

# Virtual Sports Teacher – A Serious Game in higher education

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## Abstract:

Virtual Sports Teacher is a Serious Games which is being developed by sports scientists, computer scientists and media scientists, funded by the HMWK (hessian Ministry of science and art). The primary target group of the game are physical education teacher students. In the game they can practice the procedure of a typical sport lesson, learn how to treat pupils and arrange different sport exercises. A Game Master, the course teacher of a university tutorial, can adapt the game at runtime according to the player's performance. The Game Master is able to view important statistics, to modify difficulty or to trigger game events. In Section 1, we explain the need for new forms of teaching like Serious Games. In Section 2, we present the game Virtual Sports Teacher, followed by a detailed description of the didactical and Game Mastering concept in Section 3. In Section 4 we conclude with an overview of future work.

KEYWORDS: SERIOUS GAMES, HIGHER EDUCATION, PHYSICAL EDUCATION, TEACHER, SPORT

## Introduction

Educationalists are calling for a modern teaching that is closely related to life. Teaching should no longer ignore the new information and communication technologies because technology has now become an important part of the childrens' and young adults' life. Disregarding the new media means to exclude an aspect of the childlike everyday life. Thus, basic tasks and goals would be neglected. Rather than reject these technologies, such as for example video games, teachers should take advantage of them.

A digital game, that combines playing and learning is called a Serious Game. Unfortunately, so far, Serious Games have been mostly met with resistance or suspicion. They were not trusted to stimulate the learning process, although it is proven that playing and learning are closely interrelated in human development. The connection of both is a natural state and is later separated only by the institution of school (Breuer, 2010). McLuhan and Fiore (1968/1997, cited from Prensky, 2001) said "*Anyone who makes a distinction between games and education clearly does not know the first thing about either one*".

Despite of the negative prejudices, the concept of Serious Games has become more and more popular during the last decade. Serious Games offer various fields of application (Susi, Johanneson, & Backlund, 2007; Sawyer & Smith, 2008), like Serious Games for

sports and health (Baranowski et al. 2008; Wiemeyer & Goebel, 2010), prevention and rehabilitation (Griffith, 2004; Wiemeyer, 2010), energy awareness (e. g. Enercities<sup>1</sup>), political awareness (e. g. Global Conflicts series<sup>2</sup>), in the military sector (e. g. Americas Army<sup>3</sup>), and finally Serious Games for education (e. g. Scoyo<sup>4</sup>).

There are now a number of Serious Games available for elementary school and high school. For the higher education like university, there are fewer games, and for the teacher training, to the best of our knowledge, there are none (Mitchell & Savill-Smith, 2004; Egenfeldt-Nielsen, 2005). In the project “Virtual Sports Teacher” an educational Serious Game for the teacher education, specifically for the Physical Education (PE) teacher education is being developed. The project is funded by the Hessian Ministry of Science and Art (HMWK). The project partners are the Hessian telemedia technology competence centre (httc), the Technische Universität Darmstadt, the Hochschule Darmstadt, and the University of Gießen.

### **The Project – Virtual Sports Teacher**

“Virtual Sports Teacher” is a 3D game in which the player takes the role of a PE teacher practicing a typical sports lesson. The game can be played in a single-player and in a multi-player mode. The Game Engine Unity 3D<sup>5</sup> and the authoring tool StoryTec (Mehm et al., 2009) were used for developing the game.

The game “Virtual Sports Teacher” combines theory and practice of learning and teaching in sport. The player equips him- or herself with knowledge from sport science, and learns how to teach sports to students in an autodidactic way. The player learns to convey skills in a virtual environment by using different didactic methods. Phases of practice are followed by phases of reflection. The main purpose is to activate and integrate knowledge normally taught by isolated courses like sport psychology, sport pedagogy, and movement science within an authentic teaching context (gym of a school).

The (virtual) teacher is mainly acting in a gym, presented as a 3D environment. The 3D environment comprises the teachers’ room, the principal’s office, and the gym consisting of a main hall and an adjacent room containing the sports equipment.

The player’s Graphical User Interface (GUI) contains an overview of the pupils’ personality and skill level and a bar displaying the total activity and the total mood of the pupils (see Figure 1). For example, if a student gets an exercise that is too difficult or too easy his/her mood will be affected. If he/she has to wait at an exercise station for too long, because there are too many other students, the mood also drops. If the player takes too long to build and structure the apparatus or if a student gets hurt because of an incorrect set up of the apparatus the mood of all students will drop.

To ensure individual support, there are various buttons for interactions with the Game Master (GM), for chatting and for game-related actions. Under the tab of the folder, the player can get useful information about the topic of the lesson. The player can talk to the pupils via a set of predefined statements or look at a self-made summary sheet.

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<sup>1</sup> [www.enercities.eu/](http://www.enercities.eu/)

<sup>2</sup> [www.globalconflicts.eu/](http://www.globalconflicts.eu/)

<sup>3</sup> [www.americasarmy.com/](http://www.americasarmy.com/)

<sup>4</sup> [www-de.scoyo.com/](http://www-de.scoyo.com/)

<sup>5</sup> [www.unity3d.com/](http://www.unity3d.com/)



Figure 1. Screenshot of the game Virtual Sports Teacher.

## Goal

The purpose of the project is to develop and evaluate an educational Serious Game in the form of a role play game. As a final result, the game will connect game aspects and learning aspects in a way that, ideally, while the player is caught in a flow, he/she acquires knowledge effectively and efficiently, and learns to apply this knowledge to practice. The user is intended to expand his/her competences to act successfully in the context of physical education.

## Target group

Target group are students of sport science, particularly students of the PE teacher program and tutors in the sport and PE sector. The players' previous experiences in teaching are usually very heterogeneous; presumably, most players (students) have few practical experiences. Even the level of knowledge is likely to be very heterogeneous. In the game, this heterogeneity will be considered.

## Learning goals

Concerning the learning effects of an educational Serious Game, players always learn something about the game itself. In addition to the explicit and implicit rules of the game, players will learn game-specific skills. Beyond that, digital games have effects on the users' knowledge and skills exceeding the scope of the game itself. Under certain circumstances, the acquired knowledge and skills can be transferred to other areas of life (Egenfeldt-Nielsen, 2005; Breuer, 2010).

By playing the game, the player can improve his or her teaching skills. He/she can get to know concepts, models, laws, etc. in the fields of physical education. He/she can enhance his/her self-efficacy relevant to act in front of a class, experience fun, acquire and apply knowledge and skills to increase his/her competences of successful teaching in PE. Foremost, the users should learn what he/she has to do in each situation and to consider what the rules are in dealing with students. To enhance teaching competences and to enhance self-efficacy the different tasks in the game have been constructed according to “scripts”, i. e. a pre-structured order of actions the player has to initiate in order to solve the task. These scripts become increasingly complex according to the different levels of the game.

### **Story (narrative framework)**

The principal of a model school is in a bad situation, he is desperately looking for a good PE teacher. The best and most dedicated PE teacher of his school has been seriously injured and is unable to conduct his sports lessons. The player of the game is asked to replace the missing teacher. Proven to be a good PE teacher, the player may, according to the game level, raise in his/her position. Starting in the position of a substitute teacher, He/she can first receive a temporary and later on a permanent contract. The ultimate goal is to be appointed tenured German civil servant. To proceed from one level to the next, the player has to manage teaching assignments successfully, for instance, performance of a gymnastics lesson intended to teach a back extension role (backward role to handstand). This teaching assignment is performed in an authentic sports lesson. For a successful work with the pupils the player is awarded score points. If the students are unhappy, bored or unmotivated the player will lose score points.

While the game is played some foreseeable and unforeseeable incidents happen which the player has to master. As an example, pupils may get injured, argue or fight or the principal may appear spontaneously.

By applying a realistic story with surprising incidents an increase in motivation, challenge and tension is expected. Score points and feedback are used as a rewarding system to confirm adequate actions and decisions in the game.

### **Characters**

The following playing characters are acting in the game:

- The PE teacher  
At the beginning, the player can choose his/ her character, the name of the character and its gender. The teacher is at the beginning of his/her career. Starting as a substitute teacher, he/she tries to shine with good performance and climb the ladder.
- The principal  
He cannot be played by the player him-/herself, but by the lecturer or the course teacher. The GM takes the role of the principal and can trigger several actions like an accident of a pupil.

There are also Non Playing Characters acting according to predefined scripts:

- Pupils/students
- Colleagues

## Goal of the Player

The player, in the role of a PE teacher, has to perform in an authentic teaching-learning situation. In this context the player has to make appropriate decisions about core aspects of motor learning with respect to the situation and target groups (i.e., the virtual pupils). Within this process, the player has to establish the integration of knowledge coming from different disciplines of sport science, e.g., movement science, sport psychology, and sport pedagogy. The player must observe and evaluate the movements of students and, if necessary, correct them by means of appropriate visual and verbal instructions or other methods. Besides the sports movements, the player analyzes situations, identifies problems and responds appropriately. Prior to the lesson, there are several organizational activities which have to be done by the player: structuring the lesson, selecting exercises and arranging the selected exercises and teaching methods in the correct order.

By playing the game, the player is intended to learn the following competences:

- How to structure and plan a sports lesson
- How to assemble the apparatus, which mats to choose and where to place them in order to avoid accidents (see Figure 2)
- Which methods and exercises to use to teach the students
- What are the main errors of a certain movement and how to correct them
- Which assistance to render for the exercise stations
- How to explain the assistance to the pupils
- How to arrange the order of the exercise stations
- How to motivate the students
- How to solve problems like arguments, fights, accidents, etc.

As mentioned above, these tasks can be successfully solved according to task-specific scripts. For example, to reach the main part of gym lesson, the player must process some actions in the correct order. He/she must gather and welcome the children first and then check presence and clothes before he/she can enter the room with the apparatuses. In the main part the player is subjected to very few restrictions. He/she can leave the room, interrupt the lesson or leave the students practicing alone, etc.

## Sequence of a Lesson

During the game, the user must meet various teaching assignments. He finds his next teaching assignment in his box in the teachers' room.

To give an example:

- Assignment: physical education with a 5th grade (10 students, 5 males and 5 females).
- Lesson content: Learning the back extension role.

As a next step, the player can prepare himself in the staff room by using sources provided in the game (e.g., learning courses) or he can directly enter the gym. After having entered the gym, the player first has to analyze the given situation. He must get an overview of the gym and his students. For instance, he has to check whether there are

any apparatuses left from his predecessor or where the students are located and what they are doing. The system enquires whether the player has screened the entire gym. It is important for the progress that a certain order of procedure (script) is maintained. During the first part, the teacher has to convene and welcome his pupils. After this procedure, he has to check the presence of his students and make sure that the students wear appropriate workout clothes. If he omits this check, there is a risk that a child gets injured.

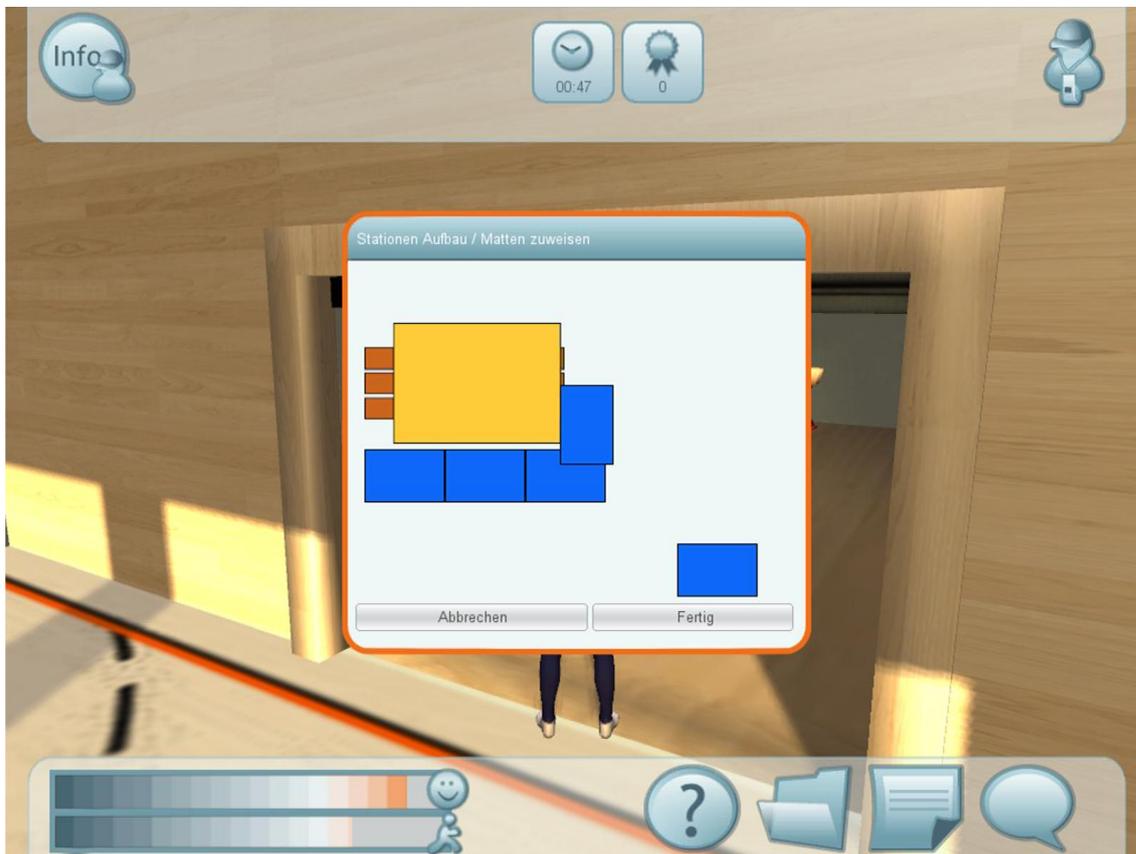


Figure 2. Screenshot of the game Virtual Sports Teacher, scene: placing the mats.

The second part of the lesson consists of the warm-up. The player must choose appropriate exercises according to the goal of the lesson and arrange them in proper order (exercises for general warming, stretching and coordinative practicing, matched to the lesson's content). After this he has to organize the build-up of the gymnastics apparatuses. The challenge is to equally engage all students in this process. If this is neglected, the students may start to dispute. After the devices have been located, the mats have to be placed in the correct position. If the player chooses too little mats or wrong mats, students may hurt themselves when practicing.

During the main part of the lesson, the teacher is more flexible in her/his actions. He/she has to fulfil the following requirements:

- He/she must assign the students to several exercise stations, depending on their skill level.
- At each station, the player must choose the adequate helping or securing position.
- His/her main task is to review gymnastic motions and to correct errors of his/her students.

- Doing this, the player must not lose sight of his/her pupils out of view. He/she must place him-/herself in a way that he/she can always see most of the students. If the player is positioned inadequately, some students may start to scuffle.

Furthermore, the player must cope with and solve disturbances that may occur during class. Typical situations are, for example, an argument or fight between some of the students or an accident caused by a defective apparatus. By chance, the principal (played by the course teacher) may come along and pose difficult questions about the teaching methods, biomechanics of the skill or first aid.

Towards the end of the lesson, the player must organize the decomposition of the devices, so that every student is involved. Finally, the player says goodbye to his students.

Preparation, organization and structure of the lesson and the actions of the teacher during the lesson will be evaluated, so that the player can obtain a detailed feedback

## **Effectors and Tools**

### *Summary sheet*

Any player can create his/her own summary sheet. Before the player starts with his/her PE lessons in the gym he/she can gather information from different sources provided in the teacher's room and include them in his summary sheet. Information is provided by integrated digitized books, the World Wide Web and web-based training (WBT), consisting of e-learning classes (e. g. biomechanics, functional analyses, educational teaching, etc.) (see Wiemeyer & Hansen, 2010). The player can take the sheet to the gym and use it any time.

### *Folder*

The folder is the guidance for the player, left by his/her predecessor, the injured teacher. In this folder, the player can get specific information from the disciplines of sports medicine, training science, movement science, physical education and sports psychology. This information is precisely matched with every teaching assignment.

The folder is always visible to the player. Related links are integrated into the individual files of the folder. To click them and get further information, the player must pay some of his/her score points.

In skill questions, the player can use the acquired knowledge and win back points. With the correct answers, the player gets more points than he/she has previously invested.

### *The Principal and further players*

In the single-player version the principal can help the player with predefined hints. In the multi-player version the principal, played by a course teacher in a university tutorial, can help with individualised aid. The principal can communicate with the player, direct his/her teaching process and help him/her in critical situations. The multi-player mode enables cooperative and communicative phases between the principal and the player, but also between individual players. Thus, the course teacher can pose questions or tasks which the player has to answer or solve directly, or the players can interact with each other to find solutions or alternatives.

## **Game Mastering Concept**

The concept of Game Master is rooted in pen&paper roleplay games (Tychsen et al., 2005). In such games, the task of the GM is to create a suspenseful story while keeping the game and thus the story open to influences of the players. The GM has to react to ideas and actions of his/her players in a way such that the story is not disrupted too much by unforeseen actions but also has to take care that the players do not get the feeling that their actions do not matter. To achieve this, the GM has to be able to always react to the players' actions having in mind the overall goal of the story.

In "Virtual Sports Teacher", we adopt this principle. However, the GM's primary task is not to adjust the game in order to create suspenseful story but to help the player/learner having a perfect learning experience. Therefore, the GM needs to influence the game in terms of difficulty and speed and alter it if necessary.

To do so, the GM needs a comprehensive in-game overview of the player's performance. So the question arises how to provide the GM with the necessary information, i.e. what parameters must be visible to the lecturer in order for him/her to be able to judge the game and learning situation correctly.

Moreover, we provide the GM with a toolset to adjust, modify, and adapt the game at runtime. So, the second question is how to provide the instructor with appropriate methods and tools to adjust the game according to her estimation of the situation.

## **In-game Assessment**

The Game Master needs to know what the player is doing at every time. For this purpose, we allow the GM to view the complete gym. The GM is not bound to an avatar, but instead he/she is bodiless and can oversee the whole scene. However, if desired, the GM can take the role of the school principal to actively take part in the game. This is a method of taking influence on the game without interrupting the gaming experience in an unnatural way (seamless learning, see Wendel et al., 2011).

In addition, the GM needs a special interface providing information about the current state in the gym. This information includes:

- The game time
- The pupils' mood
- The pupils' activity
- The state of each pupil
- All current actions of the player
- Events to occur in near future

The simulation/game time is simply displayed by a timer. The overall mood and activity bars are displayed in the same way as for the player. The state of a pupil includes information about the pupil's current activity, his/her current mood, and other static information, like character traits. All player actions are logged internally for an automatic evaluation of the player's performance. The GM is able to view the logged actions in-game. Furthermore, the GM can see all the player's interaction windows when they appear.

## **In-game Reaction**

In addition to the need for assessment, the GM also needs to be able to react to the player's actions. Therefore, we provide him with an integrated toolset enabling him to influence/adjust the game ad-hoc if necessary. The GM can trigger unexpected events, like a child having an accident, in order to increase the difficulty. On the other hand, he/she can prevent the game from triggering such actions automatically. When the virtual students are performing exercises, the GM is furthermore able to have them make exactly the errors he/she wants in order to focus on the errors he/she regards as important.

Just like in real class, the instructor will occasionally want to give hints or correct the learner if necessary. For this reason, the GM in "Virtual Sports Teacher" is not only a spectator who can trigger events, but he/she is also able to communicate directly with the player in form of a dedicated in-game chat.

In order to enable the GM to interact with the game in a more realistic and direct way, he/she can also take on an in-game role, the role of the school principal. If the GM chooses to do so, he/she plays the NPC of the school principal, illustrated by an own avatar in the game world. Being the principal, the GM has the same assessment and control options, but is illustrated as a real in-game person so he/she can actually "play" the role of the principal, giving special tasks to the player or inquiring knowledge in-game, thus improving the degree of realism.

## **Hypotheses of advantages of this Serious Game**

We expect the following advantages by playing Virtual Sports Teacher (see also Hays, 2005):

- Individual motivation by challenge, control and curiosity: The game offers an increasing level of difficulty, different learning contexts – meaning different sport skills – and takes learning preferences and gender issues into account.
- Sustainability: The game can be used not only during university courses but also be played and practised at home.
- Scalability/ social interaction/ interpersonal motivation: It is keen because more players can play this game than students can be taught in a course. Social interactions are supported in the multi-player mode.
- Economy: It is cheaper and less time-consuming because it is impossible to allocate classes with pupils for every PE student to practice and to arrange all possible situations in a systematic way.
- Transition from university to school (self-efficacy): A 'practice shock' can be avoided. The PE students are better prepared for the tasks of a teacher. By experiencing success in the game their self-efficacy will be enhanced.

## **Future Work**

A prototype of the game is just being subjected a formative evaluation. As a next step, when the game is finished, there will be an extensive evaluation. We therefore plan to deploy the game in a real university class of PE students. The following parameters will be evaluated: effectiveness and efficiency of learning, game experience, e.g., motivation, fun (e.g., Nacke, 2009) and immersion, the use of the GM role and replay-

ability. Also, the question has to be addressed, if the content to be taught is visible as such. The evaluation of the use/role of the GM will include comparisons of gaming sessions with and without a GM. The evaluation of game experience like motivation, fun, immersion and replay-ability will be done by a qualitative player interview and specific surveys. The usefulness of motion capture will be tested in a game usability laboratory by means of eye-tracking, mouse tracking and by a user experience and game experience questionnaire.

After analyzing the test results, the revealed shortcomings are to be eliminated and further evaluation will be performed.

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