an aGML project in History education.

two parts. Firstly, the full group should play the game in class after its first modification during assignment 1 and discuss its potential to teach more advanced concepts compared to its original form. The second part of the assignment is to design and document changes to the game. This second task is to be completed by individuals who are required to write a report explaining modifications to the game that accomplish the additional learning goals.

#### 7.4 Documentation

All documentation created during phase 4 of the aGML project should be written in a way that is comprehensible and usable to educators with varying levels of experience in GBL, and to support implementation within the time restrictions given by the curriculum. The documentation on its own needs to make the aGML project appear ‘manageable’. By applying aGML projects as one of their educational strategies, teachers’ knowledge and understanding of aGML should build over time, allowing them to improve projects, better integrate them in the classroom, and address ‘teachable moments’ as they present themselves [20].

Borrowing from Milkova’s [33] description of linear lesson planning, as applied to the aGML framework, a lesson plan - as shown in Figure 3 - should be created that can serve as a guideline for practitioners and contain the following core elements:

- An outline of learning goals to be achieved.
- An introduction to engage the students and, if applicable, assess their current level of understanding.
- A description of suitable learning activities.
- Methods for assessment of student learning.
- A conclusion to help students situate the new material within their existing understanding.
- A realistic timeline.

## 8 CONCLUSION

Thanks to the work of numerous people in fields such as education and game studies it is relatively straightforward to make persuasive arguments for the connection between games and learning. However, while using games in education appears to have the potential for strong positive effects on motivation and engagement, and demonstrates the ability to facilitate deep learning, it still represents an often desired but rarely used educational methodology.

While each GBL methodology shows promise, their wider adoption appears to be much lower than academic interest in them would suggest. There are many reasons for teachers’ reluctance to apply games in their classrooms. These can be perceived or real, based on restrictive circumstances or a lack of viable options, and many are shared among a broad range of educators. When these reasons are grouped into categories, it becomes clear that teachers who want to embrace game-based learning primarily lack institutional and peer support, guidance and documentation, the ability to be flexible within their given curriculum, and the time to prepare and execute such projects. Education, in particular, appears to be a field where practitioners often find themselves in relatively inflexible systems that do not easily allow for the integration of significantly different approaches. It is unreasonable to expect educational systems and institutions to undergo the necessary substantial changes in the

short term; therefore, the self-evident solution should be to adjust the approach to fit within the system.

One approach that has the potential to serve as a valuable grassroots approach - an approach that could be implemented from the bottom up to increase the acceptance and prevalence of games for instruction and learning - is analogue game-modification learning. As a subcategory of game-design learning, which attempts to utilise the cognitive benefits of design thinking while using games as a context for learning, game-modification learning is more approachable in the sense that it lowers some barriers to entry by using an existing game as a basis for designing alterations. In addition, using analogue games instead of digital games removes other requirements, such as access to computer equipment and access to, as well as proficiency in game-making software or programming languages. Given a framework that support teachers’ efforts, this approach could be used within existing systemic restrictions. The practical implementation of a lesson structure is then illustrated through a worked example.

### 8.1 Limitations and Future Work

As a next step, improving the findings of this paper through formal or informal interviews with educators would provide valuable insights and help to further adjust the details of this framework to their needs. This would also be a precursor for validation of the methodology through empirical testing in the field. Implementation and documentation of the aGML framework were based on a very basic and linear method of lesson planning, which was intentional to facilitate universal suitability but also dictated to some degree by the limited scope of this paper. Future iterations of the framework may benefit from an adaptation to a more naturalistic lesson-planning method [27]. Similarly, the framework’s assignment planning and design portion was kept rather simplistic to ensure the methodology remains approachable to educators with little or no experience in this area. To enable the framework’s applicability in various situations, it could be adapted using more comprehensive educational game design frameworks such as iPLUS [11]. While every effort was made to keep the aGML framework easy to understand, its acceptance would most likely be aided by adding more formal guidance, such as a handbook or teacher training guides [7]. Finally, while the students’ level of understanding and maturity are considered within the assignments of the aGML framework, there is no specific guidance for supporting students with learning difficulties [32]. The framework’s usefulness could be significantly enhanced by extending it to include strategies to that end.

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