

German Girls Are Goofy. An Investigation into the Knowledge Deficiencies of Digital Games that Are Designed for Learning

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Abstract

Digital games seem to have enormous educational potential. But something goes wrong. Although the field of digital games is booming, games that are designed with an educational purpose in mind have a large variety of deficiencies. The treatment of knowledge in games is a decisive factor. There is an obvious difficulty of balancing the virtual vs. the real—a phenomenon in games that is not yet well-understood. The paper demonstrates how knowledge in games may be properly used as knowledge—a step towards learning effects.

German Girls are Goofy or even Stupid

The present paper does not deal with simulation games or with games for testing. Those games have peculiarities that need a specific treatment. Instead, we focus “true” games¹ such as adventures in which players are engaged in missions, explore virtual worlds, and solve a variety of problems.

It is obviously not easy to develop pleasant serious games.

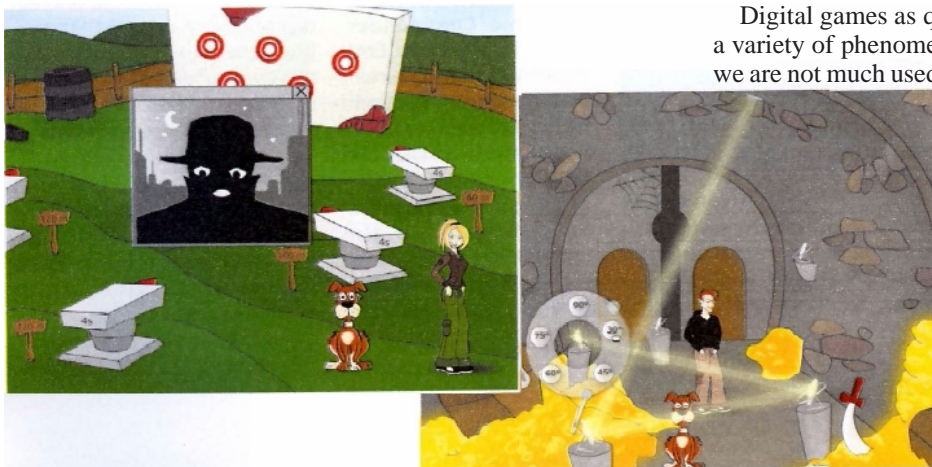


Figure 1: Two screenshots from the German educational Game MISSION: WISSEN that has variants for boys and girls

The recent German computer game MISSION: WISSEN, i.e. “Mission: Knowledge”, (release summer 2007) which is illustrated by Figure 1 is designed for students at an age of about 11 to 13 years.

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The designers, the developers, and the publisher proudly announce the games’ gender-adaptive pedagogic concept. This sounds great. A closer look is shocking. “Pedagogy” as the designers and/or developers understand it and as the publisher supports it means, for instance, that boys facing harder problems during game play are repeatedly encouraged to try again, whereas girls facing those problems may immediately consult the help function (Wiegand 2007; 2008). Girls are goofy! Maybe, goofy is not the right word. Better, developers and others seem to consider girls stupid.

The case of the game MISSION: WISSEN! reported might be extreme, but it is shading some light on the difficulties designers, developers, and publishers have with serious games.

There are some recent comprehensive investigations into the difficulties of designing games that teach such as, e.g., the report (Jantke 2006a). The number of flaws in digital games designed with some educational purpose in mind is annoyingly large. This paper is addressing a single aspect: the way in which knowledge is treated in the game world.

Digital games as quite new media are bringing with them a variety of phenomena we are not used to. For illustration, we are not much used to distinguish the real from the virtual.

The relationship between the real and the virtual has been discussed in (Jantke 2006b) with a certain emphasis on e-commerce. In virtual worlds such as, SECOND LIFE players are dealing with virtual goods and virtual currencies like, e.g. the Linden\$. Linden Lab, the enterprise operating SECOND LIFE issuing the Linden\$, does not have a bank license and, thus, its money is only virtual, although players are willing to exchange real for virtual money.

In several virtual worlds the behavioral pattern to aim and shoot (Björk & Holopainen 2004) occurs quite frequently. Aiming is always real, but shooting rarely is.

In contrast, other phenomena in virtual worlds are always real such as pictures and knowledge.

¹For illustration, readers should think of digital games such as LARA CROFT: TOMB RAIDER

The Knowledge Dilemma in Adventure Games

When you see a picture in a digital game, it's always a real picture, although a digital one. You really see it.

When you have knowledge in a digital game, it's always real knowledge. You really know something.



Figure 2: Assembling a virtual microscope in the virtual world of the digital game GENIUS TASK FORCE BIOLOGIE

Assembling a virtual microscope in a virtual world as shown in Figure 2 requires real knowledge. The problem with this particular game is (see (Jantke 2006a) for a more comprehensive discussion) that this knowledge is never used again within the game. It remains in the outside world being separated from game play; being worthless.

You don't teach by demonstrating explicitly that the knowledge your students just acquired will never be used again.

Instead, the teaching strategy should be to present chunks of knowledge in such a way that they are used, perhaps, even without explicitly noticing.

Playing a really good game is fun. As Raph Koster nicely puts it, "Fun from games arises out of mastery. It arises out of comprehension. [...] In other words, with games, learning is the drug." ((Koster 2005), p. 40)

In another German game named BRAND IM HAFEN (Engl.: Fire at the Harbor), one of the player's tasks is to resolve a case of mushroom poisoning. Figure 3 displays a related dialogue in the game. It is said that the player needs knowledge about poisoning mushrooms. But this is not true. Whatever you might know about mushrooms—what you may be really know in the real world—does not help at all.

Instead, the game is designed in such a way that the player has to take a particular virtual book from a particular virtual bookshelf and to tear of, virtually, a particular virtual page about poisoning mushrooms.



Figure 3: BRAND IM HAFEN—let's talk about mushrooms

After doing so, the case of mushroom poisoning may be resolved in the dialogue scene of Figure 3, otherwise not. There is no need to read the real text in the virtual book. There is no need to gain any knowledge.

SYBERIA (see Figure 4) is another game showing the same dilemma a dozens of moments of game play.



Figure 4: Calling home in SYBERIA in case the number is known

To enter a certain office, which is an essential step of the game play, the player's avatar has to present some fax from his office at home. For getting the virtual fax, the avatar needs to do a virtual telephone call as shown in the Figure. The player has to dial the real number on the virtual cell-phone. But this does not succeed unless he has picked up some letter from a table before. On this letter, the phone number is written.

In case a player knows the number already, say e.g. from earlier game play, this does not do. It's not the knowledge what counts, but to pass a certain predefined game state.

The Virtualization of Real Knowledge

There is abundant evidence for the need of a more systematic understanding of real knowledge in virtual worlds and, in particular, of ideas and methodologies to make real knowledge properly relevant in virtual game worlds. Knowledge must play the role of knowledge. The author calls this the *virtualization of real knowledge*.

For games which are designed with some educational purpose in mind, which aim at knowledge acquisition or (perhaps better) knowledge construction through game playing, knowledge has to play roles in the virtual world that make it function there as knowledge.

Here is a list of criteria:

- Having knowledge in the virtual world must be advantageous.
- There must be ways to exchange knowledge in the virtual world.
- There must be ways to share knowledge.
- Knowledge may come in chunks such that only the acquisition of many of those chunks suffices to gain new knowledge.
- When there are a few chunks of knowledge missing, it must be possible to guess. Guesses may be correct.
- There should be reasons to draw conclusions from knowledge.
- Knowledge may appear at different levels of abstraction or precision.

There are many further criteria such as the possibility of forgetting, e.g.

For the time being, the author will stick with the criteria listed above. For the sake of clarity, just two criteria shall be discussed in some more detail.

From the author's point of view, the first criterion is the basic one—this is the crux. In comparison, the assembly of a microscope which is never used again is simply ridiculous.

The idea of guessing deserves a few further explanations, perhaps, by means of a generic case. Many adventure games have maps showing the player which locations in the virtual world do exist and are worth to be visited. Frequently, these maps have the additional functionality of teleportation. It is custom to expand those maps during game play. When certain intermediate results have been achieved, more and more locations are shown.

In many games at many points of playing the game, the players can guess that there might be other places to visit. They might even have ideas of where places may be located. This is knowledge arising out of game play. It might be correct or, perhaps, approximately correct.

In those cases, players should have the option of trying to go there.

It is enormously frustrating if you know that there must be another location—or, at least, you believe to know—and there is no way to go there, because the designers made the a priori decision that you can't have this knowledge.

In learning situations, dealing with knowledge should never be frustrating. Learning must become the drug.

A Case Study of Knowledge about Behavior

There are paramount approaches to virtualize real knowledge; many of them should be tried out.

In a didactic design approach, it naturally depends on the learning goals which real knowledge shall be “virtualized”. In (Jantke, Knauf, & Kalkbrenner 2007) has been developed a game idea for teaching children about particular aspects of Artificial Intelligence. The game developed for this purpose is named GORGE based on a central idea illustrated within Figure 5.

GORGE is a track game. The key obstacle when moving along the track are particular cells called gorges. Pieces on the track can only pass a gorge when they form roped parties. Once a roped party has been set up, players help each other to pass the gorge according to a few simple rules of the game (see (Jantke, Knauf, & Kalkbrenner 2007)).

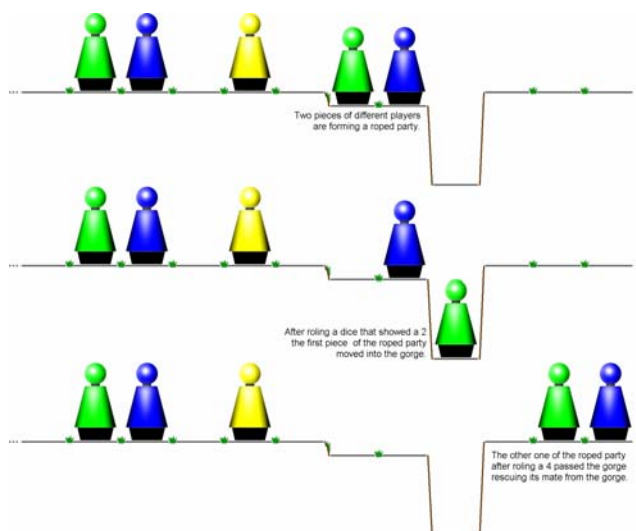


Figure 5: GORGE – roped parties passing a gorge

It is essential that children who shall learn about AI play against computer programs named NPCs (non-player characters).

Every NPC is based on a particular strategy. There are AI strategies of different sophistication (see Figure 6, e.g.).

The crux is that children by observing the behavior of NPCs can learn about their strategies. Consequently, they become able to foresee an NPCs behavior. This is clearly advantageous.

The focused knowledge about AI behavior is properly “virtualized into the game system”. Many of the criteria above are met.

Children may learn what AI strategies are, how they work, and—to some extent—how they are implemented. One of the side effects is the demystification of AI.

GORGE is a very simple case study which should not be overestimated. It is more an illustration of what it might mean to virtualize real knowledge and what it might mean that knowledge is advantageous in the virtual world.

After 20 recent varying students' implementations of GORGE within the framework of the author's winter term lecture on digital games at the Department of Informatics of

Darmstadt University of Applied Sciences, the next step will be an evaluation of how children experience to learn about Artificial Intelligence.

For the time being, the author can only demonstrate a few of the many aspects under investigation. For the sake of illustration, there will be shown a few screenshots from the implementation of the author's students Bastian Graser and Jürgen Müller.

For understanding the essentials, it is sufficient to have in mind three characteristics of the GORGE idea. First, when a piece on the track is hit by another piece, the one hit is jostled backwards to the next free cell. Second, pieces can pass gorges only by forming a roped party. Third, when a roped party goes to pass a gorge, it depends on the second player whether or not the first one is rescued from the gorge or left behind.

These features of the game mechanics are allowing for sufficiently many forms of cooperation and conflict.

For every NPC, there are 20 parameters which may be tuned to direct the NPC's behavior (see Figure 6). An evil and a friendly setup are preset and may be loaded and, perhaps, modified according to a player's wishes.

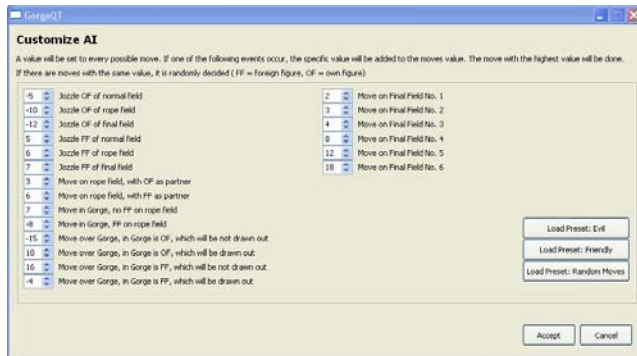


Figure 6: GORGE – setting up an NPC's intelligent behavior

Human players may play with the character of their NPC adversaries. And experimenters have a quite large space of options to explore.

In the particular game play reported here, the human plays the blue pieces on the board (see Figures 7 and 8).



Figure 7: GORGE – having set a snare for the aggressive players

The two NPCs playing the red and the green pieces, respectively, have been set up to be particularly aggressive in

a slightly different way. The NPC playing the yellow pieces is rather friendly and cooperating.

All players start with there pieces in the left upper corner and try to reach the six blue target cells visible in the lower part of the track (see Figure 7).

In the game play reported, the human player has set a snare for the aggressive players. He first moved to the leftmost gorge such that the aggressive players went the same way to attack him. Next, he moved with three other pieces to the gorge seen on top of the board. Half of the two aggressive players' pieces have been caught in a time consuming fighting at the leftmost gorge. In the meanwhile, the human player assisted by the cooperative NPC had been able to pass the other gorge (see Figure 7). As a result, by the end of the game, the aggressive NPCs left five of their pieces far behind (see Figure 8). The human has been winning the race.



Figure 8: GORGE – winning the race

Blue, i.e. the human player, scores 9 points, Green 7 points, Red 4 points, and Yellow 1 point. The friendly NPC playing the yellow pieces was a bit unlucky shortly before the end of the game. As can be seen in Figure 8, two more of his pieces came close to the target area.

Naturally, another game play of the same players is likely to have a different outcome. The only intention of the short illustrated report was to demonstrate that knowledge about NPCs' game playing behavior may be exploited in somehow interesting ways.

One approach is to begin with setting up particular NPC characteristics or, at least, to study the characteristics of NPCs set up already (see Figure 6).

Another probably more interesting approach is to learn about an NPC adversary's behavior. By watching an NPC's game play, one may gain a lot of knowledge about the NPC's characteristics.

This type of knowledge reveals all of the properties discussed above. Knowledge a human player gains about an NPC's behavior *comes in chunks*, gaps may be closed by *guesses which may or may not be correct*, there are good reasons to *draw conclusions*, and knowledge may be expressed on different *levels of abstraction*. However, the crucial point is that gaining knowledge is *advantageous*.

GORGE shall not be overestimated. It is not deemed a particularly attractive game, but an appropriate case study to deal with the knowledge issue in digital games.

Game Playing Experiments in Schools

A comprehensive study of game reception studies goes far beyond the limits of the present paper. The only aim of the present section is to inform interested readers about current studies.

During the summer term 2007, about 30 teams of the author's students in Darmstadt and Leipzig have developed and implemented the author's game JOSTLE which is even simpler than the game GORGE sketched in the present paper. A group of seven students have performed systematic game playing experiments with the game JOSTLE in a high school in Ilmenau during the winter term 2007/08. The students are currently working on the final report.

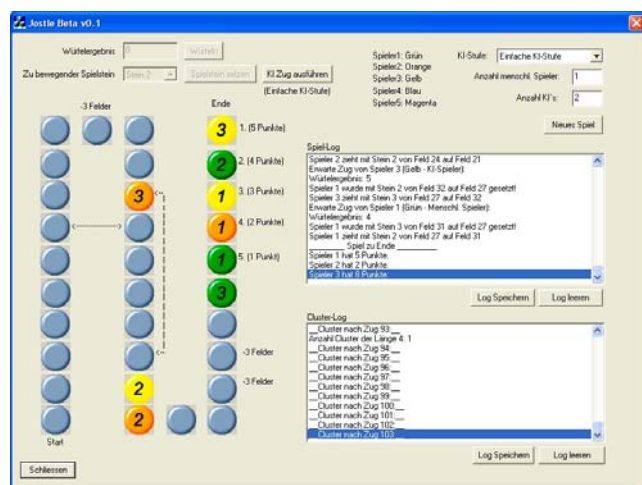


Figure 9: JOSTLE – one of the game playing and research tools

Here is just one quite interesting result. The high school students have been tested which AI implementation they consider human-like. For this purpose, a TURING test environment has been set up. Human players have been always facing two other players in a game. Sometimes, one of the other players was a human. There have been used different NPC implementations of varying complexity.

Interestingly, *not the most sophisticated reasoning* has been considered human-like, but those AI programs that show a certain “personality”.

Next to JOSTLE, the game GORGE in some of its implementation variants will be introduced into game playing studies in German schools. Winter 2007/08 was the semester of implementation. The summer term 2008 will be used for comprehensive social science experiments.

Summary & Conclusions

The issue of real vs. virtual knowledge is not the only one relevant to pleasant and successful serious games, but seems to be a particularly involved one which is mostly ignored, overlooked, or misunderstood. The dilemma in a rather large number of existing games provides sufficient evidence for this issue's relevance.

In contrast to the games industries, academia should have sufficient freedom to try out strategies of *virtualization of real knowledge* for the benefit of games which really have teaching effects.

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