

Collaborative computer game play in the science classroom

ABSTRACT

The purpose of this paper is to describe and analyse student engagement, and emerging collaboration patterns when playing a computer game for educational purposes in the science classroom. The case studied is Future City which is an annual national competition for students in grades 6–9 who take on the role of urban planners with the mission to create sustainable future cities in SimCity 4. The outcome of the analysis revealed different types of student engagement, referred to as: *executor*, *core group participant*, *temporary participant*, *invisible participant*, and visiting participant. The analysis also demonstrated that the collaborations between the students were formed by combinations of the following patterns: *predominant decision-making*, *distributed decision-making*, and *master-apprentice relationship*. The conclusions presented provide implications for instructional designs aspects to consider for educators when bringing in computer games that are collaboratively to be played in the classroom.

KEYWORDS

Game-based learning, science education, engagement, collaboration patterns, observations studies, instructional design

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PLAYING COMPUTER GAMES IN THE SCIENCE CLASSROOM

This paper presents the third study in a larger project exploring in ways computer games can play a role in science education (Nilsson & Jakobsson, Submitted; Nilsson & Svingby, 2009; Nilsson & Svingby, Accepted). The case studied is Future City (Future City, 2008), which is an annual national competition for students in grades 6–9 who take on the role of urban planners with the mission to create sustainable future cities in the commercial off-the-shelf (COST) game SimCity 4 (Maxis, 2003). The question explored in the overall project is: *what aspects of scientific practice in the classroom can be mediated through computer game play?*

TWO PREVIOUS STUDIES

Results brought forward in earlier study based on focus groups interviews indicate that computer games, such as SimCity 4, can constitute an important artefact in the science classroom that facilitate and help make students use of science concepts and theories explicit (Nilsson & Jakobsson, Submitted). The study demonstrated that the students had to articulate, discuss, and find solutions to environmental problems in a contextualised and simulated “real” world, where the game limitations and restraints contributed to prevent them from using simplified solutions to complex issues. Further on, observation studies of gaming students in action showed that the students were engaged in what can be described as scientific practice (Nilsson & Svingby, Accepted). During the act of game play, described as a *reflective practice* (Gee, 2003), the students were exploring, penetrating and manipulating the game mechanics, thus demonstrating understanding of the interdependency of factors in the system. This was, though, mostly done in a rather unsystematic way. The students did observe and discuss the results of their actions, and according to later decisions also learned from them, but use of scientific concepts, theories, and formal analyses or conclusions were largely lacking. They treated the game as a virtual dynamic system rather than as a simulated “real” world for scientific experiments. These results illustrate the assumption that computer game play in school ought to be contextualised in a way that enables the students to make sense of the educationally relevant content.

The conclusions drawn are both supported, and rejected by previous empirical research. On one hand it is argued that computer games are potential providers of dynamic representations of real world situations, where students can gain embodied experiences in complex domains that otherwise are difficult to access (e.g. Barab et al., 2007; Nelson et al., 2005; Neulight et al., 2007; Squire & Klopfer, 2007). On the other hand, previous research also demonstrate that the link between the representation and what it represents is not always made, and that gamers do not necessarily treat games as a representation of something outside of the game (Linderoth, 2009). The gamer might “only” learn what buttons to click on to receive the desirable outcome, and even though also such knowledge demands a considerable time invested to uncover, successful game play does not necessarily generate insight in the conceptual model underlying the game world (Halverson, 2005).

PURPOSE OF THIS PAPER

In comparison to the studies (Nilsson & Jakobsson, Submitted; Nilsson & Svingby, Accepted) briefly reported on above, the topic discussed in this paper does not primarily deal with how the gaming students contextualised and applied their scientific knowledge, but how they *engaged in*, and *collaboratively organised* their actions during game play. The purpose is to present a description of student engagement, and emerging collaboration patterns during the gaming process. The conclusions presented provide implications when designing learning interventions involving computer game play.

THIS STUDY: METHODS, PROCEDURE AND ANALYSIS

The premises for the pedagogical understanding and theoretical approach chosen to inform and guide the study is based upon *sociocultural perspectives* assuming a contextualised view on action and learning (e.g. Sandler, 2009; Säljö, 2005; Wertsch, 1991, 1998). Human development is looked upon as *situated* implying that knowledge constructions is not an isolated, individualist phenomenon, but depended upon interaction and cooperation with *others*, and the surrounding environment (Lave & Wenger, 1991; Wertsch, 1991, 1998). The analytical stance adopted assumes a qualitative approach, inspired by methods used within the field of ethnography (Bailey, 2007).

Thirty students (14 girls, 16 boys) in grades 7–9 (aged 13–15) from one Swedish school participated in the study. The students were divided into four groups consisting of 6–9 students each. Eighteen of the students (60%) had never been playing SimCity before entering the Future City competition. About half of the students (12 boys and 2 girls) were frequent computer game players, and played at least once a week.

The gaming students were studied “in the field”, that is, in naturalistic setting in a school environment. The observation method applied is of the kind referred to as participating observation (Fangen & Nordli, 2005). Each observation was accomplished in approximately 90 minutes. The observing researcher was sitting next to the students, taking field notes, and asking questions when actions during game play needed to be further explained.

Five practices for gathering data were used: observations, field notes, methodological field notes, audio recordings, questionnaire, and photographs. The field notes gathered during the observations followed an observation guide. Main observation targets were: collaborative patterns, decision-making strategies, and conversation topics. Audio recordings of students’ conversation during game play were made. The audio recorder was placed next to the computer screen, and the four gaming sessions were recorded without any breaks, or editing. Approximately 320 minutes of audio data was generated. Photographs were taken to document the setting of the gaming sessions. To gather background information about the respondents the students were asked to fill out a questionnaire (age, gender, gaming experience etc.) in connection to the gaming sessions.

Straight after the field studies the field notes and the methodological field notes were typed out as well as overall impressions of the gaming sessions. The audio recordings were listened through and transcribed, not in detail word by word, but in form of a summary narrative

inspired by methods used in ethnographic research (Bailey, 2007). The narrative included descriptions of the procedure, student quotes, actions, and observer's reading of the situation.

The transcribed and analysed data include: methodological field notes, field notes in form of narrations describing the gaming process, as well as descriptions of the settings, and background information on the participating students. To facilitate "systematic retrieval of pertinent sections of the data" (Berg, 2001, p. 76) categories for coding were developed and used in the analysis. The transcripts were scrutinised iteratively and reflexively in a two-phase-analysis (Patton, 2002). The first phase resulted in categories for coding. The second phase of the analysis aimed at testing and verifying the patterns that were observed in the material, and identifying possible sub-categories. These categories were then used as analytical tool to describe the gaming sessions.

PRELIMINARY RESULTS

To recapture, the purpose of this paper is to present an description of student engagement, and emerging collaboration patterns between the students when playing SimCity 4 (Maxis, 2003) in the science classroom.

The outcome of the analysis revealed different types of student engagement, referred to as: (A) *Executor*: student who was manoeuvring the mouse and, in most cases, possessed the greatest gaming competence.

(B) *Core group participant*: student who was present during the whole gaming session, and collectively in charge of driving the process forward.

(C) *Temporary participant*: student that only appeared occasionally, however when present, was actively involved in the gaming process, proposing actions, commenting on the development of the city etc.

(D) *Invisible participant*: student that was present throughout the whole gaming session, but did not engage in the gaming process.

(E) *Visiting participant*: student who did not belong to the group, but paid a visit delivering recommendations and tips, or asking questions.

The outcome of the analysis also demonstrate that the collaboration between the students was formed by combinations of the following patterns:

(1) Predominant decision-making

The game play was looked upon as a an individual project executed by the *executor* that decided what proposals to implement, and what actions to be taken. The group members came up with proposals that were "judged" by the executor. The city was referred to "the executor's city".

(2) Distributed decision-making

The game play was looked upon as a common project, and was developed as a consequence of joint decisions taken within the group. The decision-making process was based upon a thread of questions and proposals from both executor and the rest of the group members. The city was referred to as "our city".

(3) Master-apprentice relationship

The students that were less gaming competent were asking questions about events occurring

in the game. This constant stream of questions and answers between students who were more, or less acquainted with the game mechanics can be described as a *master-apprentice relationship*, or as a peer to peer learning process.

Descriptions of the four gaming student groups

GROUP 1: The *core group* consisted of four boys and three girls. The most gaming competent boy was by the others selected as *executor*. The collaboration pattern was characterised by a *distributed decision making* process. It was apparent that the students looked upon the project as a common project, based on a joint effort but headed by the core group members with the greatest gaming competence (two boys) who got the last word in every decision. The less gaming competent students were taking on the role of *apprentices* asking questions about events occurring and affordances offered within the game. One girl was acting as an *invisible participant*, and did not participate in the activity, but was present during the whole session.

GROUP II: The *core group*, consisting of two boys and two girls was running the process. The most gaming competent boy was by the others selected as *executor*. The collaboration patterns could be described as a *distributed decision-making* process and a consequence of a genuine collaboration process. There seemed to be no competition between the students in the core group, and the city was referred to as a common project. Two boys were acting as *temporary participants*. One boy and two girls were *invisible participants*, being present but with no engagement. Also three *visiting participants* were temporarily engaged in the process delivering suggestions and advices.

GROUP III: The *core group* consisted of two boys, and two girls. As in the two previous groups the most gaming competent boy was selected as *executor*. Two other boys were *temporary participants*. Two girls were sitting behind the core group, and left before the session was over. Within the core group the city was looked upon as a common project, and based on joint decisions in a *distributed decision-making* process. However, the executor was given the last word in all actions taken, and a *predominant decision-making* process occasionally tended to dominate. One of the girls was constantly asking questions about the game, and was challenging the framework of the game by proposing not feasible solutions. Her creative mind set was one of the driving forces throughout the game play.

GROUP IV: The *core groups* consisted of two girls and five boys. The *executor* was a boy who had pointed himself out for the role. Also *visiting participants* came by occasionally, and delivered tips and advices. Since the gaming process turned out to be a stressful event the group delegated the major part of the decision making to the executor. A *predominant decision-making* process was taking place, and all the proposals were “judged” by the executor. He had the last word in all decisions and even if the rest of the group did not agree upon his opinion he still went in the direction that he preferred. In a critical situation it all switched from being a common project to “the executor’s city”. The group started to question him and an aggressive tone evolved in the group. A power struggle started between the students, and instead of focusing on the development of the city a lot of time was spent on

blaming the executor for taking bad decisions. The executor neglected these accusations, and continued to play driven by his own beliefs.

CONCLUDING REMARKS

The outcome of the analysis demonstrate that the students' previous gaming competence strongly influenced how the collaboration between them was carried out during the game play. In all of the groups the student that possessed the greatest gaming competence took on the role as executor. The executors were all male. Previous statistics show that the amount of time that students (girls and boys) spend on developing their gaming competence outside school greatly varies: boys play more than girls (Swedish Media Council, 2008). The results presented in this study demonstrated that the boys' previous gaming experience placed them at an advantage, and that they took on the leading role resulting in advantages and control of the decision making process. A question important to highlight is if this primarily had to do with them taking on the role of dominate students in a school situation, or if they for once actually could make use of competences they had gained outside school?

In average the core groups consisted of five students. The rest of the members were temporary or invisible participants with a rather passive approach. Since the groups in average consisted of 7 ½ students these figures indicate that two or three of the students in each group were not involved in the game play. This implies that the students groups were far too large for this kind of learning activity.

Three groups were dominated by a distributed decision-making process. In the group characterised by predominant decision-making process the sense of fellowship was weaker. In two of the groups there was a constant stream of questions and answers between the students in a peer to peer learning activity. Through this process the students got to share their knowledge about the game world, but also got to see the system with "new eyes", and through questions challenged the framework of rules that the game world represent. The students alternated between treating the city as a common project ("our city"), and as an individual project ("the executor's city"). When the game developed successfully, the city was mostly referred to as a common project, but when the intentions failed it was seen as an individual project. Failures were then blamed on, in most cases, the executor.

These conclusions provide implications, and important aspects to consider when bringing in computer games that are collaboratively to be played for educational purposes in the classroom. To summarise; firstly, the students' previous levels of gaming competence ought to be taken in account when putting the student groups together. This is in order to avoid putting the less gaming competent students in disadvantaged positions. On the other hand, attention ought to be paid on how to embrace, and let the students apply these competences (that is, gaming competences) gained outside school in a fruitful way. Secondly, to keep all students engaged in the game play the number of students in each group should not exceed five. And, finally the great potentials of peer to peer learning (master-apprentice relationship) during game play ought to be highlighted, and recognised as a central activity in these kinds of learning situations.

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