Chapter 3
Serious Gaming Supporting Competence Development in Sustainable Manufacturing

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ABSTRACT

Becoming a sustainable global manufacturing enterprise is a challenge for almost every manufacturing organization in the world because of its multidimensional nature. Sustainability combines environmental, economic, and social dimensions and is considered to be a complex and hard to learn subject needing a lot of experience and competences. Traditional ways to create such experience and develop competences like role playing and simulations tend to take a lot of time and are expensive. On the other hand, serious gaming has proven to support learners in acquiring new and complex knowledge and is ideally suited to support problem based learning by creating engaging experiences around a contextual problem where users must apply competences to solve these presented challenges. This chapter introduces a new learning environment which is build around a gaming engine supporting the development of competences in specific subject areas. Selected competences in sustainable global manufacturing lead to the definition of scenarios, which then can be executed by a game engine, thus creating experience within the user. A knowledge ecology space allows the user to interact and reflect on learning outcomes with other participants. The subject of sustainable global manufacturing is the application case presented in this chapter showing how specific competences in this area have been identified and how a game scenario has been developed. Finally, its implementation and evaluation is discussed.

INTRODUCTION

An early and broad definition for sustainable development has been provided by Gro Harlem Brundtland, former prime minister of Norway, during her presentation of the Report of the World Commission on Environment and Development to the UNEP's 14th Governing Council Session in 1987: *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*. Overall sustainability includes the balancing of three dimensions: Environmental, economical and social sustainability.

In order to handle such a complex subject the main competence of involved managers is most probably the ability of multi-dimensional thinking, which is a competence hard to teach. Gaining such a competence relies strongly on experience. Traditional teaching (and learning) methods would focus on a one-to-one case study (or role play simulations) which is time consuming and, therefore, quite expensive in the end. The question is how such competences can be build in a learner with less time and less efforts concerning teaching staff.

There is a growing interest in games for purposes beyond entertainment. There is a common agreement that Serious Games are potential facilitators of improved learning whilst at the same time entertaining and engaging users. Examples have been developed in a wide range of fields including management science, economics, intercultural communication, psychology, military strategy, sociology, political science, and interpersonal skill development (Raybourn & Bos 2005). The hypothesized benefits of digital game-based learning include increased motivation of learners, and improved transfer of learning to the context in which the learning is applied. There is growing recognition of game based learning as a useful tool to support learning within schools and universities (Eck 2006).

However, a key challenge of building a Serious Game as an effective learning tool is the need to tailor the game design to address the competence domain. Although important, a serious game alone does not suffice to ensure learning and it is necessary to have a set of methodologies and tools to provide a learning environment that enable the tailoring of personalized learning plans tailored to the needs of the learner and supporting the individual (and the teacher) in assessing the progress made. Finally, understanding of a subject is often gained through reflection and exchange with other learners.

This chapter follows several objectives. First, the complex subject of Sustainable Global Manufacturing (SGM) is introduced and motivated. A detailed literature research provides insights in the competences one need to have to handle issues related to SGM. Based on those competences a game scenario which is part of a larger learning platform is introduced supporting learners to create such competences. Finally, the implementation and evaluation of that game scenario in the context of the learning environment is discussed.

WHY THERE IS A NEED FOR SERIOUS GAMING IN SGM

Manufacturing industries account for a significant part of the world's consumption of resources and generation of waste. Worldwide, the energy consumption of manufacturing industries grew by 61% from 1971 to 2004 and accounts for nearly a third of today's global energy use. Likewise, they are responsible for 36% of global carbon dioxide emissions (IEA 2007).

Manufacturing industries nevertheless have the potential to become a driving force for the creation of a sustainable society. They can design and implement integrated sustainable practices and develop products and services that contribute to better environmental performance. This requires a shift in the perception and understanding of

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