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Towards an Authoring Tool to Help Teachers Create Mobile Collaborative Learning Games for Field Trips

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Abstract. Pedagogical activities that combine mobility, collaboration and game mechanics present significant advantages to attract students' attention and maintain their engagement in learning. Teachers naturally try to combine mobility and collaboration when they create field trips. Indeed, they identify several Points Of Interest that learners physically need to go to, thus requiring mobility, and they usually group students in teams to encourage collaboration, even if such collaboration is seldom attained. However, using the third element - game mechanics - is harder for teachers because they are not familiar with game models and often not gamers themselves. In this article, we present the MOCOGA Model, a MObile COllaborative learning GAme Model that is designed to adapt to many types of field trips. This model also offers a nested design approach that guides teachers in enriching their field trips iteratively. This model is the first step towards the development of an authoring tool that will enable teachers to create their own smartphone applications.

Keywords: field trip, mobile learning, learning game, serious game, collaborative learning, situated learning, game mechanics, authoring tool

1 Introduction

Learning is a complex process that is still not fully understood. However, research has identified several ways of providing conditions that improve learning such as **collaboration**, **mobility** and **game mechanics** [1]. Teachers naturally use collaboration and mobility when they organize educational **field trips**. Indeed, they usually group their students in teams to promote collaboration, and provide them with several Points Of Interest (POIs) they need to find in order to complete activities (*e.g.* answer questions, identify a plant, make field observations). Yet, field trips allow for the integration of another beneficial element for learning: **game mechanics**. Indeed, the concept of Learning Games (Serious Game for education) has shown great potential lately. When used correctly, game mechanics such as competition, rewards, social recognition or exploration [2] enhance the learners' experience with emotions, which has positive effects on their motivation to start the activity, their engagement throughout the learning process and their memory [3].

In addition, now that almost all teenagers and adults own smartphones and schools are often equipped with tablets, the use of **mobile devices** can offer several advantages. Indeed, the functionalities of mobile devices, such as the GPS location system, can help students find the POIs. The camera and the audio recorder in smartphones can also be very useful for recording field observations. Finally, smartphone applications offer the possibility providing information about a POI when learners are physically in the right place and automatic corrections of the activities. Hence, the use of **digital Mobile Collaborative Learning Games** (MOCOGAs) has great potential for learning during field trips.

In this paper, we first briefly analyze the existing digital Mobile Collaborative Learning Games (MOCOGAs), in addition to a selection of digital and non-digital collaborative games, to extract common game mechanics and elements that are compatible with field trips. Section 2 presents the **digital Mobile Collaborative Learning Games Model** (MOCOGA Model). The third section presents a **step-by-step design process** that helps teachers transform their current field trip progressively into a MOCOGA. The last section presents the ongoing work on the authoring tool that will integrate the MOCOGA Model and upcoming experimentations.

2 Identifying Game Mechanics and Elements for MOCOGAs

The objective of this study is to provide teachers with a simple model and authoring tool that allow them to create mobile collaborative games for their field trips. It is therefore necessary to identify simple game mechanics and elements that **combine mobility and collaboration** and that are **adapted to educational field trips.**

To our knowledge, there are no such models and authoring tools yet. It is, however, possible to find a few authoring tools for solo mobile educational games such as orienteering races [4], city visits [5] and onboarding sessions to help new employees get familiar with office spaces and services [6]. These authoring tools provide several game mechanics that use mobility for learning, but not collaboration. It is also hard to extract game mechanics from existing MOCOGAs because there are very few [7], [8] and their game scenarios are specific to their educational goals and context.

We therefore extend our search for game mechanics and elements to collaborative games which are played outdoors such as *Capture the Flag* and collaborative board games that could be adapted to field trips such as *Pandemic*. Finally, we also identified several collaborative and multiplayer video games for which the game elements could be adapted to field trips. In all, 19 digital and non-digital multiplayer games were analyzed. The identified game elements are summarized in Table 1.

Table 1. Summary of the identified game elements

Game elements	Description	Pedagogical value	Games that use it
Customizable and recognizable teams	Allow players to choose the name and color for their team.	Increase the students' sense of belonging to the team and incentive to help each other.	*Capture the Flag, chicken-fox-viper, Domination Game*

Team base camp	Safe zone, where players can regenerate their health, rest and discuss privately.	Allow students to take time to assimilate knowledge and use it to find and discuss a common strategy.	*Capture the Flag, Overwatch, Counter Attack Multiplayer FPS*
Team synchronization	Team members must synchronize (*e.g.* be at the same place at the same time) to do an action.	Force collaboration between team members.	*Portal 2 Co-Op, It takes two, Tango, We were there, It takes two, Keep talking and nobody explodes* and some *domination games.*
Complementary knowledge or roles	Team members must coordinate to make the best use of their complementary knowledge or powers.	Encourage collaboration and participation of all team members.	MOCOGAs [13][14], *It takes two, Forbidden Island, Tango , We were there, Pandemic, Unlock, Keep talking and nobody explodes, Overwatch.*

Several other game elements where identified such as hidden role (*Ware wolf, Among US, Spy party, Murder*), slowing the best players down to keep the game more interesting (*Mario Kart*), one against all (*Predator, Battle-royal*) or the means to come back into the game if you lose (*Call of Duty*). However, these game mechanics seemed either too complex to set up or not adapted to educational field trips.

3 Mobile Collaborative Learning Game Model

The game mechanics and elements identified above were transformed into the MOCOGA game model presented in Figure 1, with the help of seven pilot teachers**.** This model is intentionally as simple as possible so that teachers have a clear idea of how the game will unfold and for students to start the activities quickly and not be mentally overloaded [9]. This model (boxes with green stripes) is built on a previous solo Field Trip model [10]. For the sake of clarity, we will describe the key concepts: a *Field Trip* is composed of several *Situated Game Units* that are triggered when the players arrive at a *Point Of Interest*; teachers can provide students with *Information* about the objects of interest in close proximity (*e.g.* tree, lake, stones, building) and ask them to complete several *Activities* such as *Answer a Question*, for which they can win points.

Our contribution - the MOCOGA Model – improves the previous model with new concepts: students are now grouped into ***Teams*** of 2 to 5 players and choose a name and a color. By default, the students team up by themselves but teachers can also compose the groups by choosing students with complementary skills for example. The position of each player is shown on the interactive map with the color of their team. Each team has a ***Base Camp*** from which they will head out to get information and then come back.

The collaborative field trip is composed of several ***Milestones*** (approximately 3 to 5) that are related to one of the skills to be acquired during the field trip. Each milestone contains several *Situated Game Units* (about 4 to 10). Teachers can add a ***time lock*** to the field trip which will encourage team members to coordinate and distribute these game units among themselves in order to win the most points in the allotted time.

Students are supposed to use the strengths of each team member (*i.e.* speed and pedagogical skills) to decide who will complete which unit. Once all the game units are completed, all team members need to synchronize to come back to their base camp. This will unlock the ***Milestone Activity***. This activity consists of a broad question requiring team members to analyze all the information and samples collected at the POIs and take time to reflect. This is a key moment of collaboration because the team members will have to share the complementary information they have collected and explain their observations, debate and take decisions in order to answer this question.

Teachers can also **make team scores available to all teams** to make them compete or even encourage to help each other if the common objective of all teams is to reach a minimum score. Students can also indicate that they **need help**, at any time. A notification will be sent to all other students as well as the teacher.

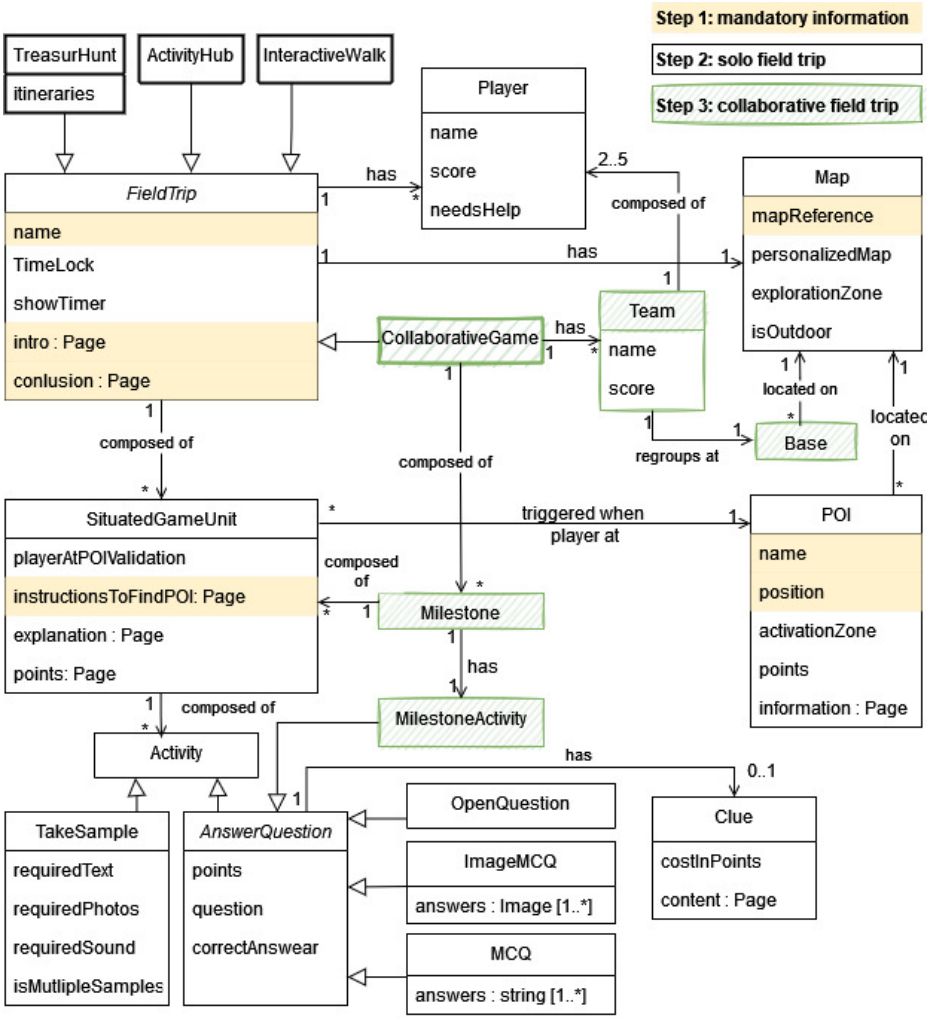


Fig. 1. Mobile Collaborative Learning Game (MOCOGA) Model

4 Modular, Step-by-Step Design Model

To be adopted by teachers, the MOCOGA Model needs to be integrated into an authoring tool that is easy and fast for them to use. We therefore propose a nested design approach, with several progressive steps, to help them transform their current field trip material into a MOCOGA. Each step reveals new functionalities and game elements that can be added to the initial field trip scenario.

4.1 Step 1: Create a Basic Guide to Find Points of Interests

The information required by the authoring tool is minimal (yellow elements in the model in figure 1): the field trip *name*, an *introduction page*, a *conclusion page*, a *map* with at least one POI. For each POI, teachers also need to provide a *name* and *instructions* to help students find this POI. All the other necessary parameters are dealt with automatically. For example, the number of *points* that players win upon arrival at a POI is set to five and the *activation zone* around each POI is triggered by GPS. By default, POIs are done on after the other (called the ***Treasure Hunt*** type of field trip).

If needed, teachers can create several *Itineraries* that can be assigned to a group of students in order to avoid them following each other. They can also decide to configure these itineraries with more or less POIs to adapt them to the learner's level. Teachers also have the possibility of changing the way the POIs are triggered depending on where their field trip takes place. The ***Activity hub*** is particularly well adapted to a field trip in a museum because the POIs are available on the map, from the start of the game, similarly to audio-guides. The ***Interactive Walk*** field trip type is well adapted to field trips in a city because the phone will send a notification to players when they are in the vicinity of a POI, similarly to tourist office applications.

At this point, teachers can simply use the application as an interactive guide that helps students find all POIs. They can continue using their usual material such as paper quizzes and information sheets.

4.2 Step 2: Set Up Situated Game Units on Each POI

After teachers try the first step and feel more confident with the technology, they can easily enhance their field trip by adding complete *Situated Game Units* for each POI. As presented by the white elements in Figure 1, they can add an ***information page*** about the POI with extra videos and links. They can add several *Activities* that learners will do, once they arrive at the POI, such as ***answering a question*** (i.e. *Open question*, *MCQ* or *image MCQ*). For each question, teachers also have the possibility of adding clues that are revealed in exchange for points. Teachers can also ask their students to ***Take a Sample*** at the POI (take notes, photos or audio recordings). Finally, teachers can add an ***explanation page*** to conclude each *Situated Game Unit* with answers to the questions, for example. In addition, teachers can decide to set a ***Time Lock*** which will displayed the time left on the application and send notifications to alert learners before time is up. Besides, teachers have the possibility of adding a ***timer*** that measures the time learners take to finish activities. This is essential for orienteering races but is an equally interesting game mechanic for other field trips. Finally, teachers have the

possibility of adding a personalized map which may display important pedagogical information (*e.g.* type of soil, vegetation, level lines on the map).

At this point, teachers can create more or less complex interactive activities for their field trips. However, the proposed activities still do not contain collaborative elements.

4.3 Step 3: Create a MOCOGA with Collaborative Activities

The third step enables teachers to easily create a MOCOGA by building on the field trip designed in step 2. As shown by the striped elements in the model (figure 1), they simply need to create ***Milestones*** by combining the *Situated Game Units* and add a ***Milestone Activity***. Ideally, a *Milestone* corresponds to a particular pedagogical sub-goal. For example, a milestone that has the goal of helping students recognize local tree species could be composed of seven game units on trees. The final milestone activity could be an *Image MCQ* in which learners have to identify the tree that is not local.

Upon completion of this step, teachers have a simple MOCOGA that they should feel comfortable with. In addition, all the functionalities related to creating groups are automatically dealt with by the application. Finally, we suggest teachers ask teams to create their base camps near the starting point. This will enable them to closely monitor teams during key moments of collaboration and provide help if necessary.

4.4 Discussion

The MOCOGA model was presented to seven teachers from various domains and levels of teaching. Those who have less experience with digital applications seem cautious and prefer testing the reliability of the system first. This option is offered by step 1 but can also be accomplished by step 3 if the scenario is kept very minimal. Teachers who are interested in interactivity, especially for children, find the functionalities they need in step 2. Finally, several teachers can imagine going to step 3 but prefer trying step 2 first, in order to assess the reliability of the tool and test the Situated Game Units. The step-by-step design method therefore seems essential for the acceptability of such authoring tools by teachers. Nonetheless, none of the pilot teachers seems ready to test the complete MOCOGA Model. It still seems too distant and "risky" because of all the potential technical problems (connectivity, use of personal phones). The only way to reassure teachers is to provide user-friendly and robust authoring tool and player app.

5 Conclusion

The objective of this study was to enable teachers to create MObile COllaborative learning GAmes (MOCOGAs) for field trips and hence benefit from the pedagogical advantages of collaboration, mobility and game mechanics. In this paper we present the first steps toward this objective: **a MOCOGA Model** that helps teachers design collaborative activities that are adapted to field trips and **a modular step-by-step design model** that is intended to help teachers adopt the MOCOGA model.

The MOCOGA Model is currently being integrated into an authoring tool and will be deployed in a few months. The interface was designed to comply with the three steps of the design model. For example, only the mandatory elements (Step 1 – yellow boxes in Figure 1) are shown on the interface. This should encourage teachers to create their

first field trip and test it out on their smartphone. All the extra are accessible in the option buttons. This tool will need to be particularly user-friendly and robust in order to help teachers embrace the MOCOGA model and use it to its full potential. In addition to this collaborative game model, we are also working on several digital tools that will support collaboration within a group of players [8].

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