EnviroInfo 2001: Sustainability in the Information Society

EcoGames – Simulation Games and Sustainable Development[1]

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Abstract

Planspiele leisten in zwei Aspekten einen wesentlichen Beitrag zur nachhaltigen Entwicklung:

- Simulationen und Planspiele erlauben eine Ausbildung, die den Menschen und die Umwelt (natürliche, monetäre und soziale Ressourcen) weniger belastet.
- Dedizierte Planspiele (EcoGames) können in der Ausbildung ganzheitliche Aspekte besser betonen und längere Zeiträume erfahrbar machen. Sie tragen dadurch zu einer Ausbildung bei, die einer nachhaltigen Entwicklung förderlich ist. Bei Ihrer Entwicklung sind aber einige Punkte zu beachten, um die Nachhaltigkeit zu fördern.

Als Beispiele von Planspielen zum Training in bezug auf nachhaltige Entwicklung werden das Java-Script-basierte Spiel Öko[2] und das textbasierte Planspiel Albuchmühle vorgestellt.

1 Introduction

The modern university and the modern company depend on an efficient and effective teaching and training. Problem solving in a complex environment needs not only facts, methods and knowledge but also personal and social competence. Planning games are an effective and valuable method for acquiring these competences. Planning games combine the learning of problem solving techniques, facts and knowledge and of management techniques with the experience of interpersonal communication and conflicts and responsibility. Hence, they are an important method of knowledge transfer and integrate high-level education in theory and practice with aspects of social learning and personal development.

In two areas, planning games have been and are in use: business games in the management training and war games in military training. This paper focuses on the use of planning games to support sustainable development and holistic education. It will help

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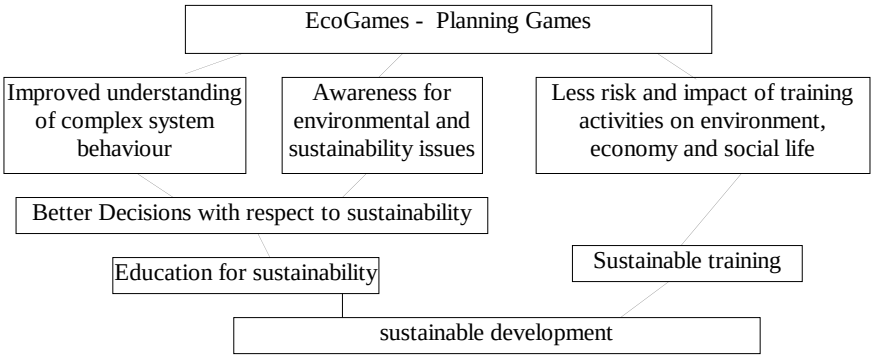
potential users to apply planning games as a means of training and education and to develop and deploy their own planning games.
With respect to sustainable development, planning games offer two advantages:

- Reduction of risk for and impact on environment and man.
- Better understanding of complex systems

These advantages can only be achieved when the basic model is adequate for the real world complexity as well as for the training purpose. A thorough modeling is necessary, considering real world knowledge and didactic experiences. Since an essential effect of education is given by the dynamic evolution of the system's state, the implementation of planning games needs knowledge about the real world and the training situation as well as computer science and didactics knowledge.

2 Planning Games and Sustainability

The following diagram summarizes the contribution of planning games to sustainable development:



2.1 Sustainable Training

With games, training can be performed without risk and without interference with the environment; hence, the economical, ecological and social impact is reduced.

- Reduction of training impacts like costs or emissions, use of personal and material resources:
  - For the German Army, every year about 90.000 hours of tank driving simulation reduce fuel consumption directly by five Mio liters (BMVg, 1996); moreover, they reduce emissions and traffic.
  - Management games allow the trainee to run a production without costs or emissions.

- Reduction of hazards and risk in the course of the training:
  - Flight trainers and training for power plant personnel allow to train critical situation without endangering human life.
  - Management Games allow the student to run a company without the financial and social risks.

2.2 Training for Sustainability

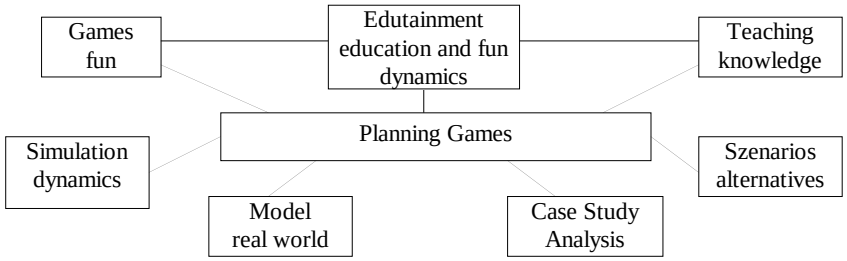
Using games, training can be performed without risk and without interference with the environment, hence economical, ecological and social impact is reduced.
Training can be performed within a complex scenario; hence, a better understanding of complex systems and of the interactions between economical, ecological and social issues can be achieved. The sustainability effects are:

- Increase of performance and reduction of continuous impacts.
- Reduction of hazards and risk and improvement of reaction in case of malfunction.
- Insight into feedback loop that cannot be seen within the normal scope of real life experiences.

3 Planning games

A planning game is a training procedure that consists of a description of a system and a situation, in which the trainee (player, user) has to make decisions and actions that influence the system. Planning games are simulation games which involve situation analysis and decisions in one or several roles and which are aimed for education and training.

Planning games are an activating way of teaching; they have similarities with several other didactic methods:



There are four core aspects of a planning game:

- It is a model. Training takes place in near-real-world situation.

- Decisions are required. Training involves problem solving.
- The situation evolves according to some system dynamics.
- The planning game has a didactic purpose (training, education).

3.1 Model

The learning situation cannot take place in the reality, since this is too complex, too expensively or is not sufficiently reproducible. The decisions, which are to be practiced, cannot be tried out at the real system. Possible reasons are time factors (social, economical and ecological systems) and risk (for social, economical and ecological systems and for groups or individuals). By using a model, the situation in the planning game becomes reproducible and comparable.

3.2 Decision

The decision aspect is crucial for real world management and for planning games. Understanding and knowledge of facts alone is not sufficient for successful actions in a real world. Not the brilliant analysis or its eloquent representation, but the decisions and their consequences and implications stand in the focus of planning games. Planning games allow action learning and the training and evaluation of problem solving behavior.

3.3 Dynamics

The learning situation is embedded into a dynamic and changing scenario, which changes autonomously (intrinsic dynamics) and in reaction to the players actions. Evaluation and learning effect are based on the development of the model.

3.4 Didactics

The planning game has a purpose in training (problem solving, analysis and decision, handling of equipment) and education (insight and knowledge).

The main purpose of planning games is to improve the problem solving process (Holzbaur, 1995). This is achieved by presenting near-real-life situations and decision problems to the player (trainee). The trainee analyses the situation, decides, takes actions and observes the reaction of the system to his decisions. The most intensive and important feedback is based on the reactions that the trainee gets immediately. The final evaluation by the trainer (or the system) is seen as a theoretical add-on and is less effective.

4 Modeling and Design

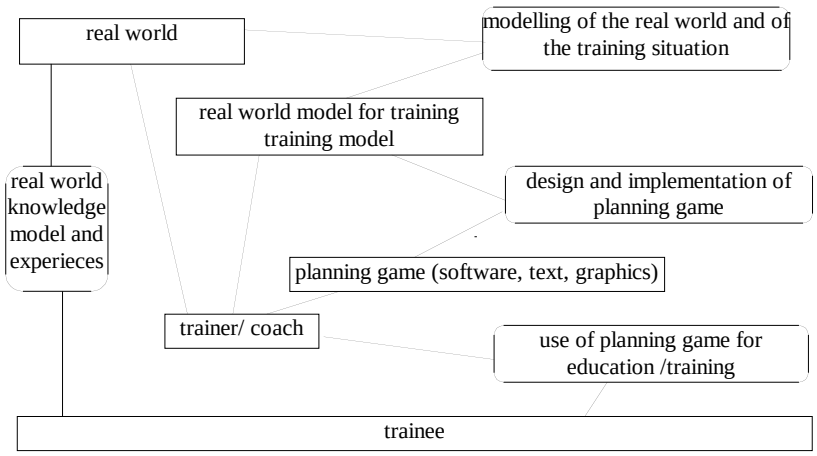
Among the necessary considerations for implementing planning games for sustainability (EcoGames) modeling and didactics are the most important.

4.1 Knowledge

In planning games, the system behavior is the only measure of success. Hence, system behavior is much more important than for classroom training, where a teacher evaluates the analysis and decisions of the trainee. We must keep in mind, that the simulation and the success or failing within the game influences not only the behavior of the trainee but also his perception of the real world and his mental model. Fortunately, trainees have an a priori real world background to fit the virtual world presented by the game.

4.2 Models

In planning games, it is important, that the underlying models are correct and adequate for the learning purpose.



Modeling has to consider the following areas:

- Modeling of the real world (object, interactions, dynamics). This also comprises the equipment and tools (hardware, software) that are to be used.
- Modeling of the training situation (behavior, goals, success criteria, evaluation)
- Modeling the real world interface (sensors, econometrics, research) and of other persons and groups (human interaction)
- Normative models about “what should be” and which results are “good”.

4.3 Didactics

When the trainee learns how to decide in a situation, it is important, that the underlying model is correct. Here, correctness of a model means:

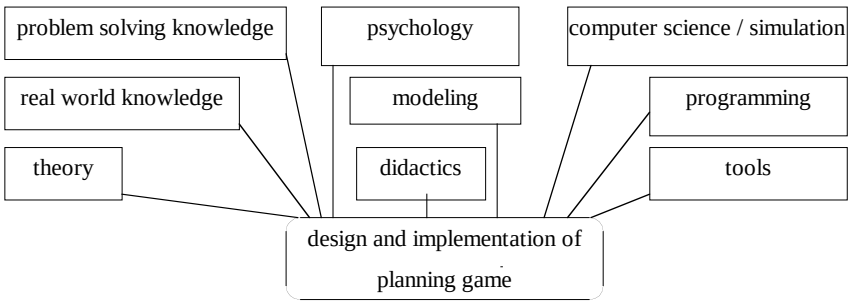
- Near to real life: The relevant aspects must be considered.
- Adequate for the learning purpose: The learning effect must be supported.

This must be considered when implementing features like

- Evaluation criteria (what is a “correct” decision?)
- Stochastic (shall the system be deterministic or shall there be random events? which events shall happen?)
- Complexity (shall the system be described as ideal or real? which connections and feedback loops shall be considered?)

4.4 Design

The design and generation of planning games needs many competences, which we summarize in the following diagram:



4.5 Implementation

The Implementation of a Planning Game is not always computer based, but always knowledge based.
There are two main components:

- A basic scenario. This is like a case study giving the system’s initial state and the information given to the trainee (this is not always the information he needs).
- The system’s dynamics. This describes the reaction of the system (including the trainer) to the players´ decisions. This may be e.g.
  - A fully automatic computer program like a computer game,
  - A trainers handbook proposing action for specific situations.

5 Examples of EcoGames

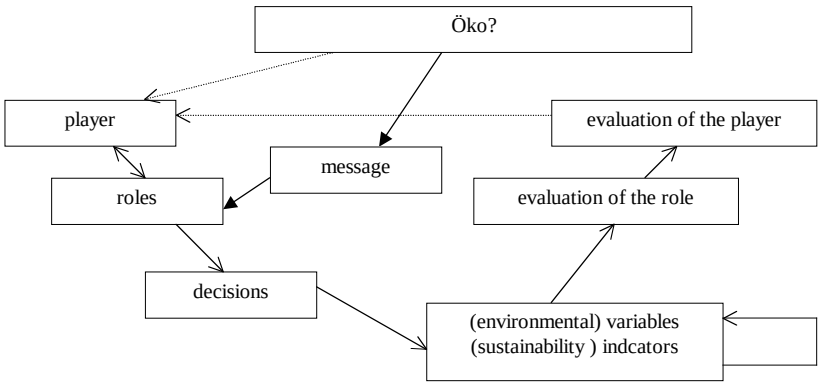
5.1 Öko²

Öko² is a planning game dedicated to sustainable development.

Öko² is a computer game for 1 - 6 players. Each player holds several roles; he can become active in one role at any time. The basic model of the game is an ecological-economical system on a certain aggregation level (global, country, municipality). The variables (sustainability variables, indicators such an environmental pollution, land use, education, security or employment) are influenced by the decisions and by the system's dynamics.

Fundamental mechanism of the game is deciding in different roles. As decision makers, each player must act in several roles. Conflicting aims are in particular given by the different evaluation of the roles. Communication between and arrangements among the players are permitted to enable cooperative problem solving.

On the display, the scales for all variables of the play (environmental impact, infra-structure, quality of life...) are represented. In addition, there are cash pots (enterprise, households...), which the players need for their action. The roles and evaluations of the players are also displayed. The game consists of a sequence of decisions: A role is selected at random. The player who has this role makes a decision from it the set of possible decisions announced by a message on the screen:



Öko² is implemented in HTML and JavaScript. The planning game was implemented in such a way that all relevant information is represented at least roughly on one single display. For further information about status, options and interrelations, additional windows are provided for every object.

The basic idea for Öko² has been presented in (Holzbaur, 1993). In 1994, the game was implemented in Pascal. After discussions with the Umweltbundesamt (German federal Environmental Agency), Öko² is re-implemented in JavaScript to allow use

within the WWW and to give users the possibility to modify and adapt the planning game to their needs.
At the moment, a version of Öko² for two players is developed. A preliminary version can be obtained from http://www.oeko2.de

5.2 Albuchmühle

Albuchmühle is part of a set of planning games for environmental management training (Holzbaur/Wolf, 1994). The game (Holzbaur, 2000) consists of scenario with several players for whom roles and hidden agendas are given. Environmental goals and economic data for the mill are the basis for this management game that is also a role-play.

There are several roles according to the organization of the mill (finance, mill, sales, transport) that have their information and data as well as their personal preferences. The dynamics of the game is given by he interactions of the players. Moreover, there are several letters (from customers or competitors) with which the trainer can start additional problem solving processes.

6 Literature

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