

Students perception of a learning environment and the teachers role while using unmodified computer games as learning tools in upper secondary education

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ABSTRACT

As the usage of computer games as teaching tools are being discussed and empirically studied, the use of unmodified, commercial, off-the-shelf games is an interesting possibility. As this may have implications on the teachers role, possibly requiring it to be different from when using specially adapted game-like education software, the students attitudes towards the learning potential of computer games with and without accompanying teacher efforts are of great interest.

To obtain information on how students taking part in game based education perceive their learning environment, an interview study was conducted. Students undertaking their 10:th and 11:th year of study as part of a test project using computer games as the main teaching tool, were interviewed about their perception of the created learning environment.

Results show that the students perceive this form of learning as having great potential, giving significantly increased knowledge in the studied areas. When comparing to how learning through games alone is perceived, it becomes clear that accompanying teacher activities are important, especially if linked successfully to in-game activities.

BACKGROUND

Among the first observed learning effects regarding computer games are those related to reflexes and hand-eye coordination. As remarked by Griffiths, these findings are also accompanied by those pointing out particular aspects of games as having important bearing on using them as educational resources: "*Research dating back to the early 1980s has consistently shown that playing computer games (irrespective of genre) produces reductions in reaction times, improved hand-eye co-ordination and raises players self esteem. What's more, curiosity, fun and the nature of the challenge also appear to add to a games educational potential*" (Griffiths 2002).

The idea to use games as learning tools emerged long before the existence of computer games, however, with "*The modern era of simulation gaming*" (Wolfe and Crookall 1998) including large simulation games such as the RAND corporations logistics simulator for the US Air Force, and the first business simulation being used in college education as early as 1957 (Dickinson and Faria 1997). These and other developments made Duke suggest in 1974 that games may

become an entirely new form of communication in education, as noted by Woods: "*He suggested that simulation games might offer a possible answer to the problems of education in an increasingly complex society*" (Woods 2004), in reference to: "*...gaming is a future's language, a new form of communication emerging suddenly and with great impact across many lands and in many problem situations*" (Duke, quoted from Woods 2004).

Further research in the area of specific advantages of computer games as educational tools has pointed out several aspects where games fit very well into key patterns of successful learning. As Gee points out, these aspects need not be related to those features that are perhaps most often noted regarding computer games, such as the graphics: "*The secret of a videogame as a teaching machine isn't its immersive 3-D graphics, but its underlying architecture. Each level dances around the outer limits of the players abilities, seeking at every point to be hard enough to be just doable*" (Gee 2003a). This positive aspect of something being hard, and the danger of making things too easy, is also discussed by Papert: "*What is best about the best games is that they draw kids into some very hard learning ... The fact is that kids prefer things that are hard, as long as they are also interesting*" (Papert 1998).

This touches on the Practice Principle, outlined by Gee as one of several principles involved in successful learning situations: "*Learners gets lots and lots of practice in a context where the practice is not boring (i.e. in a virtual world that is compelling to learners on their own terms and where the learners experience ongoing success)*" (Gee 2003b). Among other notable such principles are the Achievement Principle: "*For learners of all levels of skill there are intrinsic rewards from the beginning, customized to each learners level, effort, and growing mastery and signalling the learners ongoing achievements*", the Ongoing Learning Principle (abbreviated): "*The distinction between learner and master is vague, since learners ... must, at higher and higher levels, undo their routinized mastery to adapt to new or changed conditions ...*", and the Probing Principle: "*Learning is a cycle of probing the world (doing something); reflecting in and on this action and, on the basis, forming a hypothesis; reprobating the world to test this hypothesis; and then accepting or rethinking the hypothesis*" (Gee 2003b).

In the light of these principles, it becomes clear that computer games fit in very well as an educational tool, especially if one also takes into account that many games span across subject boundaries, being able to offer learning in several areas at once. As pointed out in a study by Kirriemuir and McFarlane regarding the roller coaster simulator game RollerCoaster

Tycoon: “The game could be used across a number of subject domains, such as physics (motion and velocity), and business and economics (running a theme park)” (Kirriemuir and McFarlane 2003).

The usage of unmodified, commercial, off-the-shelf games is not the only possibility, though. The development of a combination of educational software and computer games, often referred to as “edutainment” has been the result of efforts trying to explore the game format and fill it with more traditional, school curriculum oriented material. However, the usefulness of such edutainment software has been questioned in many cases, as observed by Kirriemuir: “However, when game-oriented entertainment and learning or educational material are combined, the result has often been disappointing; the educational value is debatable or irrelevant, and the gaming and engagement qualities compare poorly to those of pure games” (Kirriemuir 2002).

A similar standpoint is taken by Papert, viewing this edutainment “offspring” from games and education software as one possessing none of the best features from either “parent”: “Shavian reversals – offspring that keep the bad features of each parent and lose the good ones – are visible in most software products that claim to come from a mating of education and entertainment” (Papert 1998). More specifically, Kirriemuir and McFarlane points out several reasons for these shortcomings: “Most edutainment has failed to realise expectations, either because: • the games have been too simplistic in comparison to competing video games ... • the tasks are poorly designed and do not support progressive understanding ... • the target audience becomes aware that it is being coerced into ‘learning’, in possibly a patronising manner” (Kirriemuir and McFarlane 2004). These known issues regarding edutainment makes it interesting to investigate if unmodified, commercial off-the-shelf games may be more useful as educational tools.

Another issue central to using computer games as educational tools, is the role of the teacher. Here, Kirriemuir notes various misassumptions about teaching using computer games in the classroom, such as: “The teacher will be marginalised, and become partially or fully redundant, by the game. The role of the teacher is reduced to an assistant who turns the computers on and off” and “The pupils work individually, boothed, one to a game, in monastic silence. Learning is an isolated and unsocial experience...” (Kirriemuir 2005). As Kirriemuir points out, these are misassumptions, and if realised such learning environments would be very unfortunate indeed. Instead, if treated by the teacher as a beneficial resource, computer games may take the role of tools that may enhance his/her teaching, the key point being that the games are tools in the hands of the teacher. Being able to use activities occurring within computer games as starting points for educational activities extending out from the games, is one example of how the teacher in a highly creative and active way may create fruitful learning situations. A key point from a study conducted by the British Educational Communications and Technology Agency, BECTA, is that a strong teacher focus is essential: “The role of the teacher in structuring and framing the activity of the learner remains crucial if learning outcomes are to be achieved.” (BECTA 2001).

The studied test project

In Botkyrka, Sweden, a test project using computer games as the primary teaching tool for a class of students in upper

secondary education was initiated in the fall of 2003. The project first included students in their 10:th year of education, and now in the second year of the project includes students in their 10:th and 11:th year of education in a mixed fashion. This represents the first and second year of the non-compulsory education in the Swedish school system, normally corresponding to students reaching the age of 16 and 17 if continuing directly from the compulsory school system.

The project was set up in such a way that also students lacking sufficient grades in core subjects from the preceding level (year 9, the last year of the compulsory education in the Swedish school system) were qualified to apply. This was seen by the teachers and the local school authorities as an experimental way of reaching students who would otherwise have a low probability of ever undertaking upper secondary education. Also the pedagogical issue of using unmodified off-the-shelf commercial computer games as the main teaching tool was of great interest.

The students were free, up to the limitations of the project budget, to suggest game titles to be used. Although the teachers has the right to refuse any suggested game they feel would be too extreme, this veto right had never been used up to the time of the study. The resulting mix of game titles thus reflects the preferences of the students themselves:

Game titles used	Number of regular players
World of warcraft	20
Counter strike	18
Battlefield 1942	15
Age of empires	11
Age of mythology	11
Star wars galaxies	11
Warcraft III	10
Diablo	9
Rise of nations	9
Morrowind	7
Tibia	7
Sims	5
Neverwinter nights	5
Sim City 4	3
Matrix	3

Game titles used in the project, ordered by the number of students having played them regularly during their participation in the project.

With kind permission from all involved parties, we were allowed to perform an independent study interviewing both students and teachers.

RESEARCH QUESTION

As both the learning potential of computer games in general, and also the teachers role during computer game based education, are debated, more information in these areas is needed. The usage of unmodified, commercial off-the-shelf games as teaching tools in schools is of special interest, as their edutainment counterparts have been observed to possess deficiencies while pure games are observed to be highly engaging.

The research issue addressed in this paper is to find out how students using unmodified, commercial off-the-shelf computer games perceive their learning environment. Also, how students perceive the role of the teacher in a game based learning situation is studied, by comparing their perceived knowledge acquisition in the project to their perception of the learning potential of computer games alone.

METHODOLOGY

The empirical contribution of this paper is an evaluation study of an ongoing test project in Botkyrka, Sweden, using commercial, unmodified computer games as the main teaching tool in upper secondary education. The project in question includes students in both their 10:th and 11:th year of education, in a mixed fashion. The interviews were conducted towards the end of the second year of the four year test project, at a time when it was clear to the teachers which grades they would give the students at the upcoming end of that semester.

All 21 students in the project participated in the study through in-depth interviews, as well as the two teachers. The moderate number of students participating in the project is a limitation to the possibility to generalise results to the entire population, thus only conclusions regarding the participants in the project in question are drawn. Also, as all the participating students were male, and their backgrounds as immigrants/non-immigrants were not investigated, neither gender issues nor ethnical issues are addressed in this paper. However, as all the students in the project were interviewed, rather than just those choosing actively to participate, the risk of results being biased as a result of personality differences was minimised.

The interviews were conducted individually in a separate room, away from the class room, with no possibilities of anyone else overhearing the conversations. The students retained full anonymity, only being identified by a sequential number untraceable to the specific individual. Each student was informed of this anonymity, and that his or her answers would not be disclosed to anyone else. By taking these measures, the risk of students not daring to answer the questions honestly was reduced as much as possible.

During the interviews, the interviewer followed a fixed form with questions to ensure equal coverage of topics with all students. Only follow-up questions may differ somewhat among the students, depending on the answers given. The information was entered into a database for processing. Key quotes were translated to English for the purpose of appearing in this paper.

RESULTS

At the time of their acceptance to the project, 12 of the students (57.14%) had achieved all the required goals set up at the preceding level of education (year 9), and thus had graduated from that level in the normal way. The remaining 9 students (42.86%) had not been given grades for one or more of the core subjects of Swedish, English and mathematics at the preceding level (year 9). As a result, most parts of the upper secondary education were not available to these students.

Regarding gaming background, all the students reported having played games frequently prior to entering the studied project, with 13 of them (61.9%) belonging to clans or guilds.

Grades

During their time in the studied test project, the 9 students lacking core grades from the previous level were first allowed to study for those grades. At the time of the study, all 9 of these students had successfully passed this stage, so that they now had complete grades for all core subjects for year 9.

Regarding grades for year 10 and 11 a large number of grades had been given in several subjects specific to the program in question, for instance digital culture, game development, and web design. Focusing on subjects generally recognised and used in other upper secondary education programs, 16 students (76.19%) had received grades in English (10:th year level), 10 students (47.62%) were about to receive (decisions already made by the teachers) grades in English (11:th year level), and 18 students (85.71%) had received grades in social studies (10:th year level).

Students perception of their situation

When questioned about how they perceived the level of difficulty of the program, 10 students (47.62%) gave replies indicating that they found the program easy, 7 students (33.33%) found it to be of average/medium difficulty, 1 student (4.76%) found it hard, 2 students (9.52%) gave replies indicating a mix of easy and hard elements in the program, and 1 student (4.76%) argued that this was something entirely dependant on how much you asked of yourself.

17 students (80.95%) stated that they had acquired new knowledge while in the program, 1 student (4.76%) felt that no new knowledge had been acquired, while 3 students (14.29%) answered either that they didn't know or didn't answer at all.

Divided by five core subjects, the students indicated whether they had acquired new knowledge or not about them by participating in the program in the following way:

Subject	Yes	No	Other
Swedish	15 (71.43%)	5 (23.81%)	Doubtful: 1 (4.76%)
English	20 (95.24%)	0	Knew it already: 1 (4.76%)
Mathematics*	10 (47.62%)	11 (52.38%)	
Social studies	20 (95.24%)	1 (4.76%)	
History	14 (66.67%)	7 (33.33%)	

*) Regarding mathematics, 5 students of those answering "yes" (50% of those answering "yes") added "a little", "only some" or similar.

When questioned about the knowledge that could be acquired from the computer games alone (without teaching efforts from the teachers), the students gave the following replies:

Subject	Yes	No	Other
Swedish	6 (28.57%)	12 (57.14%)	Depends on chat language: 3 (14.29%)
English	21 (100%)	0	
Mathematics	8 (38.08%)	11 (52.38%)	Doubtful: 2 (9.52%)
Social studies	5 (23.81%)	12 (57.14%)	Game dependent: 4 (19.05%)
History	10 (47.62%)	10 (47.62%)	Game dependent: 1 (4.76%)

Discussing their overall impressions of the program, and how they perceived their situation while taking part in it, all 21 students expressed positive answers like "very good", "great" and similar. One student, though, added: "It should be tougher".

Teaching methods employed

Interviews with the teachers revealed that their main approach to teaching using unmodified computer games involved using in-game activities as starting points for discussions and assignments of various kinds. This method was applied constantly. Both teachers reported that the students seemed highly motivated and interested in discussing issues in fields like history, English, or social studies, if the event spawning

the discussion/assignment had occurred in one of the computer games. The teachers also frequently required the students to hand in essays describing their avatars personality, their situation in a game, and similar game related issues, and then using the received essays in Swedish class.

DISCUSSION AND CONCLUSIONS

The method of interviewing the entire class in question, as opposed to ask for volunteers, has the advantage of not just reaching a subset of individuals who might differ from the rest in various ways. In studies performed on volunteers that have actively chosen to participate, great care must be taken when interpreting the results. In such cases it is vital taking into account that the participants are more interested in the subject at hand, or at least more active and willing to take part in a study, than other people in general, even in the same age group, etc. This potential problem has been reduced as much as possible by interviewing not just enthusiastic volunteers, but everyone in the class.

It's clear that all 21 students in the program perceive their situation as being very positive, describing it in terms like "very good", "great" and similar. This doesn't mean, though, that they are all 100% happy with all aspects of their situations, as indicated by one student describing things as "Fine" but then adding: "It should be tougher, though, with higher demands on us" [in order to pass]. This comment is a single exception, however, to the otherwise completely positive replies obtained when discussing the students overall impression with the program.

When asking explicitly about the amount of knowledge acquired, the replies show a little more heterogeneity. Here, while 17 students (80.95%) indicated having acquired new knowledge, 3 students (14.29%) either didn't answer or stated that they didn't know if they had acquired any new knowledge, and 1 student (4.76%) was sure that no new knowledge had been acquired. Not knowing if something has been learnt or not may be taken as a bad sign, indicating that it probably hasn't. This may not be the case, though, as the students awareness of learning is not the same thing as learning taking place. As one of the interviewed teachers in the program puts it: "Sometimes, the students doesn't realise they have learnt something, just because it has happened through a computer game and not through traditional teaching. Not until we point it out to them, do they go 'Oh, yeah, I know that, its just like what happened in the game.'".

Level of difficulty

In the case of perceived level of difficulty of the program, more diversity is shown. Here, a the most common view was that the level of difficulty was easy, indicated by 10 students (47.62%), followed by the view that level of difficulty was "average", "medium", "just right" or similar phrases, indicated by 7 students (33.33%). One student (4.76%) found the program to be hard, while 2 students (9.52%) pointed out that it contained a mix of activities that were not on the same level of difficulty, resulting in their impression of the level of difficulty varying.

Discussing level of difficulty is complex since it is closely tied to the possibly very different reference frames of the individual students, resulting in very different levels of difficulty to be perceived. However, since what is perceived, rather than some non-existent absolute measurement of

difficulty levels, is the interesting factor in determining the students view of his/her situation, perceived level of difficulty is the more interesting factor to be considered. Variations in perceived difficulty may not only be dependant on non-deterministic factors, though, but also on conscious choices made by the individual. This is clearly illustrated by one student, arguing that the perceived level of difficulty in the program depends on how one chooses to live: "That depends on what you demand of yourself".

On a more practical level, two students pointed out that the program might benefit from dividing the students into two groups, allowing students to advance with two different paces through their studies. In both cases, these students felt that the original source of the problem was the group of students who had been admitted to the program without having passed several key subjects at the preceding level, and now slowing the rest down: "There should be two groups, one for the unqualified [those lacking grades from the preceding level] and one for the rest of us" and "It's too easy because of the unqualified [students], but it's getting better now. If it hadn't, they should be in a separate class". Incidentally, one of the teachers states that having students proceeding with different paces is something that can be handled relatively smoothly in a teaching situation using computer games such as the studied program: "It's easier to go back and forth between a more advanced and a more basic level here, than it is when addressing students the traditional way as a group in a classroom. I can give the students a more individual treatment here".

Perceived knowledge acquisition by subject

Divided into key subjects, English and social studies stand out in terms of student perceived acquired knowledge. In the former case, this is hardly surprising, given the large amount of communication both between players and between players and NPC:s (Non Player Characters) in many modern games. Since geographical distances become unimportant when using the computer mediated communication techniques inherent in online games, a natural consequence is that players frequently encounter other players from other countries, making chatting in English extremely common. Local servers using local languages (other than English) are perfectly possible, but are in practice used less than the ones with English as the main chatting language. Given the extensive verbal (textual or in some cases by voice) communication between players, it is easy to see how students with other native languages quickly can improve their English speaking capabilities through such computer games.

In the study, 20 students (95.24%) stated that they increased the knowledge of English by being in the program. The remaining student replied that he didn't increase his knowledge of English, but this was only because he happened to be speaking English fluently already, before entering the program. "It's good that I practice it here, though" he added, "so that I don't forget it". The figures regarding social studies are similar, 20 students (95.24%) indicating increased knowledge by participating in the program. Here, the remaining student though, simply doesn't feel any increased knowledge in this area.

In the case of social studies, more of the acquired knowledge seems to come from teacher activities. These activities are almost always related to the computer games being played, mostly originating from occurrences in the games, and are

then extended to activities such as discussions separate from the games. In this case, therefore, the games are often used as inspiration starters, leading to learning as a positive side effect that would not have occurred nearly as often without the active work by the teachers. This is exemplified by one of the teachers: *"When I observed the students gathering [in the online role-playing game World of Warcraft] to decide which one of two dungeons to enter, I was thrilled to see that they performed an ordered voting procedure, standing up or sitting down to indicate if they were in favour or opposed to the suggested alternatives. This led me to have several very fruitful discussion with them, going into all sorts of voting taking place in the society, from shareholders of companies to politicians in the Riksdag [the Swedish Parliament]"*.

Regarding the subject of Swedish, 15 students (71.43%) reported increasing their knowledge by being part of the program, 5 students (23.81%) felt no increased knowledge, and 1 student (4.76%) replied being doubtful about any increased knowledge in this field. Two of the students replying "yes" added: *"But that's from the teachers"* and *"Not from the games, but when the teachers asks us to write things"*, indicating game-initiated side activities such as writing essays about game related things. One student playing the Age of Empires strategy game also remarked: *"When you ask the teacher what some tricky medieval English word means, he tells you the Swedish word for that. Then you don't know what that means, either. Then he explains it, and you know a new Swedish word too"*.

In the case of mathematics 11 students (52.38%) reported having increased their knowledge by participating in the program, while 10 students (47.62%) felt they had not. Out of the students replying "yes", 5 students added *"a little"* or other comments to that effect. Two students pointed out that a lot more mathematics was used when actually constructing the games, as opposed to just playing them. Game construction was a topic just beginning to be studied in the group, and these students pointed out that mathematics was likely to be studied more as a result. However, as things had been so far, it seems clear that the vast majority of the students felt that mathematics was a field where they had learnt very little.

Regarding history, where 14 students (66.67%) reported increased knowledge, and 7 students (33.33%) felt no increased knowledge, several comments indicating that this is highly game dependent. While some games are purely fictional, others may strive to be more or less historically correct. Some students pointed out that they had learnt things about older history by strategy games set during the stone age, and also from others set in medieval times, as well as world war 2 history from the first-person action game Battlefield 1942. Students who happened to have been focused on purely fictional games felt quite oppositely that they had learnt no history from the games, *"Just some from what the teacher said when we were not playing"* as one student put it.

Learning from games or from teachers using games

The above results describe perceived acquired knowledge through participation in the test program, from games and game-induced teacher activities combined. When this is compared with the students views of what can be learnt by the games themselves, without teacher participation, an interesting pattern appear. With the exception of English, which has a very high potential in both cases, all the other subjects are perceived to have a lower potential for learning

through games alone, as perceived by the students. This ranges from slightly lower to significantly lower potential, measured by the number of positive students, as indicated below:

Subject	Game + teacher	Game only
English	20 (95.24%)	21 (100%)
Mathematics	10 (47.62%)	8 (38.09%)
History	14 (66.67%)	10 (47.62%)
Swedish	15 (71.43%)	6 (28.57%)
Social studies	20 (95.24%)	5 (23.81%)

Number of students in the study with a positive view of learning through the mix of games and teacher activities in the program, versus from games alone.

When making this comparison, one must note and be aware of one difference between the two compared entities: the game + teacher one is perceived by actual participation, and reflects the events actually having occurred in this particular test program, while the games alone entity is an estimate made by the students without necessarily trying to learn a subject in this way. This may account for the fact that for the subject of English, the learning potential is actually perceived to be slightly less for the program than for games alone. This may be due to one particular student having experienced some particular problem while taking part of the program, making him report no improvement in his English speaking abilities, while still feeling that such improvement in general is perfectly possible.

Both mathematics and history is perceived by the students as having a somewhat lower potential for learning through computer games alone, in comparison to combined with teacher efforts linked to the games. Finally, in the cases of Swedish and social studies, the students perceive these subjects to have a significantly lower potential for being learnt by games alone as compared to games plus game-linked teacher activities.

Even though no subject is without positive supporters among the participants of this study, it seems clear that in 4 cases out of 5 the learning potential is higher if the gaming experience is combined with teacher efforts linked to, and spawn from, the in-game activities. In a project using computer games as a teaching aid, the teacher activities are therefore vital. Rather than being a tool to decrease the number of teachers, computer games used in teaching appear as a tool to increase motivation and enrich the learning experience, with the teachers being able to take advantage of in-game activities as starting points for exploration of the knowledge landscape.

FUTURE RESEARCH

The study described in this paper indicates a notable learning potential in using unmodified, commercial off-the-shelf games in class. As the studied environment includes significant teacher efforts based on the games, and as the students themselves perceive games alone to have a lower learning potential if not accompanied by these teacher efforts, more studies on the teachers role in computer game based education might add valuable information in this area. Teaching methodologies focusing on using in-game activities/events in unmodified, commercial off-the-shelf computer games as starting points for learning processes appear interesting and worth more study.

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