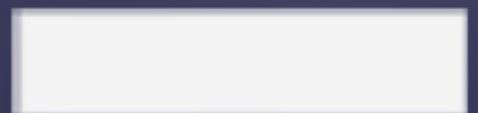
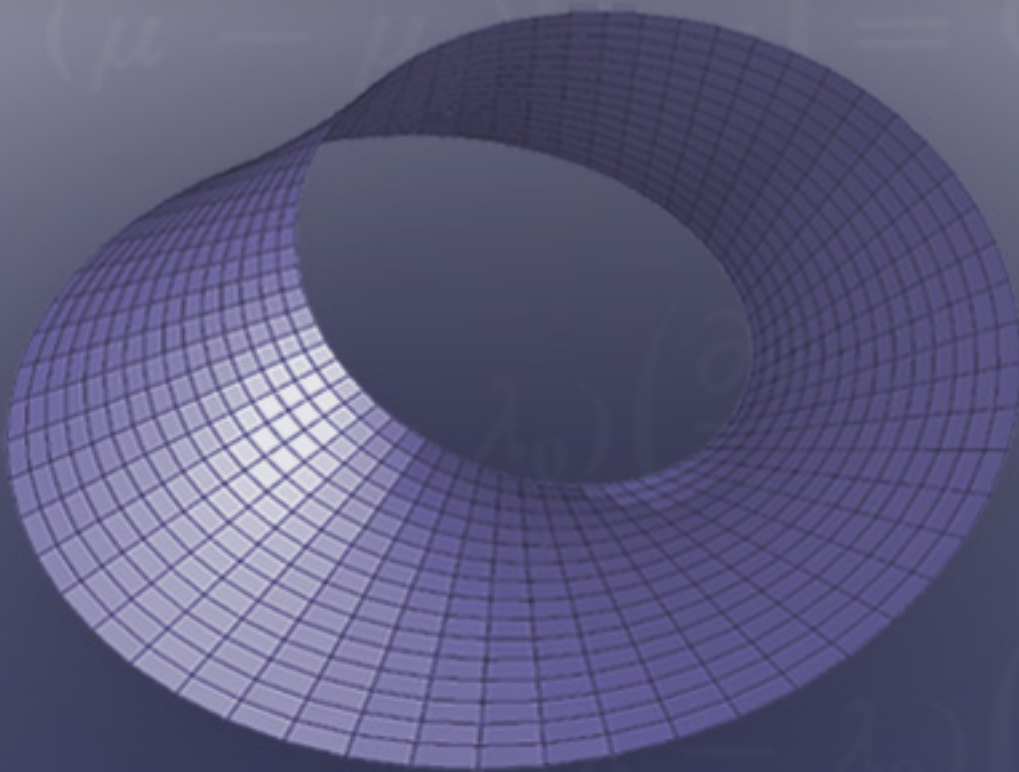




Applying digital game based learning solutions
to the primary and special classroom:
results from field studies



Applying Digital Game Based Learning solutions to the primary and special classroom: results from field studies

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Abstract: This paper documents a number of small-scale DGBL pilots designed and applied in classroom settings by primary education teachers, as practical assignments for a course within the MSc Program "ICT in Education" jointly run by the National and Kapodistrian University of Athens, the University of Thessaly and TEI of Pireaus, Greece.

The first pilot concerns a game-based application on geography topics comprising 5 prototype DGBL implementations developed with tools such as GameMaker©, Macromedia Flash© and Microsoft PowerPoint©. The study took place on a primary school classroom and employed participating observation, focused discussion and questionnaires to evaluate learning scenarios that implicate DGBL, students' attitude and practical restrictions that should be taken into consideration, reporting a success story overall.

The second case involves the application of DGBL material in a classroom of 11 children with serious mental disabilities, in order to investigate whether digital games can provide a pleasant and effective means of learning for children with special needs such as learning difficulties, mental health problems, specific physical and/or developmental disabilities. This pilot has highlighted a number of interesting practical application issues such as game usability, cooperation amongst students as well as amongst educators.

The third DGBL pilot study, concerning the subjects of "History" and "Study of Environment" at the fourth grade of a primary school of Athens with the use of DGBL applications, was designed and created solely by the educators (using Hot Potatoes and Eclipse Crossword software) who applied it effectively in a 4th primary school classroom, having total control on the creation of the game and on the actual application.

Finally, the fourth pilot was realized in two different classrooms, based on color and number games for 6-7 y.o. students and arcade math games for 7-8 y.o. ones, all implemented by the educators. Apart from field observations regarding the limitations and possibilities of DGBL activities in-class, this study has resulted in a number of demographic and qualitative observations regarding students' attitude towards DGBL. These results will be documented, together with the discussion of the overall outcomes of these case studies and the overall experience of DGBL literacy for teachers, as well as their experience on game implementation, design and application of game-based lesson plans in a real classroom setting.

1. Introduction

One of the main issues that digital game-based learning (DGBL) researchers encounter is the actual integration of DGBL solutions in the classroom reality, the main reason for this being not the deficiency of suitable gaming products but the lack of awareness of educators regarding the potential of educational use of games.

Even though Education, Media and Game Studies reveal the potentials of game-based learning, the practical reality in the classrooms differs. More research, as well as more effective supporting materials is needed to support practitioners wishing to use game-based learning effectively (Freitas, 2006). Game design should acknowledge the role of the teacher (Becta, 2001, p. 6) as well as facilitate the teacher's meaningful intervention (Lawry 1994), or else any learning success is jeopardized.

Taking in consideration these issues, we realized that the educator should play a more integral part on the DGBL procedure. Instead of being solely the final mediator between the game and the student, the educator should be the designer and implementer of the game having thus full control of the gaming experience in the classroom.

This paper, documents a case report of 4 DGBL pilot projects designed and applied in classroom settings by primary education teachers. These field implementations and studies were practical assignments for the course "Design and creation of Digital Applications" for the academic year 2007-2008. The course is part of the Joint Masters (MSc) Program "ICT in Education" jointly run by the National and Kapodistrian University of Athens, the University of Thessaly and TEI of Pireaus, Greece and is addressed to primary education teachers with main interest in ICT, digital media and especially in digital games.

The educators designed the DGBL procedure, designed and implemented the games and chose their additional sources. They were in total control of the practical issues during classroom usage and they made small scale research during the DGBL experience of their students. They were free to design their own applications and conduct different types of studies depending on their teaching experience and approach. Following, these four DGBL cases will be described separately, highlighting for each one, the design process, tips towards educators and issues raised during the overall gaming experience as well as some findings.

The focus of the paper is to examine the way these DGBL interventions were designed and implemented by the educators as well as to present some of their findings, in order to highlight their thoughts and attitude towards GBL practice in an actual classroom. Therefore, the contribution of the paper lies more on highlighting the multiple issues involved in bringing DGBL into the classroom and animating DGBL-based activities as well as the often unexpected obstacles that need to be overcome. In this line of thought, success as well as failure stories are equally important in acquiring lessons about how DGBL can be prepared and applied in-class. Still, the limited number of pilots reported in this paper allows to bring to light interesting findings rather than definitive conclusions, which clearly calls for further extensive research.

2. Lesson of Geography at the Fifth Grade of Primary School through the use of digital games

2.1 Case Study

The first DGBL project was designed and implemented by two educators for a geography lesson at the 5th grade of Primary School. The study took place on a classroom of 20 primary school students and employed participating observation, focused discussion and questionnaires to evaluate learning scenarios that implicate DGBL, students' attitude and practical restrictions that should be taken into consideration.

2.2 Planning and Application of the Intervention

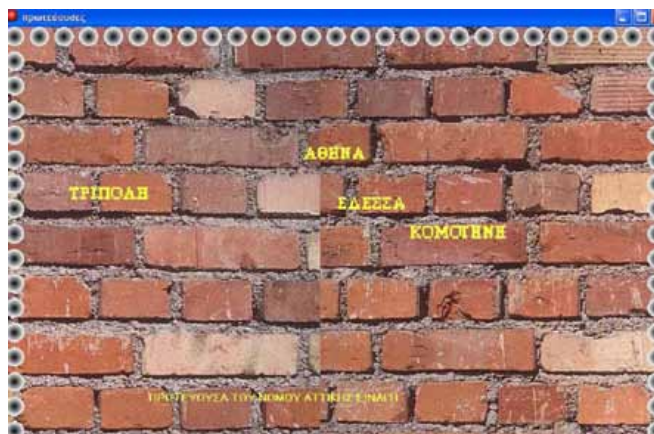
The educators, while preparing the project, tried to precisely determine all the factors that were to be taken into account in order to achieve the best possible organization. Therefore, they created *digital reporting material* supporting the area of knowledge they were about to teach, in particular – the prefectures of Greece and their capitals. The project included, original material that offers a variety of games as starting from servicing the purpose of “learning” to those mainly aimed at “playing”. Thus, they created five game-based applications, two in Microsoft PowerPoint©, one with Macromedia Flash© and two with the GameMaker© toolkit.



Picture 1: In this flash game called the “Dragon Capital”, created with Flash, the student should match the correct prefecture with its correct capital and in the end the game would teach the correct matches to the student.



Picture 2: “Shoot the city”. A game created with the GameMaker© toolkit. Students should “shoot” the correct capital of different prefectures.



Picture 3: “Chase the answer” is a quiz game with a twist, the student should find the correct answer and quickly chase it around the screen when it moves quickly along with other wrong answers.

Since it was a pilot study, the educators decided to explain to the students that their participation in the application did not have to do with any kind of evaluation and that the objective was for everyone – teachers and pupils alike - to have fun and good time, while practicing a free activity that would not have the character of a school lesson, i.e. its commonly negative aspects and features. That is the main reason why they decided to conduct the activity during the two hour period of the “flexible zone”, i.e. the zone, dedicated to educational activities that are not obligatory within the formal curriculum, trying in to avoid all kinds of interference from the formal educational activities of the school as well as to introduce the project into the right institutional frame.

The structure of the particular school unit considered relatively satisfactory, though it does not have IT trained staff; therefore the DGBL attempt required considerable personal efforts and work to successfully install the applications.

Their next step was to prepare the *curriculum* that would define the correct timing of every activity demanded by the project (making provisions for any unanticipated events) and inspire the participant students. That is the reason why they decided to provide special prizes to the winners, thus giving the project a competitive character. Afterwards they determined the instructional and training objectives of the project. Finally, they defined the roles that they would undertake in the class during the roll-out of the activity; the first educator undertook the roles of teacher and animator, while the other would participate as an observer and evaluator of the whole process.

In order to achieve better monitoring of the project, the educators created *an original protocol of monitoring and evaluation, a premeditated picture of the basis*, which they prepared following the study of relative bibliography as well as applying their own thoughts and discussions, thus focusing on various aspects of the project that were to be monitored.

Finally, they considered it useful to prepare a *questionnaire* addressed to the pupils, quite a brief one, containing questions that they regarded as essential, focusing on the essence of the evaluation made by the pupils themselves.

2.3 Conclusions

The intervening educators in their report made the following remarks, regarding DGBL in a real classroom environment:

- The infrastructure of the School, as far as technology and human resources are concerned, constitutes a critical factor that may encourage or discourage a teacher to undertake the project in question; therefore, the personal organization and synergistic

- mentality of every one of us make a decisive contribution to undertaking of such innovative activities.
- Good knowledge of modern pedagogic perceptions and the ability to implement them in the class can define, to a great degree, the success of such a project.
 - The almost certain collision between the rigidity of formal curriculum and the time restrictions of the teaching hour can be overcome through efficient use of educational frames such as the "flexible zone".
 - The time at disposal was definitely limited for the correct and unhindered application of the five games in question. Should these be presented during an additional teaching period, their efficiency might increase.
 - The field work within the frame of such a project as a lot of groups of pupils are in front of the PC monitors presupposes the creation of a *data base* supporting detailed observation of their attitudes and behavior, a rather complicated process that requires the collaboration of other colleagues as well as the consent of institutional directors.
 - The unfriendliness of public education towards the promotion of innovative projects such as the teaching and learning through the use of digital educational training games, is an important factor.

According to the educators the experience in developing the GBL applications, planning of the lesson and deploying it in the classroom was fruitful. On the other hand, the difficulties faced during the application of this project, were substantial and, in some cases, complex. By all means, such an educational proposal cannot yet constitute everyday routine in the educational practice; however the educators strongly believe that, as the pilot testifies, the process of learning should include GBL in order to augment satisfaction and motivation amongst teachers and students.

3. Designing and implementing DGBL in a Special Educational Needs school

3.1 Case study

The next study is a pilot observation in order to investigate if digital games can constitute a pleasant and effective way of learning for children with special needs such as learning difficulties, mental health problems, specific disabilities (physical or developmental).

The trial application was materialised in the Special School of a provincial village in an effort to investigate if teachers and students of a formal provincial school are familiar working with ICT.

The special school in question is located in the same area with the primary school. There are 4 teachers and 12 children from 4 1/2 to 14 years old with special educational needs. Most of the students were familiar with using computers since their school curriculum includes a special course about PC, whereas two of them had their own personal computers at home.

3.2 Planning and Application of the Intervention

The DGBL experience took place as a parallel activity to the school program and its duration was 10 hours in 5 days. As for technical considerations, the school possessed an IT laboratory with 4 computers and an internet connection. The intervening educators decided to use specific games from web pages and edutainment software which are in accordance to the National Curriculum for children with SEN, and they also developed their own games using Macromedia Flash© and Microsoft PowerPoint©.

The two intervening educators applied a pilot activity based on digital games in accordance with the formal objectives of the curriculum designed for SEN students. The basic goal was to make the students feel free to participate, have fun playing without any pressure or the fear of evaluation from their teachers.

The intervening educators' role would be clearly the role of animator and instructor in order for the students to play the games. They expressed worries regarding students' reaction with persons that they were not familiar with, and they also didn't want to disturb the daily school routine; so it was decided to visit the school and materialise the application in hours separate from the daily educational timetable in order to minimize unwanted side-effects.

The socialization objectives of the trial mainly had to do with enabling students to express themselves as well as communicate and collaborate with each other during gameplay.

The learning outcomes of the DGBL trial were oriented towards both cognitive and social educational objectives. As far as the cognitive objectives of the trial are concerned, games were chosen that would help students learn to:

- make addition and subtraction,
- recognize primary colours,
- measure and calculate money,
- put pictures in order /time sequence,
- group and distinguish objects in categories.



Picture 4: GBL Software “Round with Value”, was chosen and used by the educators regarding curriculum areas of money, value, logical decisions



Picture 5: “Emotions” was created by the educators as a medium of recognizing emotional states

The special school provided a warm reception for the project; the students showed great appreciation, however the two intervening educators faced certain problems:

- a) concerning the technical equipment; malfunction of one of the four computers in the school laboratory, special keyboards with latin characters that could not be recognized by the children, lack of utility of special levers installed and on the other side,
- b) concerning the cooperation with school educators; one teacher’s refusal to allow 3 students to participate saying they were not capable, teachers’ minimal knowledge of computers’ use, existence of only one teacher eager and available to help the intervening educators, frequent absences of children, due to illness and other problems.

The intervening educators' initial approach for organizing the trial, was to group the children per case. This was proved rather difficult and in most cases could not be realised. Thus, in agreement with the class teacher, the intervening educators decided to occupy each child in individual sessions.

During the application, the intervening educators recorded for every student, information such as age, cognitive and emotional condition, duration of playtime, games played and reactions, achievement of objective with or without help, preferences, difficulty or facility playing the games and general observations that seemed to be significance. 9 out of 12 students of the school were finally able to participate in the trial application; 6 of them played all the games, while the 3 remaining students played only games for learning colours.

3.3 Conclusions

According to the intervening educators, the most impressive observation during the entire trial was the eagerness of the children; they waited their turn to play without causing any trouble in order not to lose the opportunity to play. The teachers stated that they had not seen the students so calm except for the time they waited in order to play.

Generally the students showed a big interest and a strong will to participate no matter the errors they made. Students did not react negatively in failures during gameplay and despite problems they might face during this experience; they still wanted to be "exposed" in playing. Most students needed help but they were able to finish the gaming sessions successfully, getting better and better players after each session.

As for the school teachers, the application confirmed in certain cases their estimates for the knowledge and the capabilities of their students. However it seemed that in some cases, even though they were friendly to the whole idea of these gameplay sessions, they did not have an interest for the actual experience of their students. Sadly it seemed that the trial application constituted a rather good excuse for their absence from the classroom.

The intervening educators have considered this trial application to be a quite limited that does not allows to reach some indisputable conclusions; however, in this particular case, the use of digital games in the education of students with SEN has seemed to confirm some initial expectations, concerning both the benefits and the problems of this attempt:

- a) the training process became enjoyable
- b) digital games functioned as challenge, activated the children but simultaneously highlighted capacities and issues that the local teachers had not perceived.
- c) school teachers showed ignorance and lack of interest in using ICT tools as an instrumental part of the educational process.

4. Applying DGBL in the subjects of History and Environmental Study

4.1 Case Study

The research took place in a 4th grade class of a primary school located in Athens. The educators worked with 18 children, 9 girls and 9 boys. The teacher of the class was one of the three intervening educators, so she was the one who initially informed the students about the first details of this activity.

The overall process began with the statement to the students from their teacher that in the next school test concerning the subjects of "History" and "Study of Environment" the established process of evaluation would not be done in the usual - traditional written way but carried out electronically in the computer laboratory of the school.

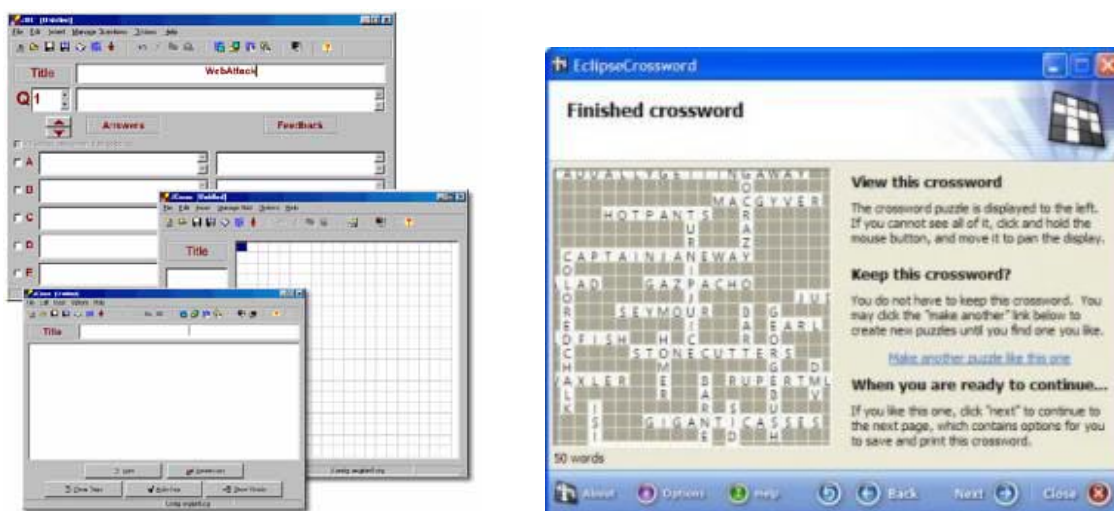
From the first moment, the educators stressed with particular emphasis that this specific activity would have the character of a game and would be not bear any grading significance or evaluation.

4.2 Planning and Application of the Intervention

The meeting with the students had been programmed for the second period of the daily school schedule (10.00 - 11.45 a.m.). Some days before, the educators had installed in the computers the digital games that they had created with two specific tools.

The first tool, named "Hot Potatoes", is available as open software with which can be used to create exercises of various forms for use either via internet or on a standalone computer. The tool produces puzzles created in a particularly friendly way and is free for non commercial educational aims, under the additional condition that the relevant exercises are also made available at the internet (details at <http://hotpot.uvic.ca/>). The educators created interactive multiple-choice and matching and ordering exercises with educational content concerning "History" and "Study of Environment".

The second tool employed was "Eclipse Crossword" (details at <http://www.eclipsecrossword.com/>). It is a program with which somebody can create crosswords fast and easily. The educators provided questions and answers, declared the size of the crossword horizontally and vertically and finally, they had the possibility to choose a specific form of the crossword among various templates. Following these choices, the crossword was automatically generated by the tool.



Picture 6: The softwares "Hot Potatoes" and "Eclipse Crossword", were used by the educators in order to create puzzles and crosswords.

On the trial day of application the educators were present at the school earlier than the second period of the school schedule to check the final details in the laboratory. Concerning the interior of the classroom, there were ten desks arranged in "П" form, with a desktop computer installed on each desk. Unfortunately, two of the computers installed were out of order so the educators had to replace them with their own laptop computers. The teacher of the class brought the students in the laboratory and put them in pairs in front of each computer. They did not allow them to seat accidentally, because they wanted a specific composition of each team: a "good" student and a "bad" one. Initially, certain reaction were noticed on behalf of the students, but finally the students accepted this arrangement.

During the whole process, the children behaved with responsibility and big enthusiasm. They showed that they had fun and that they regarded the whole activity as entertainment. Generally speaking, the educators noticed no behaviour or cooperation problems.

4.3 Conclusions

Following completion of the trial application, the educators considered important to discuss with the children about this experience (oral productions). Generally speaking, the students showed enthusiasm and demanded repetitively if the evaluation process would take place in the same way again. The educators quote some of the students:

- "I liked it, because it was like a game!".
- "Playing with the keyboard has fun, because the fingers are shaken!".
- "It was nice, because I heard the sound of the keys!"
- "When I write with the pencil I am tired, while it is easier when I press buttons!".
- "I am not afraid that I will make a mistake in the spelling!".
- "You don't shout for the bad letters!".
- "Are you sure that you won't take it into account for the semester?".

According to the educators, students showed particular interest with regard to the use of new technologies in the classroom. From the beginning they were informed about this innovation- as they would say- and thus they continuously asked for more details. They expected with enthusiasm this clearly different activity and at the same time they talked about their experiences concerning the use of computers out of school for entertainment.

It seems that usage of new technologies has strengthened the motives of learning in the classroom, judging from the reactions of children before, during and following the trial application. The educators received many questions regarding when they will work again in the same way and if they foresee something equivalent concerning the other subjects.

According to the educators that designed and applied the DGBL trial, the use of computer games as part of the educational process gave to the students and to the educators themselves alike, the joy to escape from the stereotyped frames of traditional teaching. This particular intervention strengthened their thoughts and opinions the need for more systematic deployment and regular introduction of similar applications in the educational practice or even creation of DGBL exercises with the help of the children themselves. The educators claimed that there is no doubt that they will use again digital software in the educational process. However, they will stress the dimension of playability, emphasizing more on graphics (static and moving picture, sound, intense colours, rewards) than the written text.

5. Applying DGBL color and number solutions to the primary classroom: facts and issues

5.1 Case study

The following pilot study was realized in two different classrooms, based on prototype colour and number flash games created for 6-7 y.o. students and arcade math games for 7-8 y.o. ones, all implemented by the educators.

Sample: 24 pupils 6-7 years old. 30 pupils 7-8 years old.

5.2 Planning and Application of the Intervention

Before the installation of the games into the school lab, a demo presentation of them took place into the classroom by the use of video projector, in order for the pupils to realize the structure of the game and the way of playing.

During this presentation detailed instructions were given. Pupils played a trial game into the classroom in order to become more familiar with it and enable the educator to trace possible problems in the procedure of playing.

The GBL activity was implemented apart from class hours, and its duration was divided into two sections: six hours for preparation and six hours for application into the School IT laboratory.

In the first two hours into the lab, pupils were separated into three equally sized groups of boys and girls. Every child was asked to play and get familiar with the game in order to become the best player. The whole procedure aimed to enforce the pupils' interest and create intention and competition for the game. In the second and third two-hour sections, teams of boys and girls competed separately in order to end up with one leader in each team (best player). Finally, the two leaders competed to come up with the best player of the classroom.

At the end of the activity, each pupil completed a questionnaire and was interviewed, in order to arrive at some certain conclusions about students' attitude towards DGBL.

5.4 Conclusions

Almost all children were enthusiastic about the games they had played, understood the training objectives, but also the skills they acquired. They also understood their mistakes and asked themselves to have the specific games available at home. Collaborative learning seems to have been reinforced through playing and finally the game seemed to work as an inner learning motivation.

The evolution of the activity and the personal experiences of the educators concluded in useful findings in order to end up to successful future efforts. According to the intervening educators, the choice of suitable digital games for small primary school classes should be exercised with the following criteria:

1. Easy understanding and usage of games
2. Clearly outlined objectives
3. A character of free activity for the entire application scenario
4. Positive rating rewards with possible mild penalties for understanding the errors

The key to a successful outcome for intervention is the best preparation of students by teachers. Some recommendations in this respect, based on the findings of the report trial, include:

1. Demo presentation of games in the classroom or lab PC, prior to implementation of the trial.

2. Each student should play the games in order to identify potential problems
3. Taking stock of commonly accepted among students (mainly boys-girls) to organize competition
4. The number of teaching hours, both for the preparation and the execution of the application, should be flexible and in no case restricting to students in terms of playing.

The initial stage of this project, the preparation of the application, seemed to be the most important one. It was designed in order for the pupils to learn playing these games and act quickly and in the right way facing challenges (e.g. achieve the best score so as to be recognized as the best player). The experience showed that although 6 hours of teaching were dedicated for the preparation of pupils and for tracking down their difficulties, maybe we should have given pupils more time to learn this application, play better and achieve higher scores.

Last but not least according to the educators, a fairly big difficulty is to evaluate students in the games: there should be a distinction between skills and knowledge, if there was something to change in the design of the study, this could be the way of evaluating the relationship between performant student and performant player.

6. General Conclusions and Considerations

6.1 Findings

According to all case studies, the training process became enjoyable, while DGBL functioned as a motivational challenge, which activated the students and engaged them in the learning process. In some cases problems were identified that school teachers had not perceived before, regarding students' attitude or emotional state.

Most of the educators involved in these trials stated that the experience of developing games has proven to be a particularly creative one, so much so since apart from the development of the games they also had to devise an accompanying fantasy and plot. All educators involved in the trials were more than positive on using DGBL in the near future not only as a motivational medium but as an educational one as well.

It was very interesting that all educators decided to use the GBL applications without any impact in marks. Still they all mentioned that they made correlations between the gaming and educational performance of each student, and they all made comments about how students with moderate performance were highly motivated when in the GBL session.

Even though the scope of this study was to investigate practical applications of GBL designed and implemented solely by educators, rather than presenting the educational benefits of GBL to primary school students, the educators were convinced that GBL can be used not only as an one-off extravagance for the students but also as part of the normal curriculum, adaptable into learning scenarios with a reasonable amount of effort.

6.2 Critical success factors

According to the studies, inclusion of such pilot interventions in the educational program should be designed in terms of minimizing the burden of students.

Teachers should pay particular attention to the expectations of students' attitude regarding electronic games or their ability in playing them. Moreover, it was mentioned that children should be trained in educational gaming as well, even if this means a simple set of rules. It is proposed to arrange such activities in a separate time slot, in order to avoid problems in the flow of the daily curriculum. In any

case, the key to a successful outcome for intervention is the preparation of the educators and students alike.

However, the attempt to integrate GBL into the classroom by its educator requires a systematic effort when the games in question are oriented towards educational purposes. Different types of knowledge and skills on behalf of the educators should be combined:

- profound knowledge of pedagogic theories and perceptions,
- the ability to effectively plan and implement the educational application of the game in the particularly limited and demanding time frame of the daily school timetable;
- the ability to devise games that are
 - adapted to the intellectual, psychological and emotional profile of the pupils' target group
 - attractive and engaging for the pupils
 - able to effectively meet educational objectives.

All the aforementioned factors make the work of the teacher, who engages in creating a digital game-based educational experience a successful DGBL application, extremely complicated.

According to the intervening educators, it was important that the children did not pay attention to the clearly educational aim, but to the dimension of fun and the “disturbance” of school routine. This conclusion was presented on almost every single case study, highlighting the importance of funability and a “hidden learning agenda”.

6.3 Open issues

According to the educators involved in this study, an important factor is the lack of support on behalf of public education for the promotion of innovative projects, as well as the sub-standard IT literacy of educators who seem hesitant to learn new methods. Moreover, an equally important parameter for success is the focus on explicit and evident objectives and the ability of the educators to adapt games according to their students' needs and abilities.

Educators seem to be responsible not only for the proper usage of the game, but also for the selection of games of suitable quality and adaptability to their learning scenario and goals. As noted by (Kirriemuir and McFarlane, 2004) “The games development industry needs to understand the constraints on schools, teachers, parents and above all children, of time, resources, and the requirements of curriculum and examination if games with more direct educational value are to emerge”.

However, DGBL success is not only a matter of knowledge but a question of approach as well. According to a research made by John Kirriemuir one of the main obstacles faced is “an almost totally negative media impression of computer and video games influencing the opinions of school teachers, heads and parents” (Kirriemuir, 2005). This follows up from a fact already observed by Dorn (1989) who states that the attitude of the teacher towards games influences the outcome, and the teacher's knowledge and skill in using games are also an important factor.

In the trials reported herein, in one case where the classroom educators were not part of the implementation process they showed a lack of interest in the educational outcomes of the study. The intervening educators who designed and implemented the gaming experience made referrals of unawareness and indifference from the part of the classroom educators towards the experience of their students, which is only to be expected since local teachers were not positive regarding ICT and DGBL.

Finally, the educators involved in the above trials all seem to conclude that research should turn to the development of tools and educational software which will be based not so much on behaviourism but on interactive models of learning. To achieve this goal it is clearly required that experts from technology and education work together. The profits from such an experience are of tantamount importance for the quality of their educational process as perceived by the children, in order to change the picture of the tedious and boring classroom to that of a school that creates real motives and can directly address the children's interests.

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