

# Students' Design Decisions in Collaborative Design of Location-Based Games for Learning

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**Abstract:** This paper describes a study of students designing location-based games for each other to learn history. A learning scenario was developed where groups of students create a game, receive and play another group's game, and create a media product based on their experiences. We analyse the video footage of students collaboratively engaged with designing the games and highlight how the design process involves making practical decisions, and how the notion of the *others* – the students' peers – feature in the group's interaction. Furthermore, the analysis focuses on how the design process is coordinated and collaboratively organised, and involves translation of the source material into game information.

**Keywords:** Learning through design, location-based games, history learning, video analysis

## Introduction

This paper addresses how upper secondary students make design decisions and coordinate their work when participating in a learning scenario involving collaborative design of location-based games for learning about history. A learning scenario was developed in collaboration with a history teacher where groups of students create a game, receive and play another group's game, and create a media product based on their experiences in the previous activities. The analysis of the video-based empirical material shows how the students engage creatively with the learning material and describes the interactional organisation of the process of designing games for another group of students. We further address the students' practical accomplishment of game design and how engage in a design process where they integrate curricular and other historical source materials, and place these in a narrative by constructing a number of points of interest in the location based-game. They are thus taking into account historical events, the layout of different locations, the playability of the game, and the actual game mechanics supported by the location based-game authoring tool. The location-based gaming experience was intended to feed into the creation of a media product that enables students to demonstrate their learning experience.

One of the goals for the scenario was to put students in a position to work *creatively* with the available resources by creating products (a game and a presentation), using a game authoring tool for mobile, location-based games, rather than reproducing curricular material. The students were allowed a great deal of freedom in choice of historical sources to work with. The game they designed was to be used by their peers.

The organisation of the paper is as follows. First, a literature review focusing on use of games for educational purposes, mobile and ubiquitous technology in the field of CSCL is presented. Then, the learning scenario including student activities and the main technology they used is accounted for. Next, we present the research methods used. Then we present our analysis of transcripts of student activity, and how the activity can be understood. Finally, we discuss the implications of our analysis.

## Designing mobile, location-based games for learning

The use of mobile technology to support collaborative learning has a history within the field of CSCL (e.g., Roschelle & Pea 2002; Roschelle, Rosas & Nussbaum, 2005). Tools have been developed and studied, both to support collaboration in the classroom (Chang, Wang, Chen & Liang, 2009; White, 2006), and to provide support when moving into the field (Lyons, 2009; Yatani, Sugimoto & Kusunoki, 2004; Tan, Liu & Chang, 2007). Computer games have also become increasingly used and studied for their educational potential (e.g., Kickmeier-Rust & Albert, 2012; Shute, Rieber, & Van Eck, 2011), also within the field of CSCL (e.g., Ke, 2007; Rosenbaum, Klopfer, Broughner & Rosencheck, 2007; Satwicz & Stevens, 2007; Klopfer, Perry, Squire, Jan & Steinkuehler, 2005; Bennerstedt & Linderorth, 2009).

Much of the orientation in the scholarly literature on educational games is on various learning effects of students *playing* computer games. Similarly, many of the educational initiatives towards design and creation of computer games concern computer game design in itself, rather than using the game design process for students to learn other curricula (Orvieto, 2012). One example that looks at both is El-Nasr and Smith's (2006) two case-studies of students in computer science learning computer skills through modifying, or *modding*,

existing games by working with the game engines. They found that game development involves many different skills other than programming, ranging from artistic to mathematical concepts. Lim (2008) raises the idea that students in school should be allowed to design their own computer games based on their own interpretations of the curriculum as a way to create more engagement with their own learning processes. Prensky (2008) argues that one way for educational games to be successful is that the students create such games themselves. In particular, he suggests that students create what he calls "*mini-games*" (Prensky, 2008, p. 1006). These mini-games are made by groups of 2-3 students doing their own curriculum-based research with an advisor, and usually take around one hour to complete. Resnick (2007; Resnick, et al., 2009) describes Scratch, which is an online system where students learn to program interactive, online media products such as games, stories and animations, designed to foster creative and systematic thinking. In a study where twelve to thirteen year old students used Scratch to modify the mathematics game *Gem Game*, Garneli, Giannakos, Chorianopoulos and Jaccheri (2013) found that this activity increased interest in programming, although they did not find that the modification activity had a visible effect on mathematics performance.

Schwarz and Stoecker (2012) describe the process of *Learning Game Design* as a relative new craft where game design and didactic design are combined. The design of a learning game potentially involves a number of activities, including story-, visual-, sound-, interaction-, information and character design. Sharples, et al. (2014) argue that storytelling is a promising approach to support learning, and one that can aid students in creating meaning from the abundance of available learning resources. Suitable for combining with virtual worlds, augmented reality or games, storytelling builds on the navigation of resources and can help with adding coherence to learning experiences.

## The game design learning scenario

To explore the creative design of location-based games for history learning, a scenario involving different digital tools and activities was designed. The scenario, which took place in the classroom and out in the city of Bergen, comprised three overall activities: Game creation, Game playing, and Media Product development. First, working in groups, the students tied historical themes in Bergen's history to actual places in Bergen, and combined these places and themes into a location-based game. Second, the students gave their game to another student group to play. Third, after playing another group's game, each group re-created their experiences with the different themes in the game into a media product. Most, but not all of these products were digital, combining images, video and sound captured while playing the game.

Through game creation, the students identified and combined features of the real world, represented by the different locations in the city, and their interpretations of the different written sources available to them, into a game narrative that would be discovered by the recipients as they played the game outdoors. The gaming aspect was about finding the locations in the game by following clues in the narrative. By creating a media product, the students were put in a position to reflect over and demonstrate what they learned about Bergen's history by playing another group's game.

## Theme for the games: WW2 in Bergen

The scenario was designed and planned in close collaboration with the teacher, both in terms of the theme chosen and how to use the available technology for creating and playing the location-based games. The participating teacher taught history, and was the "e-contact" at the school with expanded responsibilities related to the school's ICT-systems, and helping the other teachers with digital technology. She chose Bergen history during the 2<sup>nd</sup> World War (WW2) as the theme for the game as 1) it fit with the current curriculum, which was between "older" and "newer" history, 2) the school building was occupied by the German military during WW2, and 3) the availability of physical locations related to the theme around Bergen. The teacher identified themes and events related to 16 locations in Bergen during WW2. Examples of the themes include: 'The attack on Bergen on April 9th, 1945. Where?', 'The Printed Press of Bergen during times of crisis: Illegal papers', 'The history of Jews in Bergen', and 'Food and rationing'. The scenario comprised three phases:

- *Game Design Activity*: The class was divided in half, with each half being given a list of eight of the themes. Each half was further divided into groups of three to four students. Each group was tasked to choose a minimum of six of the themes and events, which would form the basis of their game. How they ordered the locations in the game, how they assigned a theme to a location, and what they chose to write about each, was up to them. They were also free to discover and create locations and themes by themselves. A set of documents was made available to the students at the beginning of the scenario. These included a description of the tasks, a list of learning goals, a description of how the scenario was tied to the five basic competencies (a key aspect of the most recent reform of Norwegian education),

information on assessment criteria (students were graded on their participation including collaboration and end product), a list of resources and internet-based sites with relevant historical source material, and a user manual for SILO, the authoring tool for location-based games. A collection of historical sources relevant to the theme, such as magazines and books was made available in the classroom, and the students were also encouraged to use local museums, the public library of Bergen, and the school library, and also to visit the sites physically.

- *Game Playing Activity*: Each team was to play the game they received, moving around Bergen and learning about the historical sites in the game. The students were encouraged to bring cameras with them, or to use the cameras on their private mobile phones, and record various aspects of the places that they visited so they could use it as source material for creating a media product after having completed the game. Exactly how they chose to do this was discretionary.
- *Media Product Development*: The media product the students created after playing the game could take the shape of a video or film, a wiki or a blog, or a web page. Based on previous observation of game play, it was decided that the creation of a media product would not interfere too much with the fun aspect of playing of the game, yet at the same time increase the learning potential of the game. As the game application paused automatically when they were at each site, knowing they would have to include the location in their digital media product was intended to increase the attention they paid to the site.

## Technological resources: SILO

The authoring tool the students used to create the games is called SILO. Originally SILO was designed for Nokia, using Python for S60, which is the version the students in this study used. Currently it is being redeveloped for iOS and Android, and a first basic but working version became available in 2014. SILO has previously been described in detail elsewhere (see Wake & Baggetun, 2009; Wake, Guribye & Wasson, 2011; Wake & Wasson, 2011; Guribye, Wake & Wasson, 2014), so only a summary of the basic functionality is provided here for readability of this text: (1) SILO consists of a web-based game authoring tool and an app on the phone for playing the games. (2) SILO permits a game designer to construct a storyline as a set of missions, and attach the different missions to different locations, by clicking on a map, displayed on the screen. (3) The game creator can add icons to locations, set limitations on time, configure user data, and a maximum of three hints on how to find each location.

The phone application interprets the data, and converts it into a game to be displayed on the phone and lets the user interact using the following elements on the phone screen: (1) A scrollable map, an optional marker displaying one's current position on the map, an optional track displaying the history of movement, and a game score. (2) A distance meter (shown in red and green numbers), displaying the remaining distance to the next location, which is updated every five seconds. When a player moves within a zone of 30 meters around the location, the red numbers turn green, and they are permitted to 'pick up' the POI in the game. (3) A progress bar displaying the icons representing the places that the participant has visited, and a number of empty spaces, indicating game progress. (4) A menu system, to access the game score and "pick up" the available POI in the game. (5) A mission (i.e. a description of the next location from the storyline).

While the game is being played the application is constantly calculating the distance to the next location. The distance is displayed in red until the players near the location and it turns green indicating they can pick-up the location. They are then offered information about the current location and a text that describes the next location. The game then pauses, to allow the group to think about what to do next, and an icon signalling that they have picked up the previous location is displayed. The game is over when the last mission is solved (i.e. the last location is found).

## Research methods

The research presented here is an ethnographic study inspired by ethnomethodology and conversation analysis, especially studies where the use of technological resources features as a central component in the analysis (e.g., Heath & Luff, 2000; Suchman, 2007). A key feature in these studies is the use of video recordings in the analysis (Heath, Hindmarsh & Luff, 2010). Video-based research has gained momentum in CSCL and the learning sciences (for an overview see Derry et al., 2010). As Koschmann, Stahl and Zemel (2006), point out, a key analytical commitment in such studies is "to discover within the recorded materials what the members are actually accomplishing (...) and are making relevant (...) through their interaction" (Koschmann, Stahl & Zemel, 2006, p. 7). The same analytical commitment guides the following analysis.

The main data source for this study was video, and the recordings form the basis for the analysis in this paper. A total of six sessions were filmed. These include the teacher's introduction, sessions which consisted of reading and re-writing source material tied to places, sessions where they created the game in the SILO interface, the session where they played their games, and the session where they created the media product. The recording of the activities resulted in a total of 12 hours and 45 minutes of video footage. One group was filmed for the whole scenario. The main researcher was present during the filming, and the recorded material was digitalised and reviewed after each session. To support the analysis, all the video has later been coded into a detailed activity log, describing the activities that occurred. Most sections of talk and interaction have been transcribed. Based on a review of all the transcripts, the ones that highlight the core activities involved in creating the games are presented for analysis in this text.

Additionally, interviews, observation and artefacts produced by the students were collected. Each student group was interviewed face-to-face two days after the scenario was completed. The groups that were not being filmed were observed while they worked, and field notes including which tools and sources they used, how they organised collaboratively, and so on, were recorded. The teacher was also interviewed in a more lengthy session, lasting about one hour. All interviews were recorded and transcribed. Furthermore, the student products that were collected included the games that they created and the media product that they created. The games were copied from the SILO system to a file in MS Word.

## Analysis of the game design activity

In the analysis we focus on how designing games for *the others*—referring concretely to the group of students that will receive their game—features in their design process, how the group coordinate their collaborative work, and *how* the creative work of designing a location-based history game involves a series of design decisions. The excerpts are presented using the following structure, from left to right: turn number; turn taker; transcript of speech based on Jefferson transcript notation; and a description of other relevant aspects of the activity to the right. Original language is Norwegian, available below each translated utterance in grey text.

Excerpt 1 took place in the second session of the game design process, about an hour into the work session. Their interaction concerns how they coordinate their work in the group. They are seated around a table with one computer each, and writing the optional hints that will help players who are stuck during game play find the next location in the game. They are working with the list of themes provided for them by their teacher, and have not yet assigned all the themes to a physical location. In a previous exchange they have divided the themes between them.

Excerpt 1:

|   |        |  |   |
|---|--------|--|---|
| 1 | Hanna: | Which one should I tie it to then? (3.0) You wrote for number six there? | Picks up piece of paper with list of themes |
| 2 | Simen: | (0.7) >No for< (.) >no for< (.) for number three                         | Looks at the paper                          |
| 3 | Hanna: | (1.2) But we have to find out where to place it                          | Puts down paper                             |

This excerpt exemplifies how they interactionally coordinate their work, and in the process make explicit the kind of work they need to get done in order to finish their task. This kind of articulation work (Gerson & Star, 1986) is not a process that occurs separate from the content of their task as a kind of “meta-collaborative” interaction, but is inextricably tied to the content of their work. In Turn 1 when Hanna asks which theme she is to tie the hints that she has written to and whether Simen is already writing for theme number six, we see this mix in one utterance. It is a question of coordination and of how this ties to the actual decision she has to make about how to formulate the text and which location they have decided to have following the one she is writing about. In Turn 2 Simen specifies that he is writing for theme number three. Hanna then points out that they also need to place their text on a location on a map in SILO.

Excerpt 2 takes place in the third session of game design. The students are discussing how to connect the historical material with the narrative in the game.

Excerpt 2:

|   |        |   |                            |
|---|--------|---|----------------------------|
| 1 | Hanna: | Is that place to be mentioned in that hint sort of? | Sitting next to each other |
|---|--------|---|----------------------------|

- 2 Kaya: (.) I'm writing it like this (.) find the place  
where the Germans' ships were (inaudible)
- 3 Hanna: (2.0) Yes (.) But they don't know anything about  
that?
- 4 Kaya: (.) No
- 5 Hanna: (.) But they are going to learn it right? I feel  
that it is a little
- 6 Kaya: (.) Is that a little difficult?
- 7 Hanna: (.) Yes, because they have no relation to (.)  
(inaudible) Yes it is actually possible to imagine  
of course

In Turn 1 Hanna asks whether she should include the name of the location about which she is writing, and in Turn 2 Kaya replies with giving an example of how she has written the text for one of her locations. The theme that she is writing about is the attack on Bergen on April 9<sup>th</sup>, 1940, and her choice is that the participants are to search for where the German ships were moored. In Turn 3, Hanna points out that the participants won't necessarily know where that is, to which Kaya agrees. In Turn 5 Hanna speculates that the participants are going to learn that, possibly through playing the game. She begins on a sentence where she assesses the difficulty in finding the location by the information they have made available. In Turn 6 Kaya finishes her statement by asking whether that is too difficult to understand. Hanna agrees that it is difficult, but not impossible if they use their imagination. In Turns 3, 5 and 7 in this extract the pronoun "they" is used. The use of *they* refers to the group that will play the game, and features throughout the interaction in this phase of the activity. In particular we see it in utterances such as the ones presented here, where it is a mix of envisioning what it will be like to actually play the game, and how difficult it will be to find the different points of interest, as articulated in Turn 6. This way they are explicitly bringing the other team (as players of a game) into their design decisions.

Excerpt 3 took place during the first session of the scenario. They are discussing the game mechanics as it relates to the first item on the list of themes that the teacher has provided, which they are to transform into a location in their game. More concretely the group is discussing where in the order of the route of locations they are to place this particular location.

Excerpt 3:

- |   |        |   |                                 |
|---|--------|---|---------------------------------|
| 1 | Simen: | We can't put the number one first (.) because then<br>they will (start on) it straight away         | Is looking up<br>from pc screen |
| 2 | Hanna: | (1.5) Surely we can have the number one first (.)<br>why not?                                       | Looks at pc<br>screen           |
| 3 | Simen: | (0.5) No (.) because then they will receive it<br>straight away (.) they won't even have to (guess) |                                 |

In Turn 1 Simen comments that they shouldn't place the top item on the list first, and argues that doing so will permit the other team (the group receiving their game) to find this location without any effort. Concretely, this location is their own school building, which was requisitioned and occupied by Germans during WW2, and Simen is presuming that they will start the game play session there. In Turn 2, Hanna responds to this statement by stating the opposite of Simen, which is that they can indeed place the school building first, and then asks why not, which prompts Simen to explain further. In Turn 3 Simen responds that it would make the other team find the location straight away, because of the 30 meter circumference around the school, which they presumably start the gameplay from, and that they wouldn't have to search for the location (that they will start the game from within the 30 meter circumference). His response highlights the central game mechanic element that gameplay is about searching for locations based on limited information, and that by placing their own school first, they would contradict this aspect of the game in their design. This is an important aspect of the game design, and another group used Google Street View to study locations closely before deciding on exact location of the POI (to search for natural obstacles to the decided game route not visible on maps).

Excerpt 4 took place in the third session of game design. They are discussing how difficult the game should be. Previous to Turn 1, they have discussed that they think the game should be challenging enough for the players to have to use extra hints in places, but that the game should still be possible to complete.

Excerpt 4:

- 1 Kaya: Yes (.) cou::ld make it (.) But they (1.5) It is not supposed to be like they are not to be able to make it
- 2 Hanna: (.) <sup>o</sup>This one is very simple (.) If you think like that<sup>o</sup> Lowers voice, both lean into the screen
- 3 Kaya: (0.5) Yes maybe a little simple?

In Turn 1 Kaya agrees that the game should be challenging, but that they should not make the game impossible to complete or too difficult. In Turn 2 Hanna responds by talking about one concrete location in the game, which she finds very simple. She points to the screen, highlighting the game information she is talking about. She lowers her voice considerably, to avoid talking loudly about game information, and both lean closer to the screen, and their body language clearly shows that they are hiding something, and that it is a matter of secrecy. In Turn 3 Kaya agrees that the location to which Hanna is referring might be too easy to find.

The whispering illustrated in Excerpt 4, is prevalent in much of the interaction in this phase. Although the whispering is partially a result of the students being placed in the same room as the team they were designing games for, it is clear that they orient themselves toward not revealing what they are doing for the other team.

## Discussion and summary

In the game design phase analysed above, we have looked at an activity where the students are involved in *learning through design*. This idea is not new and a key argument in constructionism was that having students engage in design activity could be a fruitful way to support learning (e.g. Papert, 1980; Resnick, Ocko & Papert, 1988; Resnick, 2012). This paper offers a detailed empirical analysis of what kind of interaction the students are involved in when learning through design. A key observation is that the students in this learning scenario, where there were groups of students designing games for each other, do engage creatively with the learning materials and the resources made available to them. They need to transform the materials and concrete locations into points of interest in the location-based game. Further, they relate to the historical materials and sources to create a game and thus have to make design decisions and reflect upon how the game will be received by the other team of students. Such considerations are visible in the interaction and a topic of discussion in the group activity. We have illustrated this point through showing how the students explicitly address this through the use of “they” in their interaction, and showing how they explicitly discuss what the other students will learn from playing the game they are designing and finding the right level of difficulty for the game-play. In this way, the other team features as putative users of the mobile game in the interaction when they are making design decisions. This resonates with Woolgars classic study “Configuring the user” (1992) where he looks at how “along with negotiations over who the user might be, comes a set of design (and other) activities which attempt to define and delimit the user’s possible actions” (p. 61). In our analysis we see an example of how the users are present in the design decisions of the teams where considerations of how difficult the game play will be relates to how they define and delimit the users’ scope of action. The point that they are making a game for other students also points to a pedagogical challenge for the students: They are accountable for making a game that is playable for the other team, and the other team will evaluate them when they play the game.

This discussion also pertains to how the scenario was set up to be a collaborative activity. They collaborate in different ways, and in the above analysis we have looked at the process of *collaborative design*. When the activity is organised as a collaborative design activity, the students must coordinate their decisions and articulate content of the narrative for each other within the group.

A key idea in designing the authoring tool (SILO) is that it should be easy to design location-based games, and the design activity is tied to the construction of a narrative and descriptive text that ties the content to the given location. Some of the intricacies of this process are to find interesting physical locations to say something about a theme, to support a suitable sequencing of the POIs, and another is to place the pin and deal with the circumference of the POI. The students deal with these aspects in their interaction and collaborative activity. More generally, the authoring tool is designed to support the process of designing location-based games, and the notion of meta-design as discussed by Fischer (2009), a way to involve end-users in design by “designing for designers” is relevant. In this study we have showed a way to use an authoring tool for location based games to make students designers of games and in this way get them involved in learning through design and to be creative participants in what Fischer calls “richer ecologies of participation” and not only as passive

receivers of texts and other curricular materials. This strategy is also called *underdesign* (Fisher, 2009) and involves making tools for content creation rather than ready made content to be passively consumed, and creating technological and pedagogical conditions for participation in design activities. We see this as a promising way forward to support collaborative learning with technology.

This paper has presented a scenario involving the design of location-based games, where the participants' peers were to receive and play the game designed. Based on video focused on one group throughout the scenario, we have analysed their game design process. We studied how the notion of designing for their peers; *the others*, featured in their design process, how they coordinated their collaborative work, and how the creative work of designing a location-based history game involves a series of design decisions that have to be made.

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