

## Chapter 2

# Balancing Instruction and Construction in Virtual World Learning

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### **ABSTRACT**

*In game-based learning and in teaching using virtual worlds, designers creating the products and teachers providing them to students are both faced with a dualism between instruction and construction. Open-ended virtual worlds may provide authentic settings and inspire experimentation; on the other hand a lack of guidance may result in learners losing direction. The chapter conducts a narrative review of concepts across disciplines that describe the dilemma and imply certain instructional design strategies. Many authors advocate constructivist learning, but with instructional elements added. The authors collect their recommendations and apply and refine them in their own ideas: adaptivity inspired by Cognitive Apprenticeship, guidance on the basis of Cognitive Task Analysis, and immersive, interactive quest journals. Study setups and first results from ongoing projects illustrate the theoretical considerations.*

### **INTRODUCTION**

Fifteen years ago, the first author became involved in an ambitious project: to create a virtual hospital for training students of medicine. Two years later, *Docs 'n Drugs: The Virtual Polyclinic* (Martens, 2004) was made available to the first students at the University of Ulm, Germany, through a Web

page. Behind it was an Intelligent Tutoring System (ITS). Already then, we were thinking in terms of constructivist learning and digital storytelling, employing a case-oriented approach. The learner meets virtual patients who narrate their health problems. Students may try out different forms of diagnosis and treatment – without hurting anyone. The idea of setting up the hospital as a virtual world

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was already there, but at the time technologies like Java 3D proved to be cumbersome and inefficient. Nowadays, virtual world technology has become more easily accessible to designers. A number of 3D hospitals have appeared in *Second Life* (e.g. Toro-Troconis et al., 2008), even in entertainment computer games (*E.R.*).

Virtual worlds in teaching open up a range of possibilities. We can bring a rainforest, a power plant, an ancient civilization, or life in a far-away country to the classroom or students' homes. Different from a book, photos, or a video, students may interact with the content, have meaningful experiences and try out lots of things. In multiuser scenarios, students may communicate and cooperate with teachers or peers — even people in that far-away country — from any place. Virtual classrooms, labs, factories, or theater stages have the potential of stimulating imagination, creativity, and personal expression, thus helping realize the vision of constructivist, third-generation game-based learning (cf. Egenfeldt-Nielsen, 2007).

It starts already with the customization of one's avatar. Once this is done, the student may explore the virtual surroundings and experiment with them to gain insight about the subject matter. What happens, if I push this button? Does the balance of the ecosystem change, if I introduce this new species? Can I place an order in a restaurant in France? What if Hamlet had treated his girlfriend better? But then, the underlying model of the ecosystem may be too complicated for a student to grasp through experimentation. Who helps out with missing vocabulary? If there are too many buttons to push, with which might the student start? Will they learn the technical concepts behind the machine, or just in which sequence to press differently colored buttons?

Virtual worlds in education do not succeed by themselves. Designers creating the technology and teachers implementing them in their curricula need to make informed decisions based on insights from learning theory and media design. If we disregard the aspect of human cooperation

for a moment, educational virtual worlds can be seen as microworlds, i.e. closed environments with well-defined rules that make up the behavior of the world, allowing the learner to interfere via a set of actions, to construct mental models, and thus to discover the rules by experiencing them.

Papert (1980) introduced microworlds for experiencing and experimenting with Newtonian laws of motion in the early 1980s, at the time realizing them through turtle graphics in his programming language for kids, *Logo*. Today, 3D worlds like *Second Life* already come with an implemented, interactive Newtonian physics engine.

If executing actions results in meaningful or joyful activities for the learner, he or she may reach a state of transportation (switching focus from the real to the virtual world), presence (feeling as if being in the virtual world), engagement (feeling involved in what happens in the virtual world), immersion (experiencing actions and activities in the virtual world as one's own), and/or even flow (experiencing intense intrinsic motivation during the activities, 'losing' oneself in a task). These are desirable effects of game design and virtual worlds. Achieving immersion etc. in the users will not automatically mean, though, that construction of knowledge related to the learning goals will take place. For instance, the learner might 'lose' him- or herself in the subject matter as intended, but not draw types of intended conclusions. They might lose track of the many possibilities and digress, constructing some knowledge, but not related to the goals. They might learn how to customize their avatar, or, better, to actually operate the virtual devices provided, yet they might not be able to formulate and validate hypotheses about a simulated phenomenon.

Discovery learning (also inquiry learning) is a typical form of constructivist learning in science domains where the student is expected to formulate hypotheses and to validate them in a lab environment — be it virtual or real. In their literature review, de Jong and van Joolingen (1998) point out that discovery learning is hard. They cite

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