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MODELING REALITY WITH SIMULATION GAMES FOR A COOPERATIVE LEARNING

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ABSTRACT

In this work we want to show the importance of visualization, interfaces and re-design techniques through 3D modeling, animations and VRML in the developing of the simulation games for education or training purposes in a production environment. We also present some theories, concepts and a classification of different games on a two-dimensional map for displaying the variety of games and as a way for selecting a game that is appropriate to a specific pedagogical situation, in the wide taxonomy context of the learning and education programs for a cooperative learning. Finally we also present some features of an simulation game, for the production management of a product (Printed Circuits Boards) in order the trainees practice the main stages in the manufacture of this product, through the platform of WWW and the techniques already presented in this text for a high level of performance. The analysis and data sharing is actually in gather action because this is a work that is in progress.

1 INTRODUCTION

On last years several types of games have been successfully used on the production teaching and in the introduction of variety planning methods in the industrial environment. The simulation games have proven to be a very useful means used as a supplement to others instructional methods. Games have been useful, as means for creating awareness and understanding on the present production planing methods and for testing new planning principles. But the use of games must be placed and used in a very defined pedagogical context (Riis 1995).

2 GENERAL CONCEPTS

2.1 Simulation Games, Definition and Theories

The Society for the Advancement of Games and Simulation in Education and Training (Saunders 1987) defines simulation concept saying that is a working representation of reality and that it may be an abstracted, simplified or accelerated model of process.

The notion of game is played when one or more players compete or cooperate for pay-off according to a set of rules or a game that means a setting in which participants make choices, implement those options and receive consequences of those decisions as an effort to achieve given objectives (VanSickle 1978).

A simulation game is a mixed feature of a game - competition, co-operation, participants and rules... with those of a simulation - incorporation of critical features of reality. Simulation game is a hybrid form involving the performance of game activities in simulated contexts (Duke & Greenblat 1981). Most of the simulation games are general games for educational purposes, but more and more company specific games, tailored for specific organizational aims can be seen.

Simulation games can be, for different objectives such as: activity-based, computer-based or manual, like board and card games (Ruohomaki 1995). Learning and education is the most common application area of simulation games and the experimental learning theory by Kolb (Kolb 1984) is suggested as a holistic integrative perspective on learning that combines experience, perception, cognition, behavior... and is based on learning models of Lewin and Piaget.

2.2 Pedagogical Dimension and Applications

Some games may cover different objectives such as: create awareness, develop and solutions. But the games vary to the pedagogic depth, which may be reflected in the following points: create awareness and insight, teaching and training. In industry specific games have three objectives that may reflect phases in the design process, in the understanding phase that implies developing and testing others solutions in a prototyping mode.

Sometimes there is some reluctance towards the use of simulation games as an educational tool, because a lot of them are not really embedded in an integrated multi-stage framework consisting of theoretical concepts, trial game, evaluation sessions, and a discussion at the end that consists of drawing out and summarizing the main learning points.

So an educational framework is necessary to motivate the trainees to go through the simulation game intensively in order to implement the experience and knowledge that was gained during previous sessions (Muller 1995).

Simulations games can be applied for the teaching of facts, concepts and principles or processes simulated by the game and to train specific skills.

In a cooperative dimension they can be use to demonstrate, to distribute and promote an exchange of knowledge among participants, to stimulate thinking (Elgood 1990). Also they are active experimentation of the learning process, because they test different implications of concepts in new situations "in a real life context".

The participants in a simulation game should be able, after a training program, to apply learned principles to new situations such as: make decisions, solve problems and work in small groups.

3 LEARNING ENVIRONMENT, SIMULATIONS GAMES AND CLASSIFICATIONS

The simulation games are one area of learning environments and by learning environments, we intend that they are computational environments that lead the participants or students to one learning situation. Next we present one brief taxonomy of different types of learning environments (A. Paiva 1997, EAEEIE 1998) in the sense that simulations games classification is one part of this systems.

* Teaching Aided System
* Intelligent Tutorial Systems
* Micro-worlds or Exploratory Environment
* Training Systems (Bloom 1995)
  - Simulators/Train specific skills
  - Free Simulations Aided by Computer
* Simulations or Educational Games
* Interactive Learning Environment
* Intelligent Learning Environment
* Virtual Learning Environment
* Collaborative Learning Environment (also for Internet platform)

Different parameters are needed to classify the simulation games but in one context of production management we present the following two-dimensional map with a variety of games (Riis 1995), Figure 1.

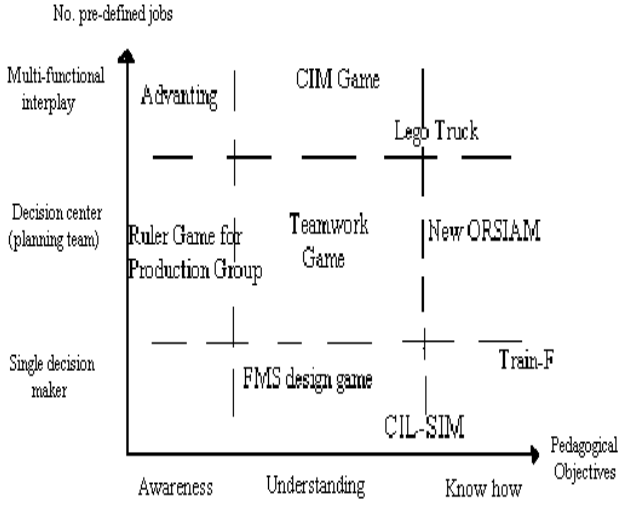

Figure 1: Simulation Games with Different Features

This map is an introduction to the variety of this kind of products. It consists on vertical axis, the number of predefined jobs in the game, and on the other axis, the pedagogical objective, also it is a way for selecting a game.

3.1 Cooperative Learning

In a large area of simulations games the participants take part in a cooperative action and it happens on those situations, where people need to train together by exchanging of expertise, completing together tasks, sharing objects and files or simply performing brainstorming and/or taking part in training meetings.

So the learning objectives begin when the participants use the appropriate game in a certain context such as social research, economics, business, management and production.

The goal is that participant should than be able to transfer the knowledge they have learned from simulated context to real life situations in many fields through complex abstract models of reality. With these games the participants share their experiences together and change their viewpoints about the subject studied, so this interactive or cooperative learning could lead to so call shared knowledge among the participants (Marcos 1997).

The positive effects on the groups of the participants are increased the communication and co-operation; development of interactions skills; changes in the classroom relations, like empathy; develop group skills; increased

knowledge and the conflict resolution in teams (Ruohomaki 1995).

4 REQUIREMENTS OF SIMULATION GAMES

The main requirements of the design process are described in terms of four steps: initializing, designing, engineering and operation (Mikkelsen 1995). Initializing means defining the objectives and the scope of the simulation game.

Different ideas might lead to different types of games, so the elements of a simulation game are introduced, which may serve as a useful checklist during the design process. The concept of game is the main purpose of the design. The basic ideas to be conveyed through the simulation game should be defined in the design process.

Two main goals in the simulation game are presented: First is the game process representation of one real life situation, such as: logistic system, manufacturing process, control method.... Secondly is the learning process.

Similar to this approach the Ruler Factory game (Hansen 1995) is one example of a small manufacturing system. The learning process is obtained by experiencing the relations between actions and consequences. This may lead the participants to change procedures and rules in the manufacturing process. Most of the times the simulation game inspire changes in the real life system. One important element of the game is the sequence illustrating the process and the scenarios. The participants should understand the simulation game itself in one easy way and to learn the means and their symbols.

The next step is the engineering process characterized by different aspects according to the requirements and ideas described in the simulation game concept: Clear and logic game; usable staging and technology; the games must keep simple. The managing of different subjects and problems should be done through more games or versions of the game.

Finally the use of the game is one important aspect and must be carefully considered, in order that the participants see the game as powerful element in the development or in the learning process, for which the game was designed in the context of an constructive way for a quickly learning. The game, should not also be considered as a needless activity.

4.1 Main Purposes

Morry van Ments (1983) defends that the games are developed for different purposes, but two of them are seen to be more relevant: education and demonstration. Also the purpose can be detailed: to describe - illustrate or demonstrate an issue, a situation or a process; to demonstrate - a method or a technique; to practice - training and education; to reflect - experiment and obtain response; to prepare - increase or direct the attention towards a certain situation.

But it is important to not formulate the purpose of the simulation game too wide and it must be developed according to exact/clear focus. It will be use by different groups in different situations.

The resources and equipment limit many times the simulation games. Then one aspect to be considered is the different places, where they will be use and for attenuate this the use of Internet could be a good solution to solve this problem.

4.2 Game Elements

The main elements of a game are described by Duke & Greenblat (1981) with 12 elements: model, scenarios, pulse/events, game process, game periods, roles, procedures, decisions, results, indicators, symbols and materials.

In this work we focussed the model element as a way to represent a delimited reality by 3D (three-dimensional) modeling and VRML - virtual reality modeling language, (VRML, 2000, Nadeau, 1997). To be a realistic picture of a system some simulation models are animated and the participants can interact whit the scenario by the use of various commands.

The system developed is similar to the Figure 2, where the participants contacts with the various production stages and simulates the drilling of the board by a simulation game trough the introduction of different parameters, that we will refer on next paragraph.

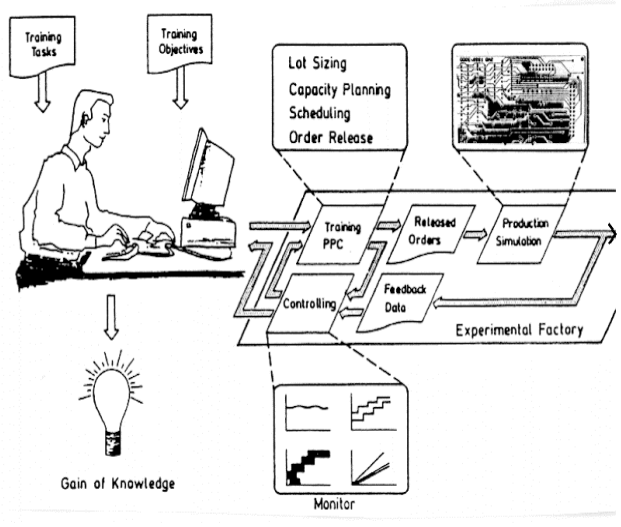

Figure 2: General View of control Loop for Training Process (Wiendal 1995)

5 SIMULATION APPLICATION

5.1 Visualization, Interaction and Modeling

Nowadays the visualization is the most important approach to extract relevant information from the huge of data produced by today's computational and experimental works. Visualizations are now recognized as a powerful

approach to get insight on large datasheets produced by scientific experimentation's and simulations (Towne 1993, p. 47, Lefer 1997) and the introduction of these 3D models are a way for a better understanding of this information, and to a better performance of all simulate process.

One of the main advantages on using 3D (three-dimensional) drawings and animation features on this simulated process is that you can detect design flaws that appears credible, when seen just on paper in a 2D (two-dimensional) drawing and also you can view operations from various angles and levels of magnification (Banks 1999, p. 11).

The interaction and analytical techniques on the Web with the 3D dynamic scenes are a way for a simulation optimisation and they increase the performance and realism of the participants.

The users in the WWW platform can actually visualize the dynamic process/animation of a manufacturing cell, but the general features addressed with their use that include model building, visualization, output analysis and optimisation are some of them actually in development (Salisbury 1999).

Although the interaction facilities by the VRML viewer Cosmo (Cosmo 2000) allows participants to move around and interact with 3D worlds such as: walk - with the mouse in the world to move around; slide - to move straight up and down or to slide left and right; look - to look around without moving; point - to get closer to an object in the world and for one object or group of objects floating in space.

The capabilities provided by virtual reality in order to animate simulations are one relevant area (Davis 1999, p. 141, Farr 1999). The VRML are essential in making the vision a reality (Fishwick, 1999). The V-Realm Builder editor in native VRML 2.0 models the objects in graphic scene. The functionality of this program is combined with a unique intuitive interface that brings the operations of cut, paste, drag and drop simplicity to the designing of complex virtual worlds and those 3D animations (Ligos 1997).

The simulation of a modeling game for Internet environment will include models of 2D and 3D as well as virtual reality and we use the VRML standard language because it is a key multi-platform technology shaping the conceptions of different realistic animated models and through the WWW it is possible realizing a distributed design framework supporting multi-disciplinary and organizational collaborative design as well as analysis activities.

5.2 Developed Features

In this simulation game the concept "Single decision maker" is present, in which the participant controls tasks and at same time, is integrated in this process loop.

He can vary parameters within experimental environment, he can influence the production features and he can read information of others parts of the Printed Circuits Boards (PCB) manufacturing such as: Cutting; Laminating; Placement of the PCB drawing in the board; UV lamp; Developing tank; Erosion tank; Scouring; Tinning tank; Drilling machine, Figure 3, (Galvão 1997a , Galvão 1999). Finally he takes on planing and controls tasks.

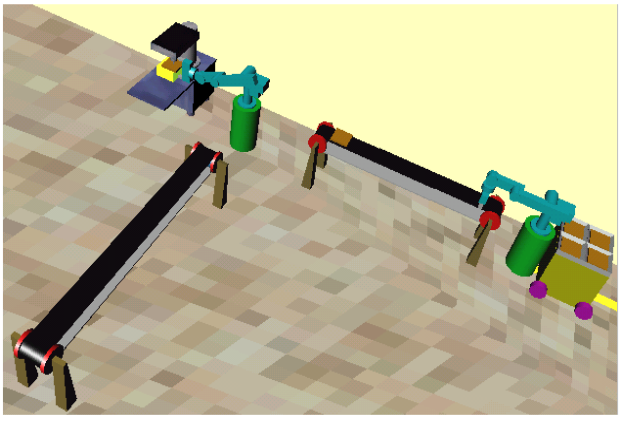

Figure 3: Drilling Machine and Boards Transportation System

The training system is similar to Figure 2, but at this time only few parameters are operational to simulate the drilling of the board and to know what decisions the participants should do to play this game.

The relevance of using this simulated model is:

- one motivates way for the worker to learn these important manufacturing parameters
- the complexity of different mechanism in the process
- a fast way to practise
- the communication way among participants leads to a cooperative learning.

The subject area of this application is centred in main production principles and methods, specially addressed to one kind of production situation: the drilling board time and the load and unload, the drilling machine in one scenario of CIM (computer integrated manufacturing) production, Figure 4, 5, 6 several views.

The next explanation about the process simulate is a part of the present developing project.

The participant should simulate, the time of drilling the board for to control, the planing management activities (the velocity of which conveys, the time to load and unload the board...). These are dependent of the number of holes and the size of each hole.

In the simulation game module, the participant can introduce:

- the numbers of holes and diameter

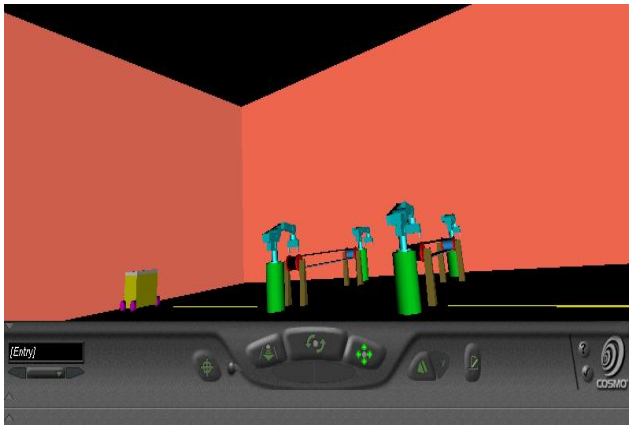

Figure 4: The Participant can Interact with Scene (the conveyer belts to load/ unload the board)

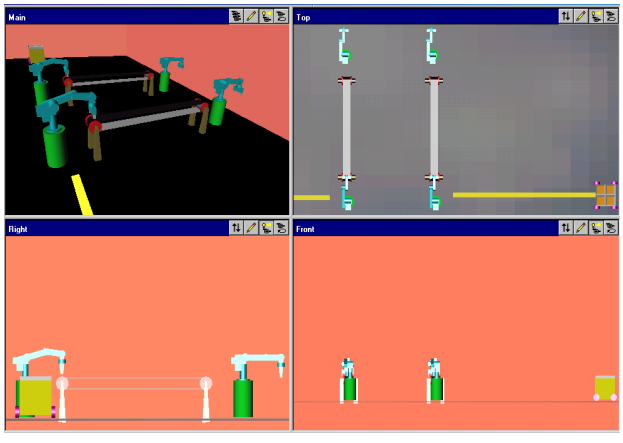

Figure 5: Four Views of the Conveyer Belts to Carry the Boards

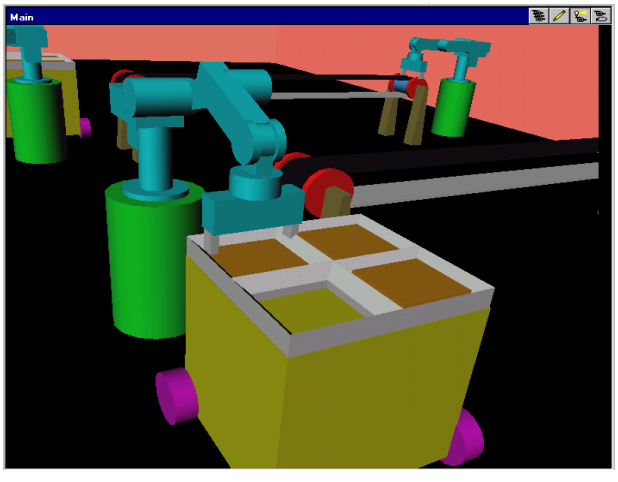

Figure 6: The Load Detail of the Boards in the Carrying Vehicle

The game rules, actually, consists on the board size that are the same, and the game objective is to know the medium time of drilling the board.

This are dependently of the drilling machine velocity, if it is necessary change the drills or not for the various holes diameter and the number of drilling machines, on which manufacturing cell in the production process (Galvão, 1997b).

If the size of the board is different the table that support this plate need to be adjust for each board, so the time for this operation also need to be control in the management planing activity.

If different participants use the manufacturing system, also different medium times of drilling action will appear, so, to a higher performance level they should change values among them for determine the best velocity in the conveys to storage the boards.

Like on traditional methodology the participants can simulate this process through an excel-sheet, but that would be a motivate methodology and different mistakes can appear.

The trainees can see the results for to control a lot of instructions about the CIM production principles, in order to learn about this kind of production and management.

They should do the download of the application, because these simulations are slow due to current band-width limitations in the Internet platform, in order to introduce the parameters in the simulation game module.

5.3 Communications for Cooperative Work

The communication way among participants in order to change ideas and learn about the using of the system is one synchronous communication system: Yahoo (<http://messenger.yahoo.com/messenger>). The main features are verbal communications and chats. The verbal communications between two individuals is supported; any pair of students and/or faculty can chat using voice, but for these sound cards and microphone must be available in the computers. A lot of pairs of participants can chat asynchronously.

The chat that uses text between multiple individuals is supported. This mechanism may be useful for tutoring assistants to hold on-line facilities.

So by this way, the participants can change various information's for a better understanding of all simulate process, and this leads to a cooperative learning.

6 CONCLUSION

The training program in one company that includes simulation games could contribute to impact on a unit or a department in this production area, such as: increasing productivity, better quality or more fluent workflow. Also this games can be seen as an interesting and attractive

method for individual training and for groups, in industries as well as for promoting learning in developing area.

Most of authors (Randel 1992, VanSickle 1986) have concluded that simulation games are at least as effective as other methods for teaching knowledge about facts, concepts and application of knowledge. They believe that simulation games have greater impact on participant's attitudes than other instructional techniques. The key to success in applying games derived from our own experience and the presented design techniques through VRML, three-dimensional modeling and animations for the Internet platform.

This tool simulation games can be seen as an relevant and encouraging method for training activities in companies as well as for promoting learning and development in one organization, where the cooperative learning among the participants and the supervisor will be a powerful tool in the companies context.

The results from the first testing have been collected and they will be evaluated. A statistical analysis of the data will be presented soon.

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