Integrating games into the classroom: towards new teachership

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New Pedagogical Approaches in Game Enhanced Learning:

Curriculum Integration

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REFERENCE

Managing Director: Lindsay Johnston
Editorial Director: Joel Gamon
Book Production Manager: Jennifer Yoder
Publishing Systems Analyst: Adrienne Freeland
Development Editor: Austin DeMarco
Assistant Acquisitions Editor: Kayla Wolfe
Typesetter: Deanna Jo Zombro
Cover Design: Jason Mull

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

New pedagogical approaches in game enhanced learning : curriculum integration / Sara de Freitas, Michela Ott, Maria Magdalena Popescu, and Ioana Stanescu, editors.
pages cm
Includes bibliographical references and index.
Summary: “This book addresses the major challenges associated with adopting digital games into a standard curriculum, providing fresh perspectives from current practitioners in the education field”--Provided by publisher.
ISBN 978-1-4666-3950-8 (hardcover) -- ISBN 978-1-4666-3951-5 (ebook) -- ISBN (invalid) 978-1-4666-3952-2 (print & perpetual access) 1. Educational games--Design and construction. 2. Simulation games in education. 3. Computer games--Design. I. Freitas, Sara de, editor of compilation.
LB1029.G3N46 2013
371.39’7--dc23

2012048159

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 7
Integrating Games into the Classroom:
Towards New Teachership

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ABSTRACT

The game-based learning approach has already shown its strengths from the learners' point of view. However, there are numerous unrevealed ways to support teachers' work within the game-based approach. Unfortunately, games that exclude the teacher from the game-based learning process dominate the markets, which is of great concern. Thus, the aim of this chapter is to study the use of novel game features that enable teachers to participate in game-based learning events. In this chapter, the teacher's role in the game-based learning process is considered through several different game examples that are designed to fulfill both learners' and teachers' needs. The examples show that there are both computational and non-computational methods that can be used to support learning and teachers' work in the game world. Based on previous results it can be argued that the diffusion of game-based learning can be facilitated only if both learners' and teachers' needs and goals are taken into account.

INTRODUCTION

If a teacher from 1910s would come to classroom at 2010, he or she would notice that something has changed, but not remarkably. However, the same reaction would not be possible either for doctors or process workers in factories. Why teaching remains the same? If we take a deeper look into teachers work, we notice that classroom has not changed, but the skills required from a teacher have been dramatically changed. Nowadays teacher is seen more like a coach for learning. Furthermore, the real point for discussion is how the educational technology research has forgotten the practical dimension of the teachership, especially in game based learning solutions. It has become evident

DOI: 10.4018/978-1-4666-3950-8.ch007

that teachers would need more effective tools for coaching, management, and assessment.

In recent years, Game Studies has rapidly developed into an important interdisciplinary research field as well as a nascent academic discipline. The rapid growth of the game industry has aroused wide interest, particularly among educational technology researchers as well as digital learning material producers and publishers. It is known that the possibilities to use digital games in education have been considered since the 70s. Nevertheless, the concrete and scientific ambitions to produce high quality educational games have been quite minor. Actually, the quality of produced games has not met the expectations of the educators and the use of games has not become as general as expected. Probably, the most significant factors that have lowered the quality of educational games have been the lack of a theoretical game design foundation as well as game developers' low yield expectations. In fact, the overall level of educational games indicates that the usefulness and the real power of game-based learning have still not been fully realized.

Apparently, the rapid growth of the entertainment game market has reawakened the interest of educational researchers and producers. It seems that games will get another chance to prove their usefulness in computer-assisted learning. At least the starting point for this revival is better than before. First of all, researchers have understood the meaning of pedagogical foundation in educational game design (e.g. Dunwell, de Freitas & Jarvis, 2011; Ketamo & Suominen, 2010; Kiili, 2007, Kiili & Ketamo, 2007; Amory & Seagram, 2003; Garris, Ahlers & Driskell, 2002). Secondly, the infrastructure of schools has developed a lot during the last decade. Thirdly, it has been argued that we are moving towards a new generation of educational use of games (e.g. Egenfeldt-Nielsen, 2007). According to Egenfeldt-Nielsen (2007) such third generation educational games rely on a socio-cultural approach, where the learning process is seen as being mediated in a social and situated context. Furthermore, third generation educational games focus on the students' engagement with games (Gee, 2003) and emphasize the meaning of the teacher as a facilitator that expands the scope of computer games from just playing to learning (Egenfeldt-Nielsen, 2007). However, research dealing with third generation educational games has been mainly conceptual and is lacking of the empirical grounding of the approach.

In general, game based learning approach has shown its strengths and opportunities from the learners' point of view (e.g. Ketamo & Kiili, 2010a; Ketamo & Kiili, 2010b; Virvou et al., 2005; Ketamo, 2003; Sinko & Lehtinen, 1999). However, there are numerous unrevealed opportunities to support teachers' work with game based approaches. Support is not limited only to on-line game statistics, but game based approaches can extend teachers' role in very meaningful ways.

In this chapter, teacher's role in game based learning process is considered through several game examples that can be classified to third generation educational games. We consider teacher's role in game-based learning with the help of AnimalClass game, Eedu Elements game, Media Detective game, ALICE Fire Evacuation game, and Magos game-authoring environment. We argue that these game based solutions are rare, because the development of these games has focused on fulfilling both learners' and teachers' needs.

CASE STUDIES

This research is a meta study about authors' research between 2005 and 2012 in the area of educational games. The games have been studied in terms of educational sciences, usability, user experience and technology. Such exhaustive research results make it possible to create summaries about pedagogical use of educational games from classroom integration and a teacher point of view. The detailed list about used background research materials is presented in the Additional Readings

section. The overall aim of this paper is to uncover the opportunities that third generation educational games can provide for schools and raise discussion about teachers' role in game based learning. Five case studies presented in this chapter consider educational use of games from several perspectives and that way provide quite exhaustive view on the theme. In general, the discussed approaches are meant to strengthen and speed up teachers' work in game based learning environments.

Integrating Games into Classroom: AnimalClass Case

The AnimalClass game series is developed according to Finnish curriculum. The background of the games is in Learning by Doing (Dewey, 1938/1997), Learning by Teaching and Learning by Programming (Papert, 1980). The idea of AnimalClass is to put a learner (player) into the role of a teacher. In AnimalClass the player has complete freedom to teach his virtual pet however he wants, even wrongly. The pet learns the things that are taught. The results described in this section are based on authors' previous studies and general feedback that teachers have provided after using the games in teaching.

Case Specific Background

In AnimalClass case, learning is discussed and analyzed in terms of conceptual change. Traditionally, most learning theories rely on the assumption that concepts change through an enrichment of prior knowledge (Vosniadou, 2007). Conceptual change differs from these learning theories, because it cannot be achieved through additive mechanisms involving only the enrichment of pre-existing knowledge. In fact, the conceptual change approach emerged from an effort to explain the radical reorganization of conceptual knowledge and acquiring an understanding of difficult concepts (Vosniadou, 2007).

Merenluoto's and Lehtinen's (2004) model of processes of conceptual change describes a learning situation in which the learner experiences tasks dealing with phenomenon calling for a new conceptual understanding. A learner's cognitive, metacognitive, and motivational sensitivity to the task influences how the learner perceives the task. With sensitivity Merenluoto and Lehtinen (2004) mean the extent to which the learner is aware of and interested in the novel cognitive aspects of the phenomenon. The model distinguishes three possible learning paths: the experience of conflict, the illusion of understanding, and having no relevant perception. These paths that form the theoretical basis of this research are briefly presented next (for a more detailed description, see Merenluoto & Lehtinen, 2004).

The first path, the experience of conflict may lead to radical conceptual change. The optimal level of prior knowledge of the phenomenon, sensitivity to novel features of the situation, and the process of tolerating the ambiguity resulting from experienced conflict are critical processes in conceptual change. The experience of cognitive conflict reduces a learner's certainty about the phenomenon. Thus, the learner does not rely only on his/her prior knowledge, but is ready to change his/her knowledge beliefs. Toleration of ambiguity is crucial. "Coping with a complex conceptual system is possible only if a learner has sufficient metacognitive skills to grasp the conflicting notions" (Merenluoto & Lehtinen, 2004, p. 525). Also motivational aspects affect how a learner deals with ambiguity. If tolerance of ambiguity is high, a learner feels that the experienced conflict is solvable. In contrast, low tolerance of ambiguity may decrease sensitivity or lead to a loss of trust, resulting in low certainty and avoidance behaviour.

In the illusion of understanding path, conflict is passed by unnoticed because of overconfidence. Self-efficacy and high motivation may increase a learner's tendency to take the

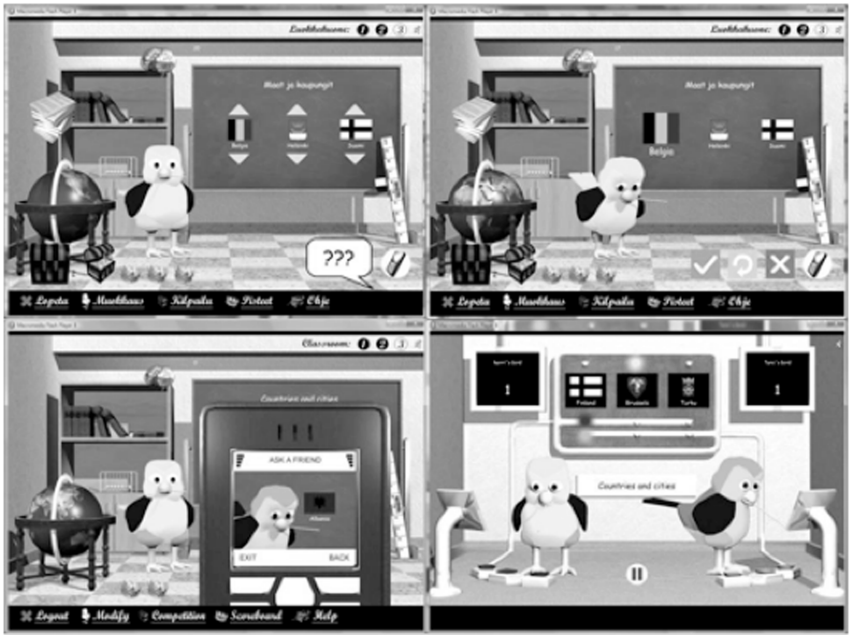
illusion of understanding path. On this path, a learner recognizes some familiar elements in the new phenomenon, but his/her prior knowledge is not adequate for paying attention to the novel aspects of the phenomenon that go beyond his/her current conceptions. Familiar elements of the phenomenon arouse an illusion of understanding, which leads to an enrichment of naïve models or the construction of synthetic models. However, high motivation may lead to perception of the conflict and result in more radical conceptual change later on. In fact, Merenluoto and Lehtinen (2004) argue that cognitive change requires time. Thus, in mathematics learning games it is important to engage learners in playing for as long as possible in order to maximize the probability of conceptual change taking place.

In the no relevant perception path, the learner misses the conflict because of his or her broad cognitive distance to the phenomenon to be learned. The possible cognitive overload (Sweller, van Merrienboer, & Paas, 1998) confuses the learner and may lead to avoidance behaviour or routine activity unrelated to the cognitive demands of the task. Because any attempts to create cognitive conflicts are doomed in this path, game elements facilitating conceptual change cannot be designed for these learners. The only way to support these learners is to provide them with the information that is needed to understand the phenomenon and so be able to perceive the cognitive conflicts.

Description and Learning Activities of the Game

At the beginning of the game, a player gets his own virtual pet, a teachable agent, which wants to learn mathematics, natural sciences, languages or music depending on the game title. The task of the player is to teach his pet the content related to the subject of the game. In the beginning, the virtual pet does not know anything; its mind is an empty set of concepts and relations. The player has complete freedom to teach the pet what he wants. Teaching is performed in the classroom (see Figure 1). In AnimalClass games the teaching

Figure 1. Question construction (top-left); evaluating the question (top-right); calling a friend (bottom-left); competition (bottom-right)



is always based on statements constructed by the player. The pet answers according to its previous knowledge. If there is no previous knowledge, it will guess. The player then tells the agent if pet's answer was correct or not, and based on this, the pet forms relations between concepts and pet's conceptual structure is updated.

The pet learns inductively: Each teaching phase increases and strengthens the network of concepts. During the game play the conceptual structure in the pet's AI evolves. When the virtual pet has achieved a conceptual network of a certain size, it starts to conclude. For example, if the virtual pet knows that concepts A and B belong in the same group and concepts A and C belong in the same group, it can conclude that also B and C belong to the same group. On the other hand, if the virtual pet knows that concepts A and B belong in the same group and concepts A and C belong to different groups, the virtual pet can conclude that B and C belong to different groups. Thus, player does not have to teach everything to their pet and the player can optimize his teaching.

A brain icon above the pet (see Figure 1) is used to describe the quality of learning. If the quality increases, the brains get bigger, and if the quality of learning decreases, the size of the brains get smaller. If the overall concept network is wrong, the brains is replaced by a cactus to show the player that he is doing something completely wrong. This kind of wrong teaching can be corrected by teaching the correct structure enough times. The game AI uses all the taught information behind its decisions and therefore it takes time to override the wrong learning.

The AnimalClass was designed to support reflective thinking. Usability issues were taken into account when there were no risks of decreasing reflective thinking. The major challenge was to design the user interface easy to use, but still leave the thinking and decision-making to the player. For example, the user interface does not inform of the wrong kind of construction of a question. The user can cancel the question and construct it again if the user figures it out from the pets' answer or answering behavior. In Figure 1, top-left, the player has constructed a question that consists of two concepts that are related and one concept that is odd. When the question is ready, the player asks the question from the pet by clicking the 'ask' –button (balloon with three question marks). The pet answers according to its previous knowledge. The virtual pet answers anyway, even if it does not know the answer or, if the question is impossible, in these cases it will guess the answer. Gestures of the pet indicate whether it guesses or not.

In Figure 1, top-right, the virtual pet has given its answer by pointing out the concept, which it thinks that does not belong in the group. The player should judge the answer: if the answer is correct, the player should click the green 'correct'-button. If the answer is false, the player should click the red 'wrong'-button. If the player notices that he has done an impossible question, the question can be cancelled by clicking the yellow 'cancel'-button.

The classroom supports learning in two ways: In the beginning, constructing a task requires knowledge about the subject. If there is not enough knowledge, player is encouraged to discuss the problem with their friends. During this process, the player has to apply his knowledge and/or increase his knowledge. This process can also be seen as non-formal learning, where a player's interest (achieved by playing) directs the learning rather than formal instructions. Secondly, judging the answers requires specific knowledge about the question. Basically, a player can construct a question with less knowledge than answering requires. Now when the player should also judge the answer, the game also requires detailed knowledge about the subject combined with applied knowledge.

The player can send his/her pet to a competition (Figure 1, bottom right). In the competition, the pet competes in a quiz against someone else's pet that has been taught by a real person (possibly a friend or classmate). The game server constructs the questions and judges pets' answers that are

determined based on players' previous teaching. The role of the player is to observe the successes and failures of his/her pet in order to grasp the pet's current skills and misconceptions. Of course, many players tend to encourage their pets in the competition by whispering comments to their pets, like "Hey, it's the one in the middle." Also this kind of encouragement supports learning: when a player tries to advise the virtual pet he has to solve the question at the same time. A competition challenge is automatically accepted; a player cannot refuse to compete. Because the competition is based on the conceptual structures of pets (previous teaching), the challenged player can be offline. Furthermore, in order to support social interaction a call-a-friend application was implemented into the game (see Figure 1, bottom left). Call-a-friend enables to ask questions (answers to created questions) from friends' pets.

Teacher's Role in the AnimalClass Games

The results of our previous studies support the possibility to mine (in terms of Data Mining) detailed information about learning and playing processes and provide such information for teachers (e.g. Ketamo & Kiili, 2010b). The teacher tool was designed to be easy and fast to use in classrooms. It was meant to improve teacher's capabilities to instruct pupil in real time. Because the semantic networks are slow to search or analyze manually, the most relevant information is mined, compressed and presented at four main areas of the teacher tool.

In the beginning, all the available concepts are on the 'not taught'-area. After teaching the virtual pet the concepts form a network with multiple relations and this structure is mined and compared to correct structure. According to this analysis, the concepts are presented either as 'correctly taught' or as 'wrongly taught' concepts. If the conceptual network is correct and strong around a concept, the concept will be upgraded into the well-taught area.

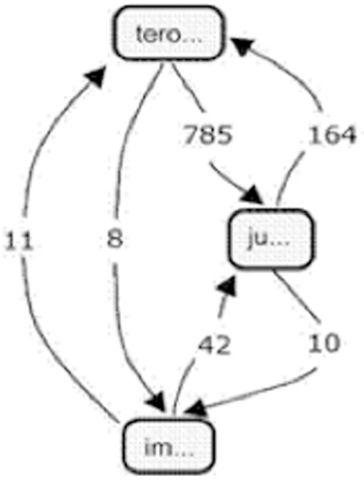
In just a few seconds a teacher can see what is wrong in some pupil's game play and after that teacher can help the pupil by providing some relevant correction suggestions. The idea is that a teacher can encourage pupil to think reflectively and point out problems in pupil's previous teaching. Teacher should not correct pupils' game play, but pupils should do it himself. With this tool, a teacher can manage game play even in large groups such as 20-30 pupils.

The game play can be used to support teacher's work also in terms of social networks: Because competing against classmates tells something about class's real world social networks, it could be useful to provide this information to a teacher. The formation of social networks is done with similar Data Mining methods than teacher tool's diagnostics. According to previous studies (e.g. Ketamo & Suominen, 2008) we can point out 1) two main types of social networks and 2) two clearly definable minor types of social networks.

First major type of social network is formed by the persons at the top of the ranking list of the game and their challengers. The cluster itself was not a surprise, but the clarity of the cluster from a modeling point of view is a bit of a surprise. Nevertheless, there was no hypothesis set in advance; the clusters were expected to be more 'noisy' and not as clear as structures. The second main group of the social networks was formed between, for example, classmates or other friend based groups (Figure 2). In these groups, the dominant feature was tightness of the group: There were many considerably strong two-way relations, but only a few one-way relations in these groups.

Two clearly defined, but not so frequent, types of social networks (less than 5% of the population) appeared, for example, in groups based around a central person and refer to a situation in which a center person has either two-way or one-way relations to other members, but other members do not even have one-way relations to one another themselves (Figure 3).

Figure 2. The social network structure of a 'classmates' type of group. The usernames are partially hidden in order to minimize the possibility of recognizing players.



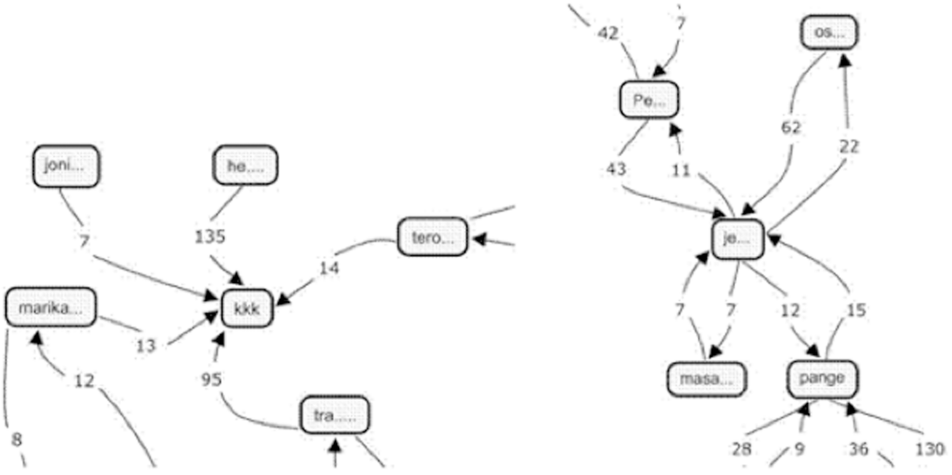
In Figure 3, left network, a central person is challenged by several classmates or friends. This can be explained either as a mobbing or as a leadership. In a case of mobbing, the classmates pick up an opponent that they know is e.g. low skilled in the game domain. However, if a person is likely to be mobbed, he/she can remain anonymous by not telling his/her username. Classmates cannot figure out a username in the game, but they certainly can force a mobbed pupil to tell his username. In a case of leadership, the classmates pick an opponent that is a central person of the class's real social network. Furthermore, if a person is a social leader of the class, he/she probably challenges his/her friends as in Figure 3 right network. To conclude, the visualization of players' social structures may facilitate the teacher to maintain better control of his/her class also in the virtual game world.

Findings and Discussion

In AnimalClass games the teaching of own virtual pet was found very motivating. The development of a virtual pet's conceptual structures makes possible to uncover the frequencies, dependencies, and patterns behind conceptual change. An interesting finding was that learners could use different playing strategies to achieve good results.

From teacher's point of view, AnimalClass enables almost any didactic approach: from teacher centered classroom management to social learning with peers and from Behavior-

Figure 3. Left network: possibly a case of mobbing? Right network: social leadership? The usernames are partially hidden in order to minimize the possibility of recognizing players.



istic stimulus-response tracking to open ended learning-by-doing. Furthermore, the teacher tools in AnimalClass supports teacher in several way. In classroom level, teacher can check the progress in general at class or he/she can search themes that are difficult for most of the pupils. In individual level teacher can find in seconds what to discuss with individual pupil.

The biggest challenge in AnimalClass is the learning curve of the game itself. The gameplay and the aim of the game is difficult to realize for pupils. Furthermore, the teacher tools are like research tools, a teacher have to use time to start to use the tools.

Integrating Games into Classroom: eedu Elements Case

From educational outcome point of view, AnimalClass was a success. Furthermore, the game mechanics and AI was awarded in several educational and games industry contests. However, the game never made a worldwide breakthrough in everyday classroom use. One reason was that the gameplay was not easy to start. In other words, it takes more than 15 minutes to clearly understand the idea of the game. Finally, AnimalClass was only a collection of different themes, not a complete solution like a textbook and thus it was not appealing enough for teachers.

The following eedu Elements game solves these two major challenges: its gameplay can be learned in 15 seconds, it is extremely easy to take in use in schools and at home. Methodologically Eedu Elements applies similar solutions as AnimalClass (see: Ketamo 2009; Ketamo 2011). Finally, it is not just a game, it is a Finnish school (currently mathematics) delivered in a game format. In this way all children can access Finnish curriculum and learning-by-doing style of teaching. Basically the goal Eedu Elements is to produce equal education for all.

Game Description and Learning Activities

In the game mice can get cheese only by getting through mathematics labyrinths faster than cats can. Players' task is to teach necessary skills for their pets (mice). When their pets do have enough skills player can send it to labyrinth to survive on its own - catch the cheese before the cat.

Understanding the story is a critical point for player in order to get good gaming experience. In our first tests too many pupils didn't get the idea from external instructions, so the story and all instructions were embedded into the game as comic strips. Similar type instructions appear every time when a player moves into a new task or into a new kind of gameplay. The instructions can be skipped, but e.g. pre-school and first grade pupils like to watch the instructions time after time. In other words, they really perceive the ideas how to play the game and also like the comic strips as stories.

To give the pupils a feeling that characters are really their pets, there are several mice and cats to choose. If player chooses a mouse, it is expected that the mouse is taught correctly. In case player wants to help mice, he/she can start teaching cats wrongly. The idea in teaching wrongly is simple: many pupils are afraid of showing his/her weak skills. When the aim is to fail, it does not matter if you sometimes teach correctly. Eventually, before you can teach wrongly, you have to know correct answers, and so the process is same as when teaching correctly.

When starting teaching, the pet goes to classroom (Figure 4). In the classroom a teacher (owl) asks questions from mice and cats. Player can help his/her pet by pointing the pet's thoughts. The pet learns exactly according to the teaching. If the player teaches correctly, the pet learns correctly and vice versa. After the player has taught enough conceptual relations for his/her pet, a challenge

Figure 4. An example of the classroom (left); an example of the labyrinth (right)

icon appears on the screen. By clicking the icon, player sends his/her pet into the labyrinth to compete against the cat. In labyrinth (Figure 4) the pet is on its own and player's task is to observe how it manages in the competition.

In the labyrinth both characters pick the doors according to their taught knowledge. During the labyrinth player can observe what to teach more. If mouse wins, the level is completed and next level becomes playable. The achievements are auto-saved and all the completed levels remains playable—of course, the player may want to achieve the maximum numbers of stars into his/her badge.

When all features are implemented in fall 2012, the game characters can compete against any other taught character any time, no matter if the human player is online, because all the taught behavior and skills in pets' AIs (brains) are always available in online. According to our previous studies, the social connections in the game and in the real world during the game play are important elements for the motivation (Ketamo & Suominen, 2008; Kiili, Ketamo & Lainema, 2011).

Each grade consists of 45 or more levels, containing hundreds of different exercises per level. The game as well as the content will evolve all the time, so players are not expected to get bored after played the game once. Furthermore, the production technology has been designed in a way that enables very cost effective production. All assets are reusable and easily updated. Adding new exercises or new levels can be done in hours. Designing a whole new grade takes only few weeks if there is no need for new graphics. Graphics design, as design, we cannot speed up.

Teacher's Role in the eedu Elements

Eedu Elements game's skills -tool is meant for parents and teachers to quickly observe what the learner has taught for his/her pet. The visualization shows correctly taught concepts in the upper part of the skills-area and wrongly taught concepts in the lower part of the area. In a case pupil is teaching cats, it is expected that the most concepts are in the lower part of the area. The quantity of the teaching is visualized in a way that concepts that are taught a lot appears in the right side of the area and little taught concepts on the left side of the area. Quantity of teaching also means that what more relations a concept does have, that more right it is located. Concepts that have not been taught do not appear in the skills -area at all.

When focusing on dependencies between the taught conceptual structure of pets and pupils achievements measured with traditional paper tests, we can show that the taught conceptual structure is strongly related to the post-test score ($0.4<r<0.7$) with all tested content on mathematics

and natural sciences. This is an important result in terms of reliability of the game as assessment/evaluation instrument. In the game one level represents approximately one school week in Finnish curriculum. In the game, the player can get one to three stars when completing the labyrinth. If the player completes the level with one star that represents satisfactory skills while three stars represent good skills. However, the results of the gameplay are always a bit fuzzy: a player can have just good luck and receive three stars with two stars performance. Furthermore, once and a while a nearly perfect mouse can lose in a labyrinth if there is just that one difficult question for it. So the evaluation/assessment with Eedu Elements in a single level is only indicative, but completing a whole grade requires skills that would be required to pass the same grade in a Finnish school.

Furthermore, when summarizing the game achievements, the schools and the national level policy makers can receive analysis about competences and skills in general level in order to develop their teaching or formal curriculum. The analytics are that detailed that we can point out general bottlenecks of education: e.g. in Finland there is an interesting bottleneck related to fraction numbers with odd nominator (Figure 5) that we have revealed from playing behavior. These numbers mediate or connect nearly all difficulties related to converting numbers between decimal numbers, fraction numbers and percent numbers. In other words, in Finland we should pay attention on how to teach odd nominated numbers for pupils.

When going deeper in details, wrong answers or misconceptions are not the only relevant factor explaining learning outcome. According to data received from gameplay, avoiding number (or concept) indicates directly poor performance in such concept. In Figure 6 some of the numbers and frequencies avoiding the numbers during the gameplay are presented. In fact we can see that once again the most avoided numbers are the odd nominated fraction numbers.

Findings and Discussion

From teacher's point of view, the easy start of the pedagogical activity in the classroom is one of the most important features. The second big feature is the gain. This does not mean only educational outcome, but also how a teacher can apply the tool in his/her classroom management. Thus, educational game should be designed in a way that it is 1) fast and easy to start, 2) requires only little or none technical support, 3) provides something useful for a teacher, and 4) does not restrict teacher's classroom management.

In the classroom use, eedu Elements is really easy to start: Teacher just gives tablets to pupils and playing can be start. Pupils, today, learns very fast how to use tablets and they are not afraid to

Figure 5. Misunderstood numbers and the strongest dependencies between misconceptions

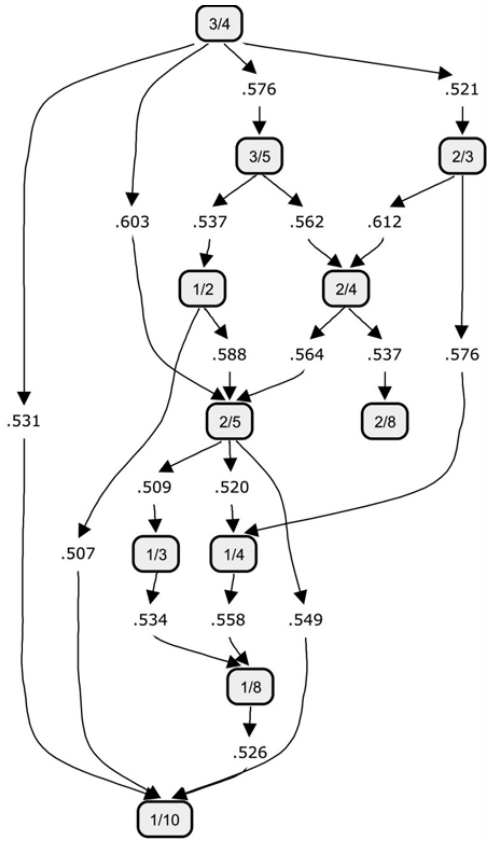
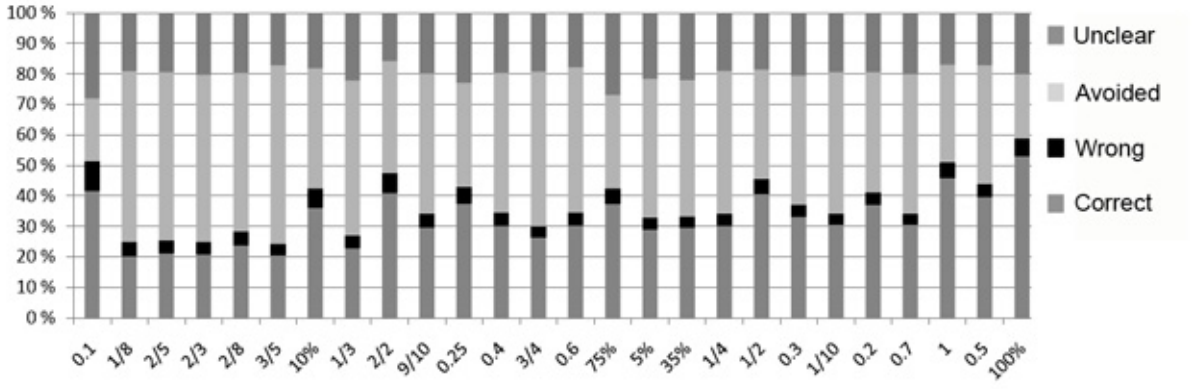


Figure 6. Frequencies of correct answers, wrong answers and avoided numbers. Unclear means that in some cases an individual player has understood such number correctly while in other cases he/she has not.



ask help from classmates when having troubles. Furthermore, the game play can be learned really fast, in seconds, so the teacher does not have to explain what to do. However, some teachers still feel themselves outliers when pupils are playing the game. They do not participate as much as they will participate when filling exercise book. However, important is, that even though some teachers do not participate in gameplay activities, all thought the game is very useful for kids.

Integrating Games into Classroom: Media Detective Case

Media Detective is a learning game designed for media education. Media education should not be confused to merely teaching through or with media. Instead, it should aim to develop children's media literacy so that they have the ability to access, analyze, evaluate, and create media in a variety of forms. This task is very challenging, because the required knowledge and skills are very broad and hard to teach. This was also the driving force behind the development of Media Detective game that aims to develop students' media literacy and ability to produce, evaluate, and interpret media messages critically. Furthermore, game includes elements that teach copyright issues, safe use of Internet services, and other data security themes. The learning content is embedded into a realistic story that integrates the challenges and learning tasks into a coherent and harmonious entity. The aim of this case is to present how teacher can actively participate in game events and can guide players directly in the game world.

Game Description and Learning Activities

In this section a superficial description of the story and the game activities are presented. In Media Detective a player takes on the role of an undercover agent working as a journalist who tries to clear up a theft and a related copyright offense. The master disk of the forthcoming movie has been stolen and pirate copies are sold in Internet and streets of Mediaville. The police have reduced the suspects to six persons that are all actors of media industry and they have somehow participated in the production of the stolen movie. In the game the agent (player for now on) interviews suspects, becomes familiarized with their work and does feature stories about them while trying to solve the crime (Figure 7). The player has a partner, an experienced agent, who helps and guides him during the game. The partner called Silva comments the decisions of the player and tries to activate player to think the content more deeply.

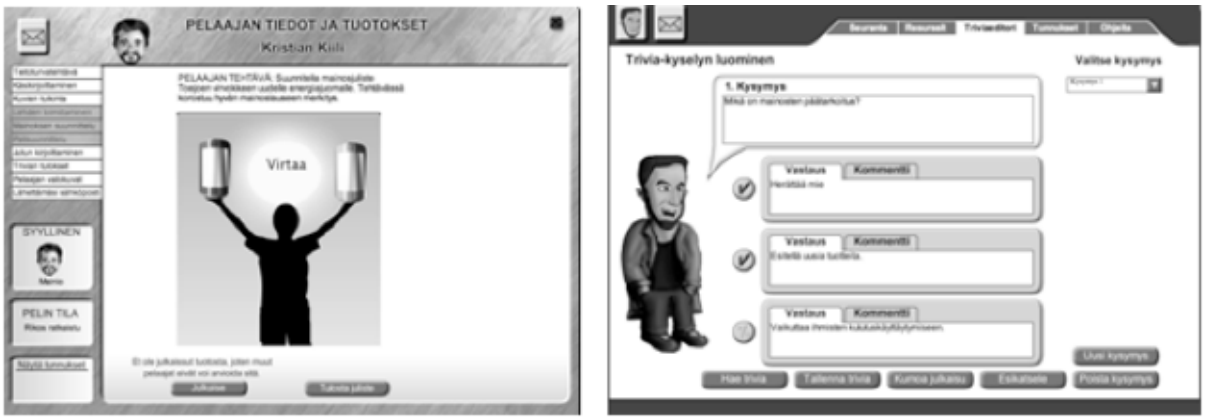
Figure 7. Interviewing a suspect (left); writing a feature story (right)

The interviews form the core of the game. They include both theoretical content about producing media messages (related to interviewee's work) as well as content needed to solve the crime. When the player has conducted an interview he is allowed to familiarize with suspect's work more deeply by performing a production task. Production tasks allow player to apply the theories that he has learned during interviews in practice. For example, in advertising agency, the player is obliged to produce an advertisement for a soft drink company and in LudusPoint game company player is obliged to design a level and related storyline for a platform game (Figure 8). The use of production tasks is justifiable because several studies have shown that challenging learners as producers of materials increase the learners' understanding of the subject matter (e.g. Kiili, 2005; Stern, Aprea, & Ebner, 2003; Hall, Bailey & Tillman, 1997). Furthermore, the creation of media messages supports also the formation of player's interpreting strategies of media messages. In fact, during the game player faces numerous media messages that he has to interpret and analyze in order to solve the game.

Teacher's Role in Media Detective Game

Players demand some intelligence from educational games due to their prior playing experiences with entertainment games. However, the develop-

Figure 8. Advertisement creation tool (left); game level editor (right)



ment of AI-based game elements is expensive and challenging—especially in an educational context where the characters should provide constructive feedback for players. Furthermore, it is extremely challenging to form AI-based game elements that trigger reflection, which is a key process in learning. Therefore, Media Detective uses an alternative method of forming intelligence into the game, in which a teacher has a significant role. This method is called illusion of intelligence (Kiili, Ketamo & Lainema, 2011).

The idea of illusion of intelligence approach is that a teacher can communicate with players through non-player game characters included in the game world. It can be said that a teacher has many faces and identities. In Media Detective a teacher has two ways to communicate with players. Firstly, the teacher can take the role of player's partner, agent Silva. In other words, the teacher can create speech lines for the partner and aim them at a certain player. This kind of tutoring system allows the teacher to give constructive feedback to players and makes differentiation of teaching easier in a game context. Secondly, the teacher can communicate with players with game's internal e-mail system. The teacher can send e-mails to players from different non-player game characters. This feature was implemented in order to form a feedback channel for tasks requiring creative content producing. Provided speech line templates and e-mail templates support teachers' communication with players. The template messages have been designed to trigger reflection in players and they also facilitate teachers' adoption of the roles of non-player game characters.

In order to be able to tutor players, the teacher needs to be aware about players' performance and progress in the game. Therefore, Media Detective includes also an observing tool. The teacher can grasp with one look the overall progress of the glass. Furthermore, teacher has also a possibility to check players' productions in real-time and publish them into the game world, if they are decently made. After the first pilot studies also a trivia creation tool was embedded into the teacher's tool. Teachers requested this because they wanted to also test players' knowledge after the game. Most of the teachers thought that the production tasks were not adequate indicators of players' learning. In practice, a teacher can start the creation of a trivia from scratch or use or modify a trivia made by another teacher. When the trivia is published, the players can perform it after solving the game and finally the teacher can check player's performance from teacher's tool.

The observing tool makes it possible to use player-generated content also outside the game world. Such feature supports the integration of game content to other teaching. For example, a teacher can show someone's production task to whole glass and use it to raise discussion or deliver printed advertisements to students and ask them analyze them etc. As we can see quite simple tools provide a lot power and possibilities for a teacher. However, the integration of games into other teaching depends much on teacher's motivation and creativity.

Findings and Discussion

The results described in this section are based on authors' previous studies and general feedback that teachers have provided after using the game in teaching. The evaluation of Media Detective has indicated that the illusion of intelligence approach is a successful method that can be used to support teachers' work and facilitate players' experiences. In fact, many of the players have been impressed with the artificial intelligence of the game. For example, Matti stated that: "Hey, the artificial intelligence of the game was awesome. The author of the game should work for Remedy" (Remedy Entertainment is a game company that has published some very successful games). Naturally, Matti's enthusiasm was mainly the merit of the teacher who could create the kinds of messages that did not disturb the harmony of the game - teacher could act like a believable

game character. On the other hand, the evaluation studies have showed that messages created by a teacher can also ruin the whole game. For, example one teacher used agent Silva to inform players that it was time for a lunch. After that, players did not know anymore how to interpret Silva's messages. Thus, the success of illusion of intelligence approach depends on teacher's skills to adapt the roles of different game characters so that the whole game forms a harmonious entity and the teacher-generated content does not stick out from other game content? This phenomenon relates to the concept of suspension of disbelief. According to Rollings and Adams (2003) suspension of disbelief reflects a mental state in which a player chooses, for a certain period of time, to believe that this pack of lies (the game) is current reality. It is important to realize that when suspension of disbelief is lost, it is extremely difficult to capture player's attention in such a way again. This is the thing that teachers should realize before they start to teach with games allowing them to create own content.

Overall, teachers have emphasized that guiding players is quite easy, but the real challenge lays in getting players to think more deeply. This is a real challenge also for the game designers. How the performance of the teacher can be supported so that the teacher can provide cognitive feedback for players? One thing is clear, the tempo of the tutoring have to be manageable in order that teachers have enough time to produce effective and constructive messages for players. However, the evaluation studies have revealed that in spite of some delay players seems to like the feedback system of Media Detective. The feedback provided with e-mails has experienced to be very effective, because it is contextualized. For example, one player said that, "I really liked the way how the game provided feedback from my tasks…It felt powerful because it game from real professionals." The player referred to e-mails generated by a teacher and send through non-player game characters. The results have shown that the feedback delivered through non-player game characters were more effective than the feedback that the teacher gave face-to-face. In other words players were more eager to modify for example their advertisement posters based on feedback that the CEO of advertisement agency provided. However, as mentioned before the success relays on teachers ability to maintain the suspension disbelief and the harmony of the game. To summarize, the illusion of intelligence seems to be a respectable approach to fulfilling the expectations of students as well as teachers and can be used to support reflection.

Integrating Games into Classroom: MAGOS Case

Due to social, economic, and technological changes in our society, creativity is nowadays seen as basic survival and success factor. It has been argued that innovation, creativity, and production of media should be emphasized also in the school of the future (Kangas, 2010). The gameplay of Media Detective involved content production tasks that support the development of such 21-century skills. Because user generated content approach, especially the game design task of Media Detective, motivated both students and teachers we decided to create better tools that allow non-programmers to create and share their own games.

First, we developed a 'Pelitehdas' tool that allowed students to create Tetris-based games. Although the tool was quite simple, it provided great possibilities for teachers to use learning by designing games method in different school subjects. The positive feedback and the usefulness of the game development approach motivated us to continue this work. In 2012, we started an EU funded project called MAGICAL in which we are now developing more open-ended game-authoring environment, called MAGOS, for non-programmers. We decided to present MAGOS shortly in this chapter, because it includes some game elements that are derived from Media De-

tective game and it supports the development of 21-century skills that will be emphasized in the curriculum of the future. Furthermore, learning by developing games approach may provide schools a cost-effective way to introduce game based learning in classrooms, because the game development environments are not bound to any single theme or subject.

Case Specific Background

The pedagogical strategy, Learning by Developing Games, is theoretically founded on Dewey's learning by doing approach (Dewey, 1938/1997) and Papert's learning by programming approach (Papert, 1980). The pedagogical idea behind Learning by Developing Games approach rely on an assumption that construction of artifacts helps children to reformulate their understanding of the subject and express their personal ideas and feelings about both the subject and the constructed artifacts (Kafai, 2006; Papert, 1980). Although the constructed artifacts motivate children a lot, they can be regarded only as by-products of learning. In its best the design and development of artifacts is creative teamwork, which supports reflective thinking, collaboration, problem solving, and co-construction of knowledge.

A distinction between game authoring and game programming approaches needs to be made. Game authoring is a process of creating, arranging, and structuring content and rules in an interactive game development environment whereas game programming is more advanced process of writing source code of a game. According to Yatim and Masuch (2007), an ideal development tool for children would scale in programming 'granularity' in order to grow in capability along with the user's programming skills. The Scratch is a good example of such visual programming language designed for children (Monroy-Hernández, et al., 2011). The idea of Scratch relies on Lego bricks—the Scratch grammar is based on a collection of graphical programming blocks that children can snap together to create programs (Resnick, et al., 2009). In order to lower the starting floor, the blocks are designed such a way that they fit together only in ways that make syntactic sense. The aim of the MAGOS environment is to lower the starting floor even more and that way support the wider use of the learning by designing games approach.

Description and Learning Activities

The MAGOS game-authoring environment is targeted for children and teachers. We want to emphasize that we do not try to develop a new visual programming language like Scratch (Monroy-Hernández, et al., 2011), but a game-authoring environment that relies on dragging, selecting, clicking etc., but still provides wide possibilities to create different types of games. By selecting game-authoring approach instead of programming we want to make the adoption of the environment as easy as possible.

Unlike traditional game-authoring environments MAGOS is designed to support collaborative game development. Games can be developed individually or in small groups (2-4 persons). All developers of the group can modify the same game simultaneously. In practice, each user gets a spell set (certain game development tools). Spell sets include potion bottles that are used to add characteristics for game elements. Spells are activated by dragging the bottles on existing game elements, which activates a tool pane that can be used to modify spell's characteristics. Four different types of spell sets exist: artistic spells, sound spells, psychic spells, and mock-up spells. In the beginning, each user can select their spell set, but two persons cannot select the same. For example, the artistic spell set includes drawing tools, animation tools, etc. With dividing tools between different spell sets and users, we aim to facilitate discussion between users and make the user interface of the MAGOS as simple as possible—for the user it is easier to handle small set

of tools at a time. In order to facilitate collaboration and development process, users are allowed to change the spell sets in the fly. For example, if the user with a psychic spell set has made an object and defined some collision rules, he can ask from the user owning sound spell set a possibility to interchange spell sets so that he can create and add a noise for a collision. If the user agrees the spell sets are interchanged. Communication and awareness tools are added to facilitate the collaboration between users. However, if only one user creates a game he or she can control all the spell sets.

The research has shown that the uses of existing materials inspire users and arouse creative ideas. In MAGOS we encourage and empower users to build on the work of those users who want their work to be reused. MAGOS allows users to share or publish their game projects in two different ways: 1) publish for only playing or 2) publish for playing and remixing. The authors of the games that are remixed will get credits of their original work and the credits can be used to buy licenses to remixable content.

Teacher's Role in MAGOS

In general, MAGOS provide wide possibilities for teachers to integrate game development into their teaching. However, the learning by developing games may first sound too complicated and challenging. Thus, the learning curve of the used tool or environment should be very steep and teacher's participation in students' game development processes should be facilitated at least in following ways.

First, teacher's lesson preparation activities should be supported. The use of game development as a pedagogical strategy may be challenging for teachers and they may need contextualized examples to perceive the possibilities that the strategy provides. Thus, MAGOS will include an example library for teachers that can be used in lesson preparation activities. Library includes examples about teaching curriculum-based content with MAGOS environment and that tries to lower the starting floor.

Second, the previous research has shown that game design is very challenging for students (Kafai, 1995) and without teachers' support learning outcomes tend to be poor. Thus, in MAGOS a teacher can communicate with students through game design professors (wizards) included in the game-authoring environment. With such a feature teacher can guide students and give them feedback of their performance without breaking down the suspension of disbelief. This method provides opportunities to give feedback from creative production tasks that would be almost impossible to automate. However, in such solution the success depends also on teacher's abilities to adapt different roles in the environment and to collaborate with users as the results about Media Detective game have shown. Furthermore, in order to be able to give constructive feedback teachers need ways to follow students' game development processes.

Third, assessment should be supported. In general, the assessment is embedded into the projects created in MAGOS environment. If students create successful projects, it can be assumed that they have learned the subject matter. Nevertheless, the assessment of game projects is not always easy especially for teachers that are not fully familiar with games and thus we will create a framework that helps to succeed with the assessment. However, the end product is not always the only aspect that teachers are interested in. Thus, we have created also a spying tool that can be used to follow students' game development processes in real time. With this tool teacher has access to whole game design process if he or she wants to. Furthermore, a peer reviewing system will be included into MAGOS.

To conclude, if we try to integrate game development into the curriculum, it does not require a new subject into the curriculum, but using game development as a vehicle for teaching curriculum-based content and collaborative project work. We

believe that learning by developing games will become more common teaching strategy and it will shape the classroom practices of the future.

Integrating Games into the Classroom: ALICE Case

A key notion behind the EU funded ALICE (Adaptive Learning via Intuitive/Interactive, Collaborative and Emotional Systems) project is that whilst technological selection should always be driven by pedagogical need, adequate support is essential in providing educators with the tools and resources they need to perform effective blending. ALICE exploits a close integration between game engine (Unity) and learning content management system (Intelligent Web Teacher) to provide educators with the tools to both analyze learner behavior and performance in-game, and exact a high degree of control over the environment. By allowing the game's developer to annotate pedagogically salient content, information on this content is in turn communicated to the educator who can compose individual scenarios be enabling, disabling, and grouping content objects. Tracking of learner performance via XML reporting on meaningful actions also allows the educator to reflect on both individual and group performance.

Game Description and Learning Activities

The specific scenario addressed by the prototype within ALICE focuses upon training evacuation skills in schoolchildren. The developed prototype allows a high degree of customisability by the educator, with evacuation signs, interactive objects such as the player's possessions, and game elements such as the evacuation timer being capable of external run-time configuration. This functionality can be used either for pedagogical objectives, for example configuring a specific scenario containing a given learning objective, or for repurposing, extracted, and converting game content to different localisations. Through the use of Web-based services such as Google Translate, this repurposing can be taken one step further, with multiple translations of game content being provided without the need for access to the game's development environment or source code. Furthermore, the externalisation allows the educator access to game content, being able to adjust scripts for characters and other text-based game content through a simple text editor.

Teacher's Role

It is important to note that game-based interventions are rarely promoted as a complete alternative to an existing method of teaching and learning. To support the relationship between teachers, learners and the learning components within a game-based learning environment, it is desirable for games to complement a more traditional or formal methods of instruction through careful blending with an existing curricula and technologies. The ALICE game initiative supporting an educational programme around the area of civil defence, and specifically building evacuation demonstrates a technical integration of a gaming engine with a proprietary Learning Content Management System (LCMS). This approach aims to promote rapid interchange of game-based learning objects, as well as the application of existing methods for assessment or content creation, drawing further on the representation of the game as a reusable learning object; demonstrating the potential of positioning teachers as key actors in managing the learning content.

Findings and Discussion

Preliminary evaluation of the ALICE platform (Dunwell et al., 2011) demonstrated both the feasibility of the approach, and validated the ability of the platform to provide a usable resource to educators. Ongoing research is investigating the pedagogical value of the integrated approach, and

also identifying methods for addressing hardware availability and scalability. This is identified as a non-trivial issue: emerging generations of learners risk having far greater access to information technologies in their leisure time than in formal education, and both careful design and shifts in policy are required to address this. Furthermore, the notion of the "intuitive" learner is identified. Such learners learn by exploration, which can include deliberately performing incorrect actions; therefore, simply assessing the correctness of their in-game actions is of limited value in an assessment cycle. Models and methodologies facilitating a greater understanding of learners and how their behaviours correspond to levels of understanding and learning outcomes are thus a key area in future work.

FUTURE RESEARCH DIRECTIONS

Some teachers are said to avoid game based learning approaches because they are afraid to lose the control of the learning process. The approaches presented in this article are meant to strengthen and speed up teachers' opportunities to receive detailed information about the learning process and to integrate the gameplay effectively into daily classroom activities. With such solutions, teacher cannot only control the process, but he or she can use this information to master relatively large groups with numerous variances in skills. In future we should conduct robust research about the usefulness and effectiveness of game based learning solutions and clearly show how games can support learning as well as teachers work. For example, learning analytics will be a hot issue in the future and serious games provide engaging ways to collect the needed data and deliver it in understandable format to learners themselves, parents, and teachers as well as to actors that are considering reformation of the curriculum. So far, most of the analytics tools give usage reports, like times and frequencies. Such data sets are useful for IT department in order to check what content is used and what content can be removed from learning management system. However, such data is not informative for pedagogic purposes: pupil needs to know his/her strengths and weaknesses, parents and teachers need information on how to support individual child and curriculum developer needs to now the breaking points in competence development. As the studies shows, this can be answered, but not in old fashioned way by giving only usage reports.

CONCLUSION

It has been argued that we are moving towards a new generation of educational use of games. The third generation educational games stress the meaning of the teacher in game based learning by expanding the scope of the games from just playing to learning and teaching. The aim of this paper was to uncover the opportunities that third generation educational games can provide and raise discussion about teacher's role in game based learning. In this paper, teacher's role has been approached from several perspectives. We described five game based learning solutions that have been designed according to learners' and teachers' needs. The examples show that there are both computational and non-computational methods that can be used to support learning and teachers' work in the game world.

Unfortunately, games that exclude the teacher from the game based learning process dominate the markets, which is of great concern. Thus, the aim of our research has been to study the use of novel game features that enable teachers to participate in game based learning events. The hope is that the research on the potential roles of teachers in game-based learning would awake the educational game community to take more user centered design approach. In fact, it has become evident that if we want to support the diffusion of game-based learning and maximize the effective-

ness of educational games, we have to support both learners' and teachers' needs and goals.

However, the question still remains, why the teacher is usually neglected when designing educational games? Maybe one of the problems is that when game designers focus on fulfilling the demands of the curriculum, they try to make games that simply teach the subject without teacher's 'touch'. When a teacher is forgotten from the concept, we cannot expect that teachers take these games into the classrooms. Games just do not provide enough added value for them. On the other hand, the research has shown that one of the major barriers that have blocked the diffusion of educational games into schools is teachers' prejudices and negative perceptions about game based learning. Thus, it is not self-evident that although the games would rely on characteristics of the third generation educational games, they find their way into classrooms and are actually used in teaching. Thus, a lot of work is needed to change the negative attitudes and to win the trust of teachers. To achieve that, we need plenty of well-designed game examples, robust research about the effectiveness of game-based learning and good pedagogical models and support.

Finally, we argue that without binding games into the curriculum and highlighting the importance of the teacher the games will not be fully integrated into the classrooms. Eventually, the teacher decides whether the games are used in the school or not. In fact, the classrooms have not changed during the past century—teachers have: Teachers are more open to new ideas and solutions that support learning needs and pedagogical practices. Thus, the new teachership is about taking the advantage on new, and pedagogically meaningful, tools. The educational games have to master these two goals. Without a strong support to pedagogical use and evidence about learning outcomes, the educational games will not be integrated into classrooms or into the curriculum. Now, it is time to convince the educators about the possibilities that game based learning approach provides—so teachers' can take a step towards a new teachership. Lastly, we want to stress that educational game community does not have too many chances left—maybe the next strike could be too much for game based learning.

ACKNOWLEDGMENT

This work is partially funded under the European Community Seventh Framework Programme (FP7/2007 2013), Grant Agreement nr. 258169, and supported by the European Commission under the Collaborative Project ALICE "Adaptive Learning via Intuitive/Interactive, Collaborative, and Emotional Systems," VII Framework Programme, Theme ICT-2009.4.2 (Technology-Enhanced Learning), Grant Agreement n. 257639.

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KEY TERMS AND DEFINITIONS

Conceptual Change: Conceptual change is the phenomenon in which person's thinking changes radically.

Game Authoring: Game authoring is a process of creating, arranging, and structuring content and rules in an interactive game development environment that does not require programming.

Illusion of Understanding: In illusion of understanding a learner recognizes some familiar elements in the new phenomenon, but learner's knowledge is not adequate for paying attention to the novel aspects of phenomenon, which leads only to an enrichment of naïve thinking.

Learning by Developing Games: Learning by developing games is a pedagogical strategy in which students create their own games.

Teachable Agent: Teachable agent is an intelligent software component that is capable of learning.