Exploring support mechanisms for learners at-risk through a coupled game environment

Abstract. Dropping out of the schooling system is one of the prevailing problems placing youths at-risk. With this paper we propose possible support mechanisms for learners at-risk by analysing the characteristics of a coupled game. We provide a detailed description of an educational setting that is directed at supporting this target group and evaluate its individual design elements with regard to learners’ attraction to the game environment, their motivation to deal with learning content and the knowledge gain. Study results suggest that the pattern Coupled Games as realized by way of SMS interventions provides chances to support the target group.

Keywords: pattern approach, coupled games, pervasive games for learning, SMS notifications, learners at-risk

INTRODUCTION

For any individual, educational participation provides the base for socio-economic stability. However, for one in seven young Europeans, early school leaving (ESL) is one of the main educational challenges (Monné, 2012). Early school leavers strongly face the risk of lacking essential skills and eventually periling conceivable periods not in education, employment or training (NEET). Their dire need to develop basic qualifications and skills often comes along with other “barriers to learning” such as low motivation or behavioural problems (Simmons and Thompson, 2011). These are factors usually referred to when describing general characteristics of ‘the learner at-risk’. However, such a clear and definite outline is rather perfunctory and falls short of the multilayer factors that spot the individual. Manning and Baruth (1995) list a multitude of conditions that can place learners at-risk for educational difficulties such as school conditions (e.g., inappropriate instruction or hostile classroom environments), societal factors

(e.g., society’s tendency to be racist and sexist, discrimination against culturally diverse groups) or personal causes (low self-concepts, lack of motivation or problems with drugs and alcohol).

Since the late 1980s, educational research has started to increasingly focus on the many circumstances that may place youths at risk and numerous educational programmes have been implemented to counteract this trend, e.g., Entry to Employment (E2E) programmes (Simmons and Thompsen, 2011). Integral to most of the programmes is the provision of alternative learning environments that are assumed to meet the needs of learners at-risk. Instead of providing continuously “more of the same”, i.e. more homework or more reports, which is rather prejudicial to learners at-risk (Manning and Baruth, 1995), alternative learning environments allow for new experiences, outside the traditional classroom setting that comprise different forms of cooperative learning and make way for individual learning styles, for example: a description that can almost comprehensively be applied to pervasive games for learning. In general, the aspect of mobility in learning has been considered useful for the process of teaching and learning (Garrido, Miraz, Ruiz, and Gómez-Nieto, 2011; Klopfer, Sheldon, Perry, and Chen, 2011; Sánchez and Olivares, 2011) and especially for this particular target group. As Traxler (2010) points out, mobile devices provide chances to counteract social exclusion by offering low-threshold learning opportunities for students ‘unfamiliar with and lacking confidence in formal learning and its institutions, e.g., the homeless, gypsies, marginal groups, and NEETs’ (p. 132) and support those who have special potential for physiological or cognitive development. For such students, mobile devices provide chances to get out of the ‘educational mold’, which is expected by some educators but by far does not fit all learners (Manning and Baruth, 1995).

Regarding pervasive games for learning, they provide motivating, low-threshold learning opportunities and enable the creation of situated learning scenarios that enhance encoding and recall (Klopfer, 2008; Specht, 2009). Cordova and Lepper (1996) in their research have already emphasized the importance to embed learning in a context of genuine use. Contextualization,
according to their findings, can lead to substantially greater comprehension, retention, confidence, and subsequently learning. Pervasive games too, embed abstract learning activities in meaningful and appealing contexts by using existing mobile technology (Specht, 2009). Context-aware systems, for example, enhance the real world and enrich the learning experience by increasing the precision of information retrieval or making user interaction implicit; and with the further personalization of these aspects, the educational benefits can even be reinforced (Cordova and Lepper, 1996).

With this work we aim at contributing to current research in the field. Our study is directed at understanding how pervasive learning games may support learners at-risk. In the context of our ongoing research into game design patterns we more specifically focus on the effects of Coupled Games as one mechanism of pervasive games for learning. In our scenario, the game coupling comprises (a) short messaging services (SMS) notifications, which we designed as a quiz and (b) a PC-based browser game.

Thus, this paper has three objectives: (1) to outline the exemplary design of a pervasive game scenario that makes use of the pattern Coupled Games by way of an SMS-based learning scenario, (2) to present data from an empirical study that investigated the learning outcomes of such a scenario for learners at-risk and (3) to discuss resulting design issues of pervasive games for learning based on the pattern Coupled Games.

REVIEW OF RELATED LITERATURE

In our approach to pervasive games for learning we use SMS as a game element that pushes the boundaries of the coupled browser-game. Before we outline the design of this scenario we look at the use of SMS in related literature.

Even though using SMS technology is a comparatively old concept, practitioners and academics are looking at the design and impact of SMS for teaching and learning (Brett, 2011; Ziden and Rahman, 2012; Lim et al., 2011; Santos, 2010). Research into this field argues that students’
familiarity with this type of conversation (Attewell, 2005), the minimal disruption it causes (Horstmanshof, 2004), the potential of SMS for interactivity or the low-threshold access it provides with regard to learning and technology (Markett et al., 2006; Kim et al., 2006) are favourable for using it in an educational context.

One distinctive criterion for success is the individualisation and target-oriented personalisation of messages. Crabtree et al., (2007) in their report on the mobile game Day Of The Figurines, evaluated the use of regular SMS as the main interface between the players and the city. Findings from their study indicate that the success of the game relies on the ‘orchestration of messaging by behind the scenes staff’ [p. 42]. This, for example, includes ‘categorising messages so that appropriate next actions can be taken, which relies on interpretive work to make sense of messages’ [p.42] or crafting and shaping response messages to make them fit to the individual player.

The study by Santos (2010) showed that using SMS in the classroom encourages students’ further thinking and exploration of course topics outside class time and Carvus and Ibrahim (2009) report that using SMS effectively supports students learning of new technical English language words. Also, Harley (2007) stresses that text messages facilitate the development of productive relationships for those who would otherwise be socially isolated. A study on the impact of short messaging service on students’ self-regulated learning strategies argues along these lines. It suggests using the principles of persuasive technology for sending SMS messages especially for the high risk students (Goh, Seet, and Chen, 2011). The study shows that students who received persuasive SMS intervention performed better than students who did not receive any SMS intervention. Additionally, the study demonstrates a positive impact of persuasive SMS on students’ learning and suggests that the intervention is able to improve students’ self-regulated learning effort. Findings from the learner research in the course of the m-learning project support this (Attewell, 2005). The report emphasises the potential of mobile learning
scenarios to attract young people to learning and especially to involve some of the hardest to reach and most disadvantaged young adults in learning.

When using SMS in class concerns with regard to costs for receiving and sending out SMS, learner focus and attention or intrusion into personal time (Brett, 2011) have to be well considered. However, they should not hinder the use of SMS in the classroom. ‘A pedagogically supported use of SMS within classrooms may allow for low-cost implementation of real-time, text-based interactions and put an end to the familiar refrain of “turn UR mobiles off” (Markett et al., 2006).

Despite the use of SMS in class is being reported effective, little is known about effective message design and the principles that make the use of SMS successful. The paper by Yengin et al., (2011) provides a detailed analysis of the technology used for SMS and gives examples of different research studies of successful implementations in education, but gives no explanation for the stated success by defining guidelines as for example the paper by Wang and Shen (2011). They have defined an initial set of design guidelines, which describe the principles and processes of message design. Still, with regard to the benefits and drawbacks of text messaging as an accepted educational tool, further research is needed that evaluates the role of text messaging or the impact of long-term use on youth literacies (Porath, 2011).

In the following we describe a game scenario that employs SMS interventions in the form of a quiz. The quiz is coupled with a PC-based browser game for learning.

**EDUCATIONAL INTERVENTION**

For our study on the educational potential of pervasive games for learning and the support they may provide for learners at-risk, we coupled the already existing browser-based multiplayer game *BauBoss* with a mobile game extension. In terms of game design patterns we thus realised the pattern *Coupled Games*. ‘Games are coupled if they share some amount of player accessible data. They always refer to at least two games. A single game cannot be coupled. The coupling
occurs when the games in question share some data. This can be anything from player specific data, gold coins, to the actual world where the game takes place’ (Davidsson, Peitz, and Björk, 2004; p. 16). When referring to game design patterns, we always allude to the list of patterns provided by Davidsson et al., (2004). They identify mobile game patterns by a core definition, a general definition, example(s), descriptions of how to use the pattern (by listing related patterns or patterns that can be linked to it), the description of its consequences, relations with regard to instantiation (patterns causing each other’s presence) and modulation (patterns influencing each other), as well as references.

Figure 1 and 2 illustrate the multiplayer PC-based game BauBoss. It was developed to foster the acquisition of skills and abilities of learners at-risk in using commonly used application software (Schmitz and Czauderna, 2011). The development was based on the assumption that when games appeal to students, playing them will enhance their intrinsic motivation to learn and thus improve learning (Charsky and Ressler, 2010).

Czauderna and Erlenbusch (2012) evaluated the digital learning game BauBoss in a field study. In the course of this study, participants’ were offered five moderated gaming sessions to play the browser-game BauBoss. Each session lasted between 60 and 70 minutes. After each session, participants were asked to carry on playing at home. Our study was part of this evaluation. We added a set of SMS notifications to the browser game BauBoss and randomly assigned participants to an experimental group (a total of ten participants) and a control group (a total of
nine participants). The experimental group dealt with the browser game and additionally received SMS notifications (*Coupled Games*). The control group dealt with the browser-based version of the game as described above.

For the formulation of the notifications we took into consideration the target groups literacy skills. Our mobile extension comprised three messages per week and included a) an SMS quiz by way of multiple and single-choice questions (N=70), b) information on IT-related subjects (N=60) and c) hints containing personalized information on score notifications of friends (N=50), for example: “*The cities of your friends have become prosperous. By enlarging your IT knowledge, you can quickly catch up.*” The hints on IT-related subjects were sent once a week (usually on Friday). They were integrated in order to support general interest in IT and to refresh content already learned. The quiz questions were sent out three days later (usually on Monday). See Appendix A for the list of message we sent and their sequential order.

Participants had to answer the questions quickly because only the first two correct responses which we received earned the bonus, which subsequently added to the IT checker value of the browser game *BauBoss* (Schmitz and Czauderna, 2011). Generally, we provided the correct answer to all responses, i.e., to both correct and incorrect replies. With this, further chunks of information were sent to the participants. The third group of messages was individually tailored to participants. The messages contained personalized information on score notifications of friends. With this notification we aimed at supporting interest for the *BauBoss* game. Monitoring and coordinating gameplay from “behind the scenes” has proved vital for players’ gaming experience (Crabtree et al., 2007).
We designed the stream of activity through an SMS voting system (http://www.openit.de/SMS-einsatz.html), which we describe in Figure 3. This system provided a phone number through which we sent out the messages to students and in turn, received participants’ replies through the same designated number. In this way we were able to collect the responses electronically for efficient data processing. The system sorted all incoming SMSs according to date, time and telephone number and text (content). The incoming quiz results were evaluated and through the browser-based game BauBoss students received their feedback by way of an increase of their IT Checker value. In addition, the system allowed to group participants according to certain contexts such as message content, class, etc., which enabled us to customize text messages according to different categories of learners and to organize messages beforehand.

Participants

A total of nineteen learners participated in the study for seven weeks. They were recruited from state funded professional qualification programmes offered by the Education Centres for the Building Industry (Bildungszentren des Baugewerbes e.V.). The nineteen participants were all male and aged from 16 to 21 years. They had very different (and partly very difficult) learning histories as well as diverse social backgrounds and cognitive capacities. From various points of
view, this is a very challenging task. For one, the target group cannot easily be described as a homogenous group.

Also their degree of prior experience of gaming and IT knowledge varied. Only few of them have a school-leaving certificate. In general, the target group is difficult to motivate. Their low self-esteem, low frustration tolerance and poor stamina leads to high drop-out rates. Most participants frequently use mobile devices, but mainly for communication (texting messages, calling friends).

Ten out of nineteen learners owned smartphones, which were operating with four different systems (5 Symbian, 3 Android, 1 Bada, 1 iOS). Nine participants owned a conventional mobile phone. Purchasing smartphones for the experiment was not mandated. Also, they would have to be lent to learners by the instructor, who would then have been in charge for the risk of theft and loss of class time. This led to the conclusion, that for our setting the common denominator was conventional mobile devices and the use of text messaging via SMS, a service, which is present on all mobile phones. This approach allowed learners with the least sophisticated mobile phones to participate.

**Research Objectives**

In our research on the educational potential of *Coupled Games* we seek to answer two research questions. First, do pupils who receive SMS interventions find themselves more attracted to play the *BauBoss* game? We hypothesize that for the target group mobile devices enable further low threshold learning opportunities that support learners at-risk. Additionally, we expect that the aspect of personalization may contribute to their motivation to get involved with *BauBoss*.

Second, do pupils who receive SMS interventions have better learning outcomes than those playing the PC-based version of the game *BauBoss*? We hypothesize that the combination of both mobile and PC-based learning games is more effective than playing the PC-based learning game only with regard to motivation and knowledge gain. Despite the SMS interventions
delivering “more of the same”, i.e. more learning content and more questions to pupils, which is often argued to be counterproductive (Manning and Baruth, 1995), we hypothesize that directly addressing them leads to the target group’s acceptance of the additional workload.

**Data collection**

We collected data through questionnaires, interviews and log files. To capture information on both motivation and the knowledge gain, we mixed a) qualitative data such as open-ended and bounded questions with b) quantitative data coming from a standardised test and event log files generated automatically by the game.

**Attraction to gameplay.** We analysed data from learner tracking to further disclose the acceptance of the application and its actual usage. These log-data comprised log in-times, handling of IT questions within the game, use of networks and chat, etc. They complement the qualitative and quantitative results and document the real user data. Both the data from learner tracking and from the IT knowledge test we could trace back to individual participants due to a coherent use of key numbers.

**Motivation to deal with learning content.** This measure contained a post-game qualitative questionnaire with fifteen questions loosely based on a combination of already existing questionnaires to measure player engagement (Francis, 1993; Malone, 1980) and an interview. The fifteen items from the questionnaire were arranged for scoring on a five-point Likert scale, ranging from ‘agree strongly’, through ‘agree’, ‘not certain’ and ‘disagree’, to ‘disagree strongly’. We evaluated participants’ response to the game and the corresponding SMS interventions. The questionnaire included both open-ended and bounded questions designed to obtain feedback on engagement, attitude towards IT learning, game play, group and game experience.

**Knowledge Gain.** This measure was adapted from the European Computer Driving Licence (ECDL). The ECDL is a standardized test that reflects and certifies up-to-date skills and
knowledge in computer use and common software applications. The ECDL pre-test was conducted before the first game session in January 2012 and the post-test after the last game session in March 2012. Pre- and post-test comprised the same 80 IT questions. Pre- and post test were administered under the supervision of teachers and two investigators before the gaming instruction was given.

RESULTS

Log data analysis

In order to evaluate whether the SMS interventions were a stimulus for the target group to play the game, we analysed the log data. We considered ten data sets available for players of the experimental group and seven data sets from players of the control group. Table 1 sums up the results.

<table>
<thead>
<tr>
<th></th>
<th>Ex Group</th>
<th>Control Group</th>
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<tbody>
<tr>
<td></td>
<td>n = 10</td>
<td>n = 7</td>
</tr>
<tr>
<td>Time spent within the application (min.)</td>
<td>273.6</td>
<td>187.14</td>
</tr>
<tr>
<td></td>
<td>131.725</td>
<td>132.665</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>272</td>
</tr>
<tr>
<td></td>
<td></td>
<td>196</td>
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<tr>
<td>Number of active sessions (log-ins)</td>
<td>11.6</td>
<td>6.42</td>
</tr>
<tr>
<td></td>
<td>9.371</td>
<td>4.894</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Duration of active sessions (min.)</td>
<td>23.58</td>
<td>29.11</td>
</tr>
<tr>
<td></td>
<td>22.614</td>
<td>21.729</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Number of IT questions answered</td>
<td>62</td>
<td>59.57</td>
</tr>
<tr>
<td></td>
<td>29.051</td>
<td>42.902</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>51.5</td>
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<tr>
<td></td>
<td></td>
<td>61</td>
</tr>
<tr>
<td>Number of questions answered correctly</td>
<td>37.9</td>
<td>39.14</td>
</tr>
<tr>
<td></td>
<td>20.994</td>
<td>27.064</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>33.5</td>
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<tr>
<td></td>
<td></td>
<td>42</td>
</tr>
</tbody>
</table>

Table 1. Descriptive statistics from log data analysis

The log data analysis revealed that participants from the experimental group spent an average time of 273.6 minutes on the application (SD=131.725; control group = 187.14 minutes, SD=132.665). For an individual session, participants from the experimental group spent an average time of 23.58 minutes on the application (SD=22.614; control group = 29.11 minutes,
SD=21.729). Though, for participants from the control group an individual session took longer, participants from the experimental group had more active sessions on average (experimental group M=11.6, SD= 9.371; control group M=6.42, SD=4.894). We ascertained the number of active sessions by the pairs of log-in/log-out data and activities immediately after the log-in. Also, from the log data it showed, that participants from the experimental group frequently accessed the application whenever they received a message and in particular when receiving a personalized massage (see Appendix A number of reactions to individual message types).

Participants from the experimental group answered an average of 62 questions (SD=29.051; control group M= 59.57, SD= 42.902). On the other hand, participants from the control group answered more questions within the game BauBoss correctly (control group M= 39.14, SD= 27.064; experimental group M= 37.9, SD= 20.994).

**Interview data**

When comparing the results from the usage data of the application to the student feedback, a similar picture shows. Participants from the experimental group demonstrated a rather reluctant attitude towards the use of text messages. It showed that simply sending messages is not necessarily attractive to them and does not thrill them to make use of the learning offer provided. To them, BauBoss belonged to schooling activities and thus had no relevance to their everyday life. One participant remarked,

P1: […] and the SMSs come in situations when I do not expect it and this could really annoy me.

Another participants brought forward the argument of extra costs. They obviously were frequently expected despite the fact that it was made clear beforehand that any costs would be refunded.

Interviewer (I): There were SMSs sent to you. Did you receive them?
P2: I got them.
I: Did you reply to them or did you find this …
P2: No, I haven’t
I: … yes. Why haven’t you answered them? […]

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P2: Actually I did not want to. There was another number and I have E-Plus, and you then have to pay for it.

Another student argued similarly:

I: [...] Did you receive SMSs?
P3: Yes, but I did not answer.
I: How many?
P3: Yes, got many, yes.
I: How many?
P3: Yes.
I: Did you reply to none of them? Not at all?
P3: No.
I: Why not?
P3: P: I have a different provider. It will be very expensive for me.
I: That was the only reason?
P3: Yes

Some participants valued the collaborative and social dynamics of the game:

P4: “When the SMSs came. Yes, some said BauBoss again, and I have, and others have then (said) ‘Oh BauBoss!’: And we then discussed, yes once we even sat together with some people and SMSs came, from the BauBoss again and (we) then really fiddled and thought about it the whole time, what is it again? And then I said ‘Well boys, you have to boost the IT-Checker.’ And then I answered the question and that was it.

**Questionnaire data**

For motivation support of the Coupled Game scenario, we analyzed participants responses to a questionnaire. We received seventeen pre- and fifteen post-game questionnaires. The analysis is based on the feedback of fourteen participants, who completed both the pre- and the post-questionnaire (experimental group n=8; control group n=6). The following results do not report all aspects of the questionnaire but focus on descriptive statistics with regard to participants’ motivation to deal with the integrated IT content.

It was found that players of the experimental group were more interested in IT (Q09: Learning about IT is interesting, experimental group M=2.625, SD=1.386, control group M=2.667,
SD=1.054) and that subsequently they used the integrated IT content more frequently to answer the game questions. (Q11: I looked at the IT content in the IT-Café and used it for the game, experimental group M= 3.5, SD = 1.13, control group M=2.167, SD=0.898). Participants from the control group were rather competitive (Q13: I wanted to be better than my friends, control group M=3.333, SD=1.67; experimental group M= 3.375, SD = 1.317).

Players of both groups unanimously considered the IT questions as undisturbing (Q19: The IT questions disturbed my game flow, experimental group M=2.5, SD=1.225, control group M=2.833, SD=0.897). Furthermore, the questionnaire results underline participants’ statements with regard to collaboration. (Q12: I have answered the questions in the game with the help of my friends, experimental group M= 1.75, SD = 0.433, control group M=1.667, SD=0.623).

**Knowledge test**

For support mechnanisms with regard to learning, we analyzed participants’ IT pre- and post-test results. The analysis is based on the six participants that completed both the ECDL pre- and post-test. From the IT-test results it shows that the experimental group scored better than those playing the PC-based version of the game only (experimental group M= 69.33, SD= 8.38, Median=70; control group M= 65.5, SD=13.238, Median=65). However, from the analysis of pre- and post-test results it showed that already in the beginning the experimental group scored superiorly (experimental group M= 63.83, SD= 10.221, Median=65; control group M= 62.83, SD= 11.495, Median=64). Therefore, a clear assignment of knowledge increase due to the intervention is difficult. A closer look at individual student results revealed that most effects showed with students who had little IT knowledge, i.e. scored lower in the IT pre-test. The more a student knew about the topic beforehand, the smaller was the increase in knowledge.

**LIMITATIONS OF THE STUDY**

The current study has certain limitations that need to be taken into account. On the one hand, the sample size we considered was relatively small, which makes it difficult to draw broad
generalizations from the data. Still, we may draw conclusions from the experiments with regard to the design of Couple Games and the use of SMS messages for the target group.

On the other hand, participants dealt with a teaching method that was new to them. Though they are used to dealing with mobile devices on a day-to-day bases, using the mobile device for learning was new to them. It is thus arguable that with regard to the experimental group, participants’ perception and attitude towards learning and IT-content changed due to an alteration in their learning environment. Also, factors that may influence participants’ perceptions, such as their ability, prior experience with technology, prior background to mobile learning games, and personality type were not considered. Thus, further research is needed that evaluates how far these factors may influence motivation and learning.

**DISCUSSION**

In the following we discuss findings from the study and possible implications for design issues of similar mobile learning experiences directed at learners at-risk. Study results suggest that the pattern *Coupled Games* as realized by way of SMS interventions provides chances to support the target group. Effects were traceable with regard to participants’ attraction to the learning offer, for example. Participants spent more time within the application and more frequently accessed it. But although participants reacted to the mobile game intervention by interacting with fellow learners and the browser-game, few answered the questions continuously and some even expressed dislike for the quiz messages. This is contrary to the positive questionnaire results reported beforehand, but was to be expected. We identified three main factors responsible for this: Firstly, *the graphical user interface* (GUI) did not meet participants’ expectations with regard to a mobile learning game. It showed that simply sending SMS messages was not necessarily attractive to them and did not thrill them to extensively use the learning offer provided (see participants’ statement P2). Secondly, *the fear of extra costs*. Participants avoided replying to the questions because they expected extra costs despite the fact that it was made clear beforehand that any costs will be refunded (see participant’s statement P2.
and P3). Thirdly, the time at which we sent the messages was not optimal. Some messages were sent in the evenings. One participant reacted to this by stating that he was annoyed by the SMS questions for he had received the messages at times when he did not expect them, i.e., outside the sessions or in the afternoon (see participants’ statement P1). Carefully selecting the time when sending the messages is a crucial aspect for the design of a pervasive learning experience. The aspect of anytime, anywhere as a core characteristic of such learning arrangements was not fully appreciated by participants of the target group. The findings are supported by other research such as the study by Laine et al., (2010). They, too, stated that the flexibility of pervasive systems to be used anywhere, anytime, and by anyone, can be problematic.

On the other hand, employing pervasive learning games also implies the integration of contextualization and personalization, which was a major advantage. In particular, personalized information on score notification of friends can enforce learners’ interest in the game. This is supported by a study from Goh et al. (2011), for example. Also, a study by Crabtree et al., (2007) emphasized the aspect of personalizing and organizing gameplay. Their research on orchestration work in the context of game development suggests that the customization of messages, e.g. categorising messages or crafting responses, is a critical aspect of contemporary game design, which supports the learning process. However, further research is necessary in order to analyse and understand the full impact of personalized learning contexts through the incorporation of incidental individualized information, for example as implied by the findings of Cordova and Lepper (1996).

With regard to collaboration, which was not explicitly the focus of our research and is a pattern by itself, it shows that this aspect was appealing to the target group and fostered their interest in the application. In the context of our research, collaboration was limited to face-to-face discussion. Mobile technology however provides various efficient mechanisms to integrate collaboration into the gameplay (Wang, 2011), this way providing chances for social interactions, joint problem solving and thus richer knowledge construction, crucial aspects
especially when working with the target group. Participants’ feedback corroborates the appealing character of collaboration (see participants’ statement P4) and further research is needed that will further investigate efficient support mechanisms.

As for the learning outcomes we found it can be argued that the knowledge gain was based on the higher number of questions and IT-related content information that the experimental group received, i.e. more opportunities to learn. We assume however that our setting did not suffer badly from this argument because every learner had access to all the questions at any time via the IT Café.

A straightforward reuse and adaptation of the described Coupled Game scenario might be difficult to achieve in other contexts, however, study results are transferable with regard to SMS messages. Regardless of whether they function as a main pillar for gameplay or in combination with other technology, general implications for the design of text messaging elements remain the same. With regard to the application of our study results to a classical target group, future research is necessary that considers aspects of personalization, orchestration and collaboration.

CONCLUSION

Because early school leaving (ESL) is one of the main educational challenges in Europe, reducing its levels is a shared objective of EU countries. Mobile game-based learning approaches are a toehold to face this challenge. This paper’s contribution to research in the field of mobile-game based learning and the support mechanisms they provide for learners at-risk is based on four pillars. First, we outlined recent practice of SMS for education. Second, we presented a practical learning game example. The scenario we described combines a mobile quiz game by way of SMS notifications and a browser-game. Third, we depicted results from an empirical study we carried out. The study linked context information, personalization and (affective and cognitive) learning outcomes. Fourth we discussed related design issues of the setting with particular focus on the pattern Coupled Games.
Studies like the reported one can be useful for improving low-threshold learning environments for learners at-risk. We demonstrated how pervasive games for learning could be employed for educational settings by example of Coupled Games. This pattern allowed us to use the potentials of mobile phones in a very targeted manner, both as an extension to an existing learning game and as a channel for information. However, in order to better understand how mobile games support teaching and learning, further quantitative and qualitative research is needed that considers the impact of mobile learning games by way of Coupled Games and SMS interventions.

References


Appendix A). Text messages sent to the experimental group

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Kind of sms posted to the experimental group</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.01.2012</td>
<td>16:30</td>
<td>Personalized message</td>
</tr>
<tr>
<td>23.01.2012</td>
<td>16:10</td>
<td>Text messaging quiz</td>
</tr>
<tr>
<td>25.01.2012</td>
<td>09:41</td>
<td>Personalized message/hint on score of friends</td>
</tr>
<tr>
<td>27.01.2012</td>
<td>16:01</td>
<td>Information on IT content</td>
</tr>
<tr>
<td>30.01.2012</td>
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