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# Serious Games – A New Perspective On Workbased Learning

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**Abstract**

Since the foundation of the Serious Games Initiative of David Rejeski and Ben Sawyer in 2002 games from the genre of Serious Gaming have attracted increasingly special attention. Besides, it concerns (computer) games which do not serve excluding the entertainment, but contain such compelling elements. They serve primarily the mediation of information and education. In the area of vocational education and continuing education Serious Games are suited in particular when it is a matter of providing technical and standardized or difficult and complicated learning contents. By combining playful elements and requirements of the work process Serious Games promote the learning and achievement motivation. Furthermore, the interaction with the game generates procedural knowledge. How Serious Games can be done as an innovative way for workplace learning, is illustrated in the article on the basis of the first intermediate results of an empirical project on handling of heavy goods at the port.



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## 1. Main text

Meanwhile digital media supported learning processes are a matter of course. Simultaneously we consider a growing interest in workplace learning. The relocation of learning into the real corporate work process is increasingly dominating the shaping of processes in the companies on the one hand as well as vocational educational

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research on the other hand. The reasons for this development are the direct usability of learning outcomes in the work process, the relevance of problem-oriented learning for skilled workers as well as semiskilled workers and the long-term value of acquired experience knowledge for the occupational practice (Spoettl et al. 2012). The contribution discusses the question how game-based surroundings are able to promote workplace learning. Serious Games are not a new idea. Military officers as well as aeronautical research have been using war games or dangerous situations in order to train strategic skills for a long time. Meanwhile, the technological development permits the development of game-oriented applications with high quality and low costs. Digital game-based technologies are initiating the field to redefine what is meant by learning and instruction in the twenty-first century. The working definition of Serious Games says, that such games do not have entertainment or fun as primary purpose but rather than an educational purpose. This does not mean that serious games should not be entertaining. Playing the game triggers learning processes. Besides, the entertainment value of the game is not excluded, but is used rather as means for the learning process. Recent research have identified that game-based learning is a viable way to help learners to construct knowledge from ambiguity, trial and error, and to assimilate new knowledge (Adcock 2008). Games refer to structured play which is voluntary, intrinsically motivating, and involves active cognitive engagement. Game-based learning enables learners to undertake such tasks and experience situations which would otherwise be impossible and/or undesirable for cost, time, logistical and safety reasons. A game differs from a simulation in such a way that it is intrinsically motivating and involves competition. Games and their associated obstacles also create a positive kind of stress, called eustress, which is actually good for the player, providing him with a sense of motivation and desire to succeed. The motivation can be promoted by interesting game scenarios which are contextualized through work-based tasks and processes.

The current work of harbor skilled workers is marked by dealing with complex technologies, requiring cooperation and practical acquisition of process understanding as well as social competences, the readiness for lifelong learning and working in changing work tasks and environments. Furthermore the workers need basic knowledge of physics and mathematics. The initial assumption is that game-based learning environments are suited in a special way to impart abstract theoretical knowledge as well as action-oriented knowledge. Game-based learning environments support the learning of abstract knowledge to promote the learning performance.

In our knowledge society, the acquisition of systematic theoretical knowledge is undoubtedly gaining importance. Schön emphasized the role of action in shaping the content of tacit knowledge. He observed that when actions lead to unexpected action outcomes, reflection on assumptions that gave rise to the action is prompted, which augments tacit knowledge. He distinguished between the reflection-in-action, which occurs on the spot, and reflection-on-action, which occurs retrospectively (Schoen 1983). According to Dewey (1938) Serious Games enable “experience plus reflection equals learning.” Therefore, it will be necessary, to consider reflection possibilities as crucial didactical aspect designing Serious Games.

The challenge is to design a Serious Game for the particular work processes in the harbor as learning context. Just the maritime economy registers an increase in complexity, mechanization and interface management. The requirements profile of the professional forces for harbor logistics has changed and extended. The research project “work process oriented competence development for the harbor of the future” (http://www.arkoh.de, financed by the Federal Ministry of Education and Research) focusses on two work processes: Firstly, the loading of offshore wind energy components. Secondly container-related activities like loading, storing and movement (“stuffing and stripping”) of containers and also the securing of load. Especially when loading and transshipping heavy equipment in ports – e.g.: for the offshore industry experience-based knowledge plays an important role. The employees must have a sense of forces and weights. They have to be able to handle with ground conveyor, reach stacker as well as straddle carriers. The transport of components for offshore wind turbines is one of the special challenges of heavy load transporters because there are less standardized processes.

## 1. Serious Gaming as an Innovative Way for Workplace Learning

Research results have pointed out that there are at least six key properties for Serious Games to promote learning processes (Shute / Ke. 2012)

- an underlying rule system and a game goal to which the player is emotionally attached,

- experiences that offer good learning opportunities,
- a match between affordance and effectivity,
- modeling to make learning from experience more general and abstract,
- encouragement to players to enact their own unique trajectory through the game,
- easy and user-friendly interface.

To underline is that the challenge in the game should not have trivial tasks. Instead the game challenge should match the player's skill level. Furthermore, the game has to provide a tutorial or online help that enables players' (learners') skill development while playing the game.

It can be said that enterprises have four essential requirements on the use of Serious Games:

- a Serious Game should show the enterprise reality of his own as near as possible regarding organization, product and processes.
- a Serious Game shall work with real corporate data to show the reality as approximately real as possible.
- strong requirements on Serious Games' security arises regarding unauthorized access.
- Serious Games have to be easily adapted.

It is important in this connection that Serious Games are slightly adaptable, so that they can be adapted on the one hand very smoothly on the situation by the enterprise and, on the other hand, the development expenses remain within the scope. Hence, it becomes more and more important to develop actual and efficient methods which bundle up the different competences of Serious Game developers (professional expert, educational experts and IT developers) and support with the help of a structured action. The aim is to sustain individual's capacities for effective, productive and enduring working lives. This includes being able to respond to the particular yet changing requirements of work and workplaces, and successfully to negotiate transitions from one workplace settings to others (Billet et al. 2008). In our research project we focus on the question how game-based learning can enhance workplace learning especially for semi- or unskilled workers. In particular the port's work is made by semiskilled people. Usually the employees pass a course of several weeks to learn the basics about health and safety measures, load protection, lashing and cargo handling. Nevertheless, there remains a gap between the knowledge and the skills needed at work and the knowledge provided by formal courses. Since the share is high of semi-skilled workers with regard to handling of heavy goods at the port, companies are interested in training concepts which motivate the workers as well as fostering the competency development. The challenges they face should match their developed skills so that they can experience attainable challenges, but with some uncertainty of outcomes (Eseryel et al. 2014). The learning process refers to the acquisition of knowledge and skills as well as to the participation in communities of practice.

## 2. Approach and Competencies

The project considers the notion of workprocess oriented competences as a basic factor. It is based on the assumption that a reflected coping with work processes due to the commitment of the individual in his or her work situation initializes the development of work process oriented competencies. This conception of competency includes experience-based know-how on the one hand. On the other hand, it is evident that the necessary skilled-analytical abilities in the sense of "knowing how and why something works" are objects of this expertise (Neuweg 2004). Furthermore, the project assumes that Serious Games have the potential to facilitate various types of skill development. The target group is made up of semiskilled and skilled workers

For example, raising the carrier structures from the ship must just happen in a straight line, the ropes have to stand in the right corner, and unequivocal view signs of the stevedore to the crane operator are essential. Bridge crane operators are responsible in a harbor for the container envelope between ship and quay. They take charge, send or load and unload ships and trucks with the assigned containers. In her mostly high mechanized job in the floating cabin under the gantry they have to deal with more than thousand-tons-arrangements precision work. The containers are placed from a distance from up to 40 meters with an exactness of few centimeters. Furthermore, lightweight and extremely long blades have to be transported like a raw egg and expectant generator gondolas with high weights.

In order to identify the structure of the learning of harbor skilled worker, for example stevedore, thorough analyses were carried out dockside to find out details of complex problem-solving situations and synchronization-processes. In the following two characteristic work processes which are suitable for Serious Gaming are briefly introduced.

## 3. Toolbox-Meeting

The need of learning processes arises by the fact that the employees are responsible not only for single performances, but her work tasks are rather a component of a complicated process chain. Furthermore, in our analyses we identified the following influencing factors which require learning processes:

- Application of new technologies
- high claims to the industrial safety
- need of synchronization and teamwork

For clarifying the different tasks and responsibilities as well as the claims to the industrial safety, each loading and transshipping of heavy equipment starts with a so-called “toolbox-meeting”. Tool-box meetings, also called crew talks or tailgate meetings, are short meetings of the involved companies to discuss issues that primarily focus on safety topics, task sharing and responsibilities. A tool-box talk is a short talk, normally delivered at the workplace. It is informal and it is held before beginning the loading process of components for wind turbines, for example. The tool-box meeting is suited for following reasons as learning surrounding in the context of Serious Gaming. Firstly, in a game-based learning surrounding the different roles and respective perspectives can be taken. A deeper problem understanding is generated by taking over the different point of views. Hence, secondly, a game-based toolbox-meeting promotes a deeper insight and comprehension in the process chain. A common problem understanding is thereby promoted and the process orientation is strengthened. Thirdly, it promotes the communication between the different status groups and the teamwork within the workgroup. The latter is important because the composition of the team changes in many cases and the field of safety is becoming a competitive parameter. In this context Serious Games offer multilevel learning situations as well as the simulation of problems and critical situations. To experiment with different identities means that the player can change the perspectives and can take over, for example, the role and identity of a foreman or layer leader.

## 4. High & Heavy

The second workprocess refers to the transport planning and its realization in the high &heavy area such as seaport cargo handling. In this context, the game-based learning process deals with loading and securing reliably and precisely in accordance with the shipping companies, stowage and lashing provisions. This contains the catching up of all approvals, the device application as well as the transport packaging. The high & heavy area is suited for the following reasons as a learning surrounding in the context of Serious Gaming. Firstly, the game-based learning surrounding enables the learner to deal with complexity, group decision making, and decision making under conditions of time pressure without

fearing negative consequences. Secondly, the learner improves his skills in prioritizing and planning the flow of material, in particular the need of large equipment as well as joint planning and problem solving.

The overriding purpose in using serious games lies in the improvement of the task Performance, including sub-categories such as speed and fluency under varying environmental conditions, as well as awareness and understanding, involving understanding of colleagues, contexts and situations.

## 5. Outlook

Primarily, the secret of a successful digital game-based learning process is not its 3D graphics but its underlying architecture where each level dances around the outer limits of the player's competences. A special value in the context of Serious Gaming is its action-oriented approach and the manifold ways of contextualization. Serious Games offer authentic situations, so that the lessons learned can be well transferred on the real working process. In particular, in work contexts with a high demand for occupational safety, serious games offer opportunities for learning. The learning potential at the workplace can be used for self-guided learning and for competency development. The using of the Serious Games fits very well in the working context of the harbor because there are usually standby times during the day-to-day labour. These standby times offer the opportunity for forms of microlearning – short learning units which stimulate the learning motivation as well as dealing with challenging work processes- Thus, the application in the context of occupations and the sustainability of different game-based learning options will remain in the center of interest for future research and project work.

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