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IS SCHOOL A BETTER ENVIRONMENT THAN HOME FOR DIGITAL GAME-BASED LEARNING? THE CASE OF GRAPHOGAME

Miia Ronimus
The Agora Center
University of Jyväskylä
Finland

Heikki Lyytinen
Department of Psychology
University of Jyväskylä
Finland

Abstract: *This study investigated how the use of an online reading game differs in home and school environments. First and second graders* (N = *194) participated in an 8-week training during which they used the reading program GraphoGame either at home or at school under the supervision of parents or teachers. Child participants were recommended by parents and teachers recruited from the list of GraphoGame users, and adults decided whether the training took place at home or at school. We measured the frequency and duration of playing, children's engagement, development of reading skill and reading interest, and adult supportive involvement. The results revealed that children who played GraphoGame at school showed higher engagement and used it more frequently than players at home. Although teachers were more involved in the children's playing than were parents, only parental involvement was significantly associated with a child's engagement during training and the child's learning outcomes.*

Keywords: *digital game-based learning, learning environment, GraphoGame, motivation, engagement, parental involvement.*

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INTRODUCTION

Research has shown that digital games can enhance children's learning, with positive effects found, for example, in the development of reading skills (e.g., Heikkilä, Aro, Närhi, Westerholm, & Ahonen, 2013; Magnan & Ecalle, 2006; Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2010, 2011) and mathematical skills (e.g., Miller & Robertson, 2011; Shin, Sutherland, Norris, & Soloway, 2012). Additionally, children usually are very eager to use digital learning games (e.g., Rosas et al., 2003; Tüzün, Yılmaz-Soylu, Karakuş, İnal, & Kızılkaya, 2009). However, most of the earlier research concerning children's use of digital learning games has been conducted in the school environment, with fewer studies addressing the benefits of home use of digital learning games. Yet learning through educational games at home could be a valuable supplement to school instruction, especially for children who lag behind their peers in the classroom. Games could encourage these children to practice their skills during their leisure time and engage them more effectively in learning as compared to traditional paper-and-pencil homework assigned by the teacher.

The aim of this study is to compare the school and the home as learning environments for digital game-based learning in terms of the frequency and amount of game playing, the children's engagement, the learning achieved, and the level of parent or teacher involvement. Few studies have investigated how the use of the same educational game varies in different learning environments, although this information could be potentially useful for game design. For example, parents, teachers, and children may have different expectations of the game in different circumstances, which in turn may affect the way the game is used and experienced. Additionally, many digital learning games are designed for independent use, but young children in particular may benefit from adult involvement in computer-based learning (Klein, Nir-Gale, & Darom, 2000; Schmid, Miodrag, & Di Francesco, 2008; Tzuriel & Shamir, 2002). In this study, we address this issue by exploring how parents and teachers are involved in children's use of a learning game and whether their involvement is associated with the children's playing time, engagement, and learning gains.

Educational Use of Computers in Homes and Schools

Earlier studies suggest that home computers typically are used for entertainment, especially for playing games (Harris, Straker, & Pollock, 2013; Hofferth, 2010; Kerawalla & Crook, 2002; Lewin, 2004; Selwyn, Potter, & Cranmer, 2009; Valentine, Marsh, & Pattie, 2005; Vekiri, 2010) or for Internet access, email correspondence, and social media use (Harris et al., 2013; Selwyn et al., 2009; Valentine et al., 2005). School computers, on the other hand, commonly are used for writing and word processing (Harris et al., 2013; Kent & Facer, 2004; Selwyn et al., 2009), learning via educational software (Harris et al., 2013; Kent & Facer, 2004), or looking for information on the Internet (Kent & Facer, 2004).

Although the educational use of computers is more typical at school than at home, home computers also are used for learning activities. Valentine et al. (2005) found that, among 6- to 7-year-old children, 51% of girls and 42% of boys used educational computer games at home. In Vekiri's (2010) study, approximately one-third of Grade 5 and 6 students from high- to middle-socioeconomic status families used computers for educational activities outside school, such as

within the drill and practice method and for learning new content. Leisure time use of computers for education was less common among children of low-socioeconomic-status families.

However, in comparing other activities with the home computer, the use of educational software seems to be quite marginal. Kerawalla and Crook (2002) observed that approximately 10% of children's time on the home computer was spent using educational software, even though home computers were often acquired for educational purposes. In a later study, Kerawalla and Crook (2005) gave educational CD-ROMS to 32 families with children aged 7 to 11 and logged the usage of the software on the family computer for 11 weeks. They found that, despite initial enthusiasm, the use of the educational software quickly declined from 55% of the total time spent on the home computer during the first week to 10–25% during the following weeks. Holmes (2011) also observed low enthusiasm for the use of learning games on the home computer. In his study, 8- to 10-year-old struggling readers ($N = 6$) used educational games that were designed to support the development of reading skills. Although the children said they enjoyed the games and believed them to be helpful, they tended to lose interest in the games after the novelty had worn off. Moreover, the children often played games that were not appropriate for their skill level, which decreased their motivation. Finally, all children preferred other activities at home over playing the educational games.

In informal learning settings such as homes, children typically have several opportunities for choice, for example, concerning when and how to use the computer and which activities to engage in. In more formal environments such as schools, there are more restrictions (Barendregt & Bekker, 2011; Harris et al., 2013; Lewin, 2004; Valentine et al., 2005). Based on earlier research, it seems that educational computer games are not able to compete with other activities when the child has the freedom to choose which activities to engage in. Barendregt and Bekker (2011) studied an English-vocabulary-building computer game for Dutch children and found that the children least interested in using the game were those who attended a school that allowed the pupils to choose freely in which activities to engage. The children at the two other schools, where only a limited choice or no choice in learning activities was offered, were more eager to use the game. All children in the study also had an opportunity to play the game at home, but only a few children did this.

According to self-determination theory (see, e.g., Ryan & Deci, 2002), ideal learning environments are those that satisfy the three basic psychological needs of competence, autonomy, and relatedness. In learning environments such as these, the child can experience intrinsic motivation, a situation in which an individual is involved in an activity in the absence of any apparent external contingency and finds the activity itself rewarding (Deci & Ryan, 1980). Children learning in these environments are highly engaged in the learning activity, appear to be attentive and persistent, and show positive emotions such as interest and enjoyment as well (Reeve, 2002). According to Niemiec and Ryan (2009), competence can be supported in the school environment through optimally challenging learning activities and encouraging feedback. Autonomy can be supported, for example, by emphasizing students' perceptions of having choice. Relatedness is experienced when the students feel that the teacher genuinely likes, respects, and values the students. Well-designed digital game-based environments can satisfy these three needs (Ryan, Rigby, & Przybylski, 2006).

In the home environment, children typically are used to having a choice of activities. Yet, in the case of educational games, children may not be permitted to decide which games to play or when, leading to situations that can be detrimental to children's intrinsic motivation, according to

self-determination theory (Wouters, van Nimwegen, van Oostendorp, & van der Spek, 2013). Moreover, games that are designed to aid children with learning difficulties need to be used regularly to produce the desired outcomes. Yet, teachers and parents often are the ones who decide which games the child should use, when, and for how long. Wouters et al. (2013) speculated that this, in addition to problems in game design, could explain why educational games are not more motivating than traditional instruction methods, according to their recent meta-analysis.

Nevertheless, there is evidence that the educational use of computers at home may have a positive effect on children's attainments in school (Hofferth, 2010; Valentine et al., 2005) and that it may increase the motivation and self-esteem of low achievers (Valentine et al., 2005). Some studies suggest that using specific educational software at home might result in more learning gains than using the same software at school. Ben-Zadok, Leiba, and Nachmias (2010) compared the learning behaviors of elementary school students who used an online science learning environment either at home or at school. Log file analysis revealed that students learning at home took more time to complete the learning module, worked at a slower pace, and scored higher on an achievement test than students learning at school. In another study, Magnan and Ecalle (2006, Experiment 3) compared the school use and home use of a computer game that developed word recognition skills in children with dyslexia and found improvement only in the home training group. According to the researchers, this could be because the children training at home were experienced computer users and because the parents were highly motivated to participate in the study and support their children's training. The children who used the game at school had no previous experience with computers, and their teachers were not involved in the training; the at-school use was overseen by a neutral experimenter between lessons.

Adult Involvement in Digital Game-Based Learning

Research has shown that adult involvement in children's use of computers is typically low, especially at home. Harris et al. (2013) found that children between ages 6 and 16 typically used computers alone at home (58% of participants), although using them with a sibling or a friend was also quite common (32.3%). Only 11.3% of children reported that their parents were usually with them during computer use. In contrast, most participants (69.7%) reported being with friends while using a computer at school, and 25.9% reported usually being with teachers. A recent survey conducted in Finland (Suoninen, 2014) supports those at-home findings, revealing that 7- to 8-year-old children typically use digital games alone (42% of the children) or with siblings or friends (42%). A parent or other adult was the most typical companion for only 14% of the children, although about one-third of parents played digital games with their children at least once a week. Parents were less familiar with the games their children played than, for example, the television shows that their children liked to watch, and most of the parents talked about the games only occasionally or rarely with their children.

Similarly, Kerawalla and Crook (2005) found that children typically used educational software on their own at home. They suggested that this may be because the programs do not enable the parents to actively engage in the learning process or help parents understand how these programs could support children's learning at school. Parents may not feel computer-competent enough to provide support for their children's learning, and teachers may hesitate to give parents advice on how to use computers for educational purposes at home (Valentine et

al., 2005). Lack of parental involvement may also be related to the differences in the cultural contexts of the home and the school, which make it difficult to integrate educational use of computers into home life (Kerawalla & Crook, 2002). In schools, computer use typically is orchestrated by teachers, often in accordance with the underlying curriculum. Parents, on the other hand, may be reluctant to organize formal educational activities on the home computer and, even if they are not, their children may not be willing to accept instruction from adults who they do not associate with a teacher's role (Kerawalla & Crook, 2002). In a later study, Kerawalla et al. (2007) used tablet computers to make the link between learning at home and at school more transparent. In this way, the same learning materials were available both at school and at home, and parents could see how homework was related to classwork. The system was well received by both the children and their families, and the rate of use of the educational games was much higher than in previous studies.

A study conducted by Klein et al. (2000) suggested that active support from adults during the use of educational software could increase children's learning and engagement. They trained teachers to mediate the learning of 5- to 6-year-old children during the use of an educational game or an application that teaches children to program. The mediation practices included expressing meaning and affect, expanding learning experiences, regulating the child's behavior, and generally encouraging the child. The results suggested that adult mediation produced significant gains in abstract thinking, planning, vocabulary, visuo-motor coordination, and responsiveness. Providing only technical assistance or being available to answer the child's questions did not seem to help children's cognitive development. Similarly, Tzuriel and Shamir (2002) found that 5-year-old children's performances in a task that dynamically assessed a child's cognitive ability improved when their performance was mediated both by a computer program and an examiner rather than by either the computer or examiner alone. The study clearly showed that the computer alone could not replace the role of a human mediator. Schmid et al. (2008) also observed that an adult tutor played an important role in the child's interaction with a computer program that taught reading and writing skills. The tutor guided and motivated the child, particularly when the child encountered difficulties, and provided cognitive support to help the child progress or to sustain the child's interest.

The GraphoGame Learning Environment

GraphoGame[1] (in Finnish, *Ekapeli*) is a digital, Web-based learning environment designed to support children's reading acquisition. The development of the GraphoGame at the University of Jyväskylä, Finland, is based on the findings of the Jyväskylä Longitudinal Study of Dyslexia (see, e.g., Lyytinen et al., 2006). This research suggested that future reading problems often stem from difficulties in the perceptual differentiation of the manifestations of phonemes that are acoustically close and the consequent problems in learning the connections between letters and sounds (e.g., Lyytinen, Erskine, Kujala, Ojanen, & Richardson, 2009). GraphoGame provides intensive training in letter–sound connections that has been shown to help children overcome these difficulties (for a recent review of results, see Richardson & Lyytinen, 2014).

In the basic letter–sound connection task of GraphoGame, the player hears a sound while a number of letters (target and distracters) appear on the screen (Figure 1). The player is expected

Figure 1. A basic training task of GraphoGame. (The player hears a speech sound and is expected to select the corresponding letter from the alternatives shown on the screen.)

to select the letter corresponding to the spoken sound. The game provides immediate feedback: Correct answers are acknowledged; if an incorrect answer was selected, the correct alternative is highlighted before the next trial is presented. To develop reading skills in a language with a transparent writing system (such as Finnish), the game begins with connections between single sounds and letters. Once the child has mastered this skill, the game advances to developing the connections between spoken and written syllables and words. Because of the adaptive level of difficulty, the game remains optimally challenging regardless of the child's skill level at each stage of his/her playing and, hence, supports a child's sense of competence. The GraphoGame interface is simple and easy to use, and most children are able to play the game without assistance from adults. With parental consent, the players' usage data are stored on the GraphoGame Web server. These data can be used by parents and teachers who want to observe how their students or children are performing in the game, as well as by researchers who are interested in studying the learning processes of the players. For a more detailed theoretical and methodological background and description of GraphoGame, see Richardson and Lyytinen (2014).

The GraphoGame version used in this study was originally developed for a study comparing the effects of game features on children's engagement and learning (Ronimus, Kujala, Tolvanen, & Lyytinen, 2014). The game is aimed at Finnish-speaking children and it consists of tasks in which the learner connects written language units to those of spoken language units, ranging from connecting single sounds to letters and then connecting longer spoken words and pseudowords to their written counterparts. The difficulty of each task is determined by the child's responses to previous tasks, according to a Bayesian-probability-model-based adaptation technique developed by Kujala, Richardson, and Lyytinen (2010). The game version includes a reward system: After connecting 20 speech sounds to their written counterparts, the player receives a game token. After collecting five tokens, the player

gains access to a reward area of the game that offers optional playing levels. These reward games also develop reading skills, but the type and visual appearance of the tasks differ from those of the basic game. Each reward level costs five tokens; the return to the basic game allows the learner to earn more tokens. The reward games offer increased choice in the game and, as a consequence, improve the motivational appeal of the game.

Earlier Finnish studies suggest that GraphoGame can effectively help young children who need support in reading acquisition (e.g., Lyytinen, Ronimus, Alanko, Poikkeus, & Taanila, 2007; Lyytinen et al., 2009). Saine et al. (2011) found that struggling 7-year-old readers who received a remedial training program that included GraphoGame sessions achieved higher gains in reading and spelling than children who participated in a similar program without GraphoGame sessions. In another study, a shorter and less intensive 6-week intervention with GraphoGame accelerated 7-year-old children's letter naming skills, but no effect on reading was observed (Hintikka, Aro, & Lyytinen, 2005). Lovio, Halttunen, Lyytinen, Näätänen, and Kujala (2012) found that a short but intensive 3-week intervention improved 6-year-old children's phonological awareness and writing skills. The electroencephalogram (EEG) data collected in the study suggest that GraphoGame use also may be beneficial in modulating the neural basis of phonetic discrimination. Heikkilä et al. (2013) found that a brief intervention with GraphoGame increased children's reading speed of the syllables encountered in the game.

The previous studies focused on the basic reading skills of Finnish-speaking students. Meanwhile, Kyle, Kujala, Richardson, Lyytinen, and Goswami (2013) studied the effects of two English versions of GraphoGame. The GraphoGame Phoneme version progresses from small to large units of language. It first teaches the players all the phonemes (individual sounds) in connection with prototypical graphemes (letters) before moving on to consonant-vowel and vowel-consonant segments and eventually progressing to words. In the GraphoGame Rime version, however, much of the training focuses on larger rime units (i.e., the spelling units for rhyming sounds). A small set of single sounds with the corresponding written units are introduced and immediately used for presenting rime units and words containing these rime units. In Kyle et al.'s study, 6- to 7-year-old children with poor reading skills received approximately 11 hours of either GraphoGame Rime or GraphoGame Phoneme training over 12 weeks as a supplement to normal classroom literacy instruction. Both interventions led to gains in reading, spelling, and phonological skills in comparison to an untreated control group. Furthermore, the gains were maintained at a 4-month follow-up assessment. The GraphoGame Rime version produced slightly larger gains in some of the reading and phonological tasks.

The Present Study

Although GraphoGame has been widely used at homes in Finland for several years, most previous studies have investigated GraphoGame use in formal learning environments, such as schools and kindergartens. Home use of GraphoGame offers several potential benefits. First, the extra training provided at home may help at-risk children catch up with their peers before they start to view themselves as slow learners, a perception that may result in negative consequences for their self-concept and learning motivation (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Chapman & Tunmer, 2003; Morgan, Fuchs, Compton, Cordray, & Fuchs, 2008). Additionally, school days, particularly for younger students, are short in

Finland, which is why many teachers find it difficult to allocate time for GraphoGame sessions. Some teachers also may struggle to individualize classroom education so that only those with poor reading skills participate in the GraphoGame sessions, while others receive typical instruction. Finally, using GraphoGame at home also could increase parents' involvement in their children's education.

To the authors' knowledge, no prior studies have been conducted that compare the use of the same educational game in both the home and school environments while simultaneously assessing the child's engagement, learning gains, and parent and teacher involvement in the training. However, previous research does suggest that using home computers for learning is not a popular activity among children and that parents do not seem to take an active role in their children's learning via the home computer. Therefore, the primary purpose of this study is to investigate three important concepts: (a) how learning with GraphoGame is accomplished at home in comparison to in school, (b) if there are differences in children's engagement and learning outcomes between the two environments, and (c) to what extent parents and teachers get involved in the training.

The study was conducted in Finnish children's homes and schools. The participating children were identified with the help of parents and teachers who were already registered users of GraphoGame and had previously used the game with their older children or former pupils. They were asked if they knew first-grade children who needed support in their reading acquisition, and those who responded affirmatively were recruited into the study, along with the children they identified. The training took place either at home or at school, usually depending on whether a parent or a teacher had enrolled the child into the study. The adult participants were free to decide what time of the day the GraphoGame sessions would take place and for how long and how frequently the children would play, although they were advised that the game should be used regularly. The data about the usage were collected via the Internet and saved on the GraphoGame server from where they were retrieved for the analysis.

The study was framed by four primary research questions. Each of the questions is explained more fully here.

1. Does the frequency and duration of GraphoGame usage differ between home and school settings when parents and teachers have the freedom to choose the environment?

   Based on earlier studies, we expected that GraphoGame usage would be more frequent at school than at home, possibly because the use of an educational game may be easier to integrate into other learning activities at school, as opposed to into leisure-time activities at home. Additionally, children in school are used to performing activities chosen by teachers, whereas children are accustomed to more freedom in what to do at home and may resist activities that their parents choose for them.

2. Do children's engagement with the GraphoGame activities differ between home and school?

   We expected that children using GraphoGame at school would show a higher level of engagement in playing because earlier studies have suggested that the use of educational games is not common at home; this may be because children do not find the learning games as engaging as other activities at home. In this study, we addressed both behavioral and emotional aspects of engagement (Reeve, 2002) by measuring the child's concentration and enjoyment during GraphoGame use. However, self-report measures are often problematic with young children because

children's cognitive skills are still developing (Fulmer & Frijters, 2009). Therefore, we also used the adults' evaluations of the children's enjoyment and concentration in addition to the self-reports.

3. Do children's reading skills and reading interest develop differently depending on whether the GraphoGame training occurs at home or at school?

   If the results to Questions 1 and 2 suggest that school-based learning with GraphoGame is more frequent and engaging than home-based learning, one might conclude that children's skill and interest in reading activities would develop more among those learning at school. Many earlier studies suggest that time on task and engagement positively affect students' learning (see a review by Cotton, 1989) and that high reading skills and interest in reading often go hand in hand (Frijters, Barron, & Brunello, 2000; Morgan & Fuchs, 2007; Wigfield, Wilde, Baker, Fernandez-Fein, & Scher, 1996).

4. To what extent do parents and teachers get involved in children's GraphoGame usage, and is their involvement associated with children's engagement and learning with GraphoGame?

   Earlier studies suggest that parents typically do not get involved in their children's computer activities at home, and thus we expected that the parents in our study would be less involved in children's use of GraphoGame than the teachers. Prior studies also suggest that adult involvement can help the child perform better and gain more from computer-based learning tasks. However, GraphoGame is designed for a child's independent use and with an adaptive level of difficulty, so it is unclear if adult involvement in the form of helping the child to solve the learning tasks is meaningful or even desirable. The main role of the adult more likely is to recommend when the child should play and for how long, as well as provide encouragement and positive feedback to sustain the child's engagement in the training. In this study, we measure these two aspects (control over playing times and encouragement) in addition to investigating the adult's participation in the training, that is, to what extent the adult is present during the sessions. Adult presence during the sessions may support the child's sense of relatedness and, as a consequence, may increase the child's engagement in training.

METHOD

Participants

The participants were recruited from the mailing list of GraphoGame users. Parents and teachers were sent an e-mail describing the study and were asked to participate if they had a child or a pupil who either was unable to read or needed support in reading acquisition. The adult GraphoGame registrants who indicated that they were interested in participating were sent further information about the study as well as a consent form to be completed by the child's parent. The consent form included questions about the child, such as birth date and prior use of GraphoGame and other digital games. Only children whose parents or teacher could provide computer access that met the technical requirements of GraphoGame were able to participate in the study.

All children whose parents returned a signed affirmative consent form and who played the game at least once at home or at school during the study period were included in the study analysis (N = 194). More boys (n = 118, 60.8%) than girls (n = 76) are in the sample, which is probably because reading problems are typically more common among boys than girls (e.g., Rutter et al., 2004). The data show that 101 children played the game at home under the supervision of 99 parents and 93 children played at school, supervised by 27 teachers. Boys and girls were evenly represented in both learning environments. Parents typically oversaw one child's training, but the number of children playing under the guidance of one teacher ranged from 1 to 10 (M = 3.44). The hierarchical nature of data was not taken into account in the analyses because the mean number of pupils per teacher was relatively low, and almost half of the teachers (13/27) supervised only one or two children.

The mean age of the participants was 7.39 years (range 6.82–10.01). Most children spoke only Finnish (94.8%), but 5.2% also spoke a second language. Most of the children (95.9%) were in the first grade, but some second graders who were struggling at reading acquisition were also accepted in the study. Some of the children (20.1%) attended a special education class or received instruction in a small group, typically because of learning or behavior-related problems. Half of the children (50.8%) had already played GraphoGame before this study. Previous experience was more common among at-home players (71.4%) than at-school players (29.0%), probably because the majority of the parents who were registered as GraphoGame users already had some version of the game installed on the home computer. However, the game version used in this study was novel to all participants. According to the parents, nearly all children in the study (97.9%) played video or computer games during their leisure time.

Parental reports also indicated that 27.9% of the children had experienced some problems in their development (beyond struggling with reading acquisition). The most common problems were in language development (14.4%), motor skills development (5.9%), and attention (4.3%). These numbers were compared with those of registered players of the current first-grade version of GraphoGame who were of similar age and whose parents had responded to the optional background information survey about their child (N =5,692). Boys were overrepresented also in this larger sample (56.5%). The parents in the larger sample reported that 21.9% of the children had experienced problems in language development, and 16.1% in some other areas, most commonly in motor skills (6.7%), memory and naming (6.2%), and attention (5.7%). We should note that whereas the present study asked the parents to give a free-form description of the child's developmental problems, specific questions were used in the GraphoGame background information survey, which may affect the results slightly. Nevertheless, the child participants in this study were considered to be fairly representative of the children who typically use the first-grade version of GraphoGame in Finland.

Procedure

At the beginning of the study, the parents and teachers were sent a link for downloading GraphoGame and instructions for carrying out the training. Parents and teachers were told that the training period was 8 weeks long and that the children should play at least two or three times a week, preferably more often, for approximately 10 to 15 minutes at a time. They were also reminded that using the game should be voluntary for the children: A reluctant child

should not be pushed into playing the game because this could have negative consequences for a child's motivation to learn to read.

When the participating child first launched the game, the system presented pretest tasks that evaluated the child's reading skills and interest in reading and writing. Once these were completed, the game continued with the training tasks. Eight weeks after the first session, the game automatically presented the child with the posttest tasks that included the same items as in the pretest. When the posttest was completed, the game was locked and could not be used further.

Ten weeks after the first play session, the parents and teachers who conducted the training were sent an online questionnaire in which they were asked to evaluate the child's experiences with GraphoGame. The response rate to the questionnaire was 86%, with a higher response from the teachers. Parents of the school players were sent a shorter questionnaire that included questions about their children's interest in reading and writing. The response rate to this questionnaire was 56%.

Measures

Engagement

Children's enjoyment of GraphoGame and concentration during playing were measured by a survey that was presented within the game when the child finished the play session and pressed the Exit button. A female voice first asked the child how much he or she had enjoyed playing the game and then how easy it had been to concentrate on playing that time. After each question, five faces, ranging from a big smile to a big frown, appeared on the screen, and the child rated his/her enjoyment/concentration by clicking one of the faces. A previous study suggests little change over time in children's ratings of their enjoyment of playing GraphoGame (Ronimus et al., 2014), which is why we use a mean of all ratings given during the training as the measure of each child's overall enjoyment/concentration.

Parents and teachers were asked to evaluate the child's motivation and concentration during GraphoGame play via two questions in the end-of-training questionnaire. Motivation was measured by "How eagerly did the child play GraphoGame during the study?" and concentration by "How well did the child concentrate while playing GraphoGame?" The parents and teachers answered using a 5-point scale, ranging from *very eagerly/well* to *very reluctantly/poorly*. Parents and teachers also were asked if there had been any nontechnical problems that had prevented the child using the game as often as was intended. If so, they were asked to give a free-form description of the problem. Each child was rated either by a teacher or parent. The teachers who were in charge of more than one child's playing, therefore, completed multiple forms.

For the analysis, the four variables (i.e., the child's self-rated enjoyment and concentration and adult-rated motivation and concentration) were combined to form one variable measuring the child's general engagement in GraphoGame training. Cronbach's alpha for this measure of engagement was .72.

Interest in Reading and Writing

The children's interest in reading and writing was evaluated both by the children themselves and by their parents. Children rated their interest in reading- and writing-related school tasks by

responding to two questions presented in an in-game survey as a part of the pre- and posttest. The survey was similar to the one used to evaluate enjoyment of playing. The questions were presented within the pretest and posttest. Parents were also asked to evaluate how interested their children were in reading and writing via two 5-point-scale questions that were included in the consent form at the beginning of the study as well as in the online questionnaire at the end of the study. Therefore, four different interest ratings were collected (child-rated reading interest, child-rated writing interest, parent-rated reading interest, parent-rated writing interest) both at the beginning and end of the training. Because of relatively low correlations between the ratings, all eight ratings were treated as separate variables in the analyses.

Reading Skill

Reading skill was measured using two in-game tasks that were presented in the pretest and posttest. The first task involved real words and the second task presented pseudowords. In both tasks, the player heard 44 increasingly difficult words, one at a time, and was asked to select the corresponding written word from the six alternatives shown on the screen. Because the scores of the two tasks were highly correlated, the mean score was used in the analysis. Cronbach's alpha was .89 for the pretraining reading test score and .87 for the posttraining reading test score. Prior studies of GraphoGame reading tests have found a strong correlation with those of traditional reading tests administered by a researcher (Heinola, Latvala, Heikkilä, & Lyytinen, 2010).

Adult Involvement

Adult involvement was measured using four questions that were included in the end-of-training questionnaire. Adult participation during the GraphoGame sessions was measured with a 5-point scale (1 = child played alone, 2 = occasional adult visits in the room where the game was used, 3 = adult present in the room, 4 = adult present in the room and actively observing the child, providing help if needed, 5 = adult actively provided help). Teachers and parents also were asked to evaluate how often they provided positive feedback and encouragement to the child during training (5-point scale, ranging from *constantly* to *never*) and were asked if the child received rewards for playing the game (yes/no). If rewards were given, a free-form description of the type of reward was solicited. Finally, teachers and parents were asked who usually initiated the play sessions (child alone/adult alone/together) and who usually decided how long the child should play at a time (child alone/adult alone/together). Initiating a play session together was described as the adult suggesting a play session but the child making the final decision. Making the decision about the play session duration together was described as the adult setting the duration, but allowing the child to stop a bit earlier or to continue a bit longer if the child requested so.

RESULTS

GraphoGame Usage and Engagement at Home Versus at School

Children's playing start and end times and numbers of play sessions were retrieved from the GraphoGame online server where they had been automatically recorded whenever the game

was used. The analysis of the data revealed that there were clear differences in the duration and frequency of GraphoGame usage between at-home and at-school players. The results are reported in Table 1, along with Cohen's *d* effect sizes. The average total of playing time by the children playing at school was 362 minutes over 8 weeks, whereas, at home, it was significantly lower, 198 minutes ($p < .001$). Additionally, the mean number of play sessions was clearly higher among school players than among home players (22 vs. 13, $p < .001$). Children's engagement in playing GraphoGame, as evaluated both by the children themselves and by the adults observing children's playing, was higher at school than at home ($p < .001$, see Table 1).

When asked whether the game was used less frequently than intended during the training period, the teachers of 9 children playing at school agreed (the number of children represents 10.6% of the at-school players whose teachers responded to the end-of-training questionnaire). According to the teachers' free-form answers, the most common reason for infrequent playing was that the game was too difficult (4 children). In contrast, the parents of 49 children (63.6% of the at-home players whose parents responded to the questionnaire) reported that the game had been used less frequently than intended. The most common explanation was the child's unwillingness to play (33.3% of the at-home players) because, for example, of tiredness after school or poor motivation. Other common explanations for infrequent playing were that the game was too repetitive or dull (18.8%), the game was too difficult (12.5%), the child had learned to read (12.5%), and/or there was a lack of time (10.4%).

Table 1. Playing Time, Engagement, Reading, and Adult Involvement in School and Home Environments.

	Location	*n*	*M*	*SD*	*t*	*df*	*p*	*d*
Total playing time (min)	School	93	361.76	224.86	6.24	139.37	<.001	0.91
	Home	101	197.68	122.21				
Number of sessions	School	93	22.06	11.21	6.13	180.51	<.001	0.88
	Home	101	12.91	9.43				
Engagement	School	86	4.29	0.52	4.52	164	<.001	0.70
	Home	80	3.92	0.53				
Reading pretest	School	91	11.70	9.13	-4.85	182.12	<.001	0.70
	Home	98	19.05	11.62				
Reading posttest	School	65	16.15	11.11	-4.60	117	<.001	0.84
	Home	54	25.74	11.60				
Adult involvement:								
Participation	School	82	3.44	0.88	3.35	155.08	.001	0.53
	Home	80	2.94	1.02				
Encouragement	School	86	3.12	1.17	-1.51	157.63	.133	0.23
	Home	81	3.36	0.89				
Control of playing times	School	84	2.67	0.87	2.83	151.69	.005	0.45
	Home	78	2.24	1.02				

Reading Performance

There was a clear improvement in the reading scores for all children from pretest (M = 13.93, SD = 11.24) to posttest (M = 20.50, SD = 12.26), $F(1, 118) = 64.23$, $\eta_p^2 = .35$, $p < .001$. According to repeated measures ANOVA, at-home players improved their scores more than at-school players, $F(1, 117) = 4.19$, $\eta_p^2 = .04$, $p = .043$. There was also a difference in the level of children's performance, with home players scoring higher than school players both in the pretest and posttest (see Table 1).

Interest in Reading and Writing

Children's parents were asked to evaluate their children's interest in reading and writing at the beginning and end of the training. Children themselves also rated how much they liked reading- and writing-related tasks in the pretest and posttest. The number of respondents was somewhat lower at the end of training because (a) some children had stopped using the game by then and (b) a significant minority of parents, especially those of at-school players, did not respond to the posttraining survey, possibly because they were not actively involved in the study.

The mean ratings are reported in Table 2. According to the parents' evaluation, at-school players seemed to be more interested in reading and writing activities than at-home players, apart

Table 2. Children's Reading and Writing Interest in the Beginning and End of The Training as Evaluated by Parents and Children.

	Time	Location	*N*	*M*	*SD*	*t*	*df*	*p*	*d*
Reading interest (parent-evaluated)	Pre	School	89	3.46	1.06	0.23	188	.817	0.03
		Home	101	3.43	1.02				
	Post	School	52	3.81	1.01	2.15	131	.033	0.38
		Home	81	3.41	1.07				
Writing interest (parent-evaluated)	Pre	School	89	3.61	0.95	2.20	187	.029	0.32
		Home	100	3.32	0.84				
	Post	School	52	3.69	0.92	3.02	131	.003	0.53
		Home	81	3.19	0.96				
Reading interest (child-evaluated)	Pre	School	91	4.30	1.14	2.37	185.37	.019	0.34
		Home	99	3.86	1.40				
	Post	School	65	3.94	1.53	0.58	125	.564	0.10
		Home	62	3.79	1.35				
Writing interest (child-evaluated)	Pre	School	91	4.03	1.32	0.61	188	.543	0.09
		Home	99	3.92	1.25				
	Post	School	65	3.82	1.36	0.78	125	.439	0.14
		Home	62	3.63	1.35				

from reading interest at the beginning of the training in which no significant difference was observed. In contrast, according to the children's pretraining ratings, at-school players were more interested in reading than at-home players, but there were no significant differences between the two groups in posttraining reading interest or writing interest self-assessments.

Repeated measures analysis of variance was used to examine if there was any change in reading or writing interest from the beginning to the end of the training and, if so, whether the magnitude or direction of change differed between at-home and at-school players. The analysis found a marginally significant interaction between the learning environment and parent-rated reading interest, $F(1, 129) = 3.30$, $\eta_p^2 = .03$, $p = .071$. According to the parents' responses, there was an improvement in at-school players' reading interest, $F(1, 49) = 4.12$, $\eta_p^2 = .08$, $p = .048$, whereas at-home players' interest did not change significantly, $F(1, 80) = .15$, $\eta_p^2 = .00$, $p = .697$. No significant changes were found in parent-rated writing interest or in the child-rated reading or writing interests.

The Role of the Learning Environment

Because the data indicated differences between at-home and at-school players regarding prior GraphoGame experience, reading test scores, child-rated reading interest, and parent-rated writing interest at the beginning of the study, we decided to investigate whether the learning environment still would explain some of the variance in total playing time, engagement, and posttraining reading score after controlling for these variables. We used hierarchical regression analysis to investigate this. The four variables in which the differences were observed were entered in the model on the first step, and the learning environment was entered on the second step. The summary of the results is reported in Table 3.

Regarding total playing time, both pretest reading skill and earlier experience of GraphoGame were significant predictors so that the children with higher pretest reading scores and the children who had played GraphoGame before this study tended to play the game less. However, when the learning environment was entered into the model, this became the only significant predictor, with at-school players playing more than at-home players. Approximately 20% of the variance in total playing time could be explained by these five predictors.

Regarding engagement, earlier experience of GraphoGame and self-reported interest in reading were significant predictors at the first step, with those new to the game and those expressing a higher interest in reading showing higher engagement. When the learning environment was entered into the model, the child's self-reported reading interest remained a significant predictor. In addition, the learning environment was significantly associated with engagement, with at-school players showing higher engagement. The five predictors explained approximately 24% of the variance in engagement.

The strongest predictor of reading posttest score was, not surprisingly, the reading pretest score. However, the learning environment also was significantly associated with reading posttest score, with at-home players particularly showing higher reading skill at the end of the study. The five predictors explained approximately 58% of the variance in posttest reading score.

Table 3. Hierarchical Regression Model with Reading Pretest, GraphoGame Experience, Writing and Reading Interests, and Learning Environment as Predictors of Total Playing Time, Engagement, and Reading Posttest.

	Step 1				Step 2			
	B	***SE B***	β	***p***	***B***	***SE B***	β	***p***
Playing time								
Reading pretest	-3.13	1.35	-.18	.022	-0.86	1.34	-.05	.521
GG experience	-71.58	30.04	-.19	.018	-16.62	30.13	-.04	.582
Writing interest (p)	-5.16	16.59	-.02	.756	-15.19	15.66	-.07	.333
Reading interest (c)	17.46	10.86	.12	.110	4.90	10.46	.03	.640
Learning environment	-	-	-	-	-160.20	31.55	-.41	<.001
				R^2 =.09				R^2 = .20
Engagement								
Reading pretest	0.00	0.04	.05	.488	0.01	0.00	.13	.115
GG experience	-0.26	0.09	-.24	.003	-0.15	0.09	-.13	.117
Writing interest (p)	0.07	0.05	.12	.132	0.06	0.05	.10	.207
Reading interest (c)	0.12	0.03	.30	<.001	0.10	0.03	.25	.001
Learning environment	-	-	-	-	-0.29	0.09	-.26	.002
				R^2 = .19				R^2 = .24
Reading posttest								
Reading pretest	0.82	0.07	.76	<.001	0.78	0.08	.72	<.001
GG experience	-0.62	1.75	-.03	.724	-2.03	1.80	-.08	.262
Writing interest (p)	-1.23	0.96	-.09	.201	-0.91	0.94	-.07	.338
Reading interest (c)	-0.98	0.61	-.10	.112	-0.61	0.61	-.07	.322
Learning environment	-	-	-	-	4.48	1.78	.18	.013
				R^2 = .55				R^2 = .58

Note. p = parent-evaluated, c = child-evaluated

Parent and Teacher Involvement in GraphoGame Play

Teachers participated in the children's playing more actively than parents (p = .001; see Table 1). Many teachers actively observed the child's playing and provided help when needed (39.0% of the at-school players) or were present in the same room (37.8%). At home, the results show that the child typically was playing in a separate room and the parent occasionally visited (42.5% of the at-home players), although actively observing the child's playing and providing help when needed was also quite common (31.2%). There was no significant difference in the frequency of receiving encouragement between at-home and at-school players (p = .133).

The use of rewards to motivate the children to play was rare, with only 11 (6.5%) of the children receiving them, and all of these children played at home. Most of these children (n = 8) were rewarded by permission to play another computer game after first playing GraphoGame.

Play sessions were rarely initiated by the child. Only 3.6% of the at-school players and 8.9% of the at-home players were reported to play typically on their own initiative. At school,

the sessions were most commonly teacher initiated (53.6%), whereas at home, the decision was typically made by the child and the parent together (48.1%). Limiting the time used for playing was more common among at-school players than at-home players. At home, 38.8% of the players were allowed to play freely as long as they wanted, whereas at school, this was possible only for 7.0% of the players. In both learning environments, it was most common that the child and adult decided together how long the session should be (72.1% of the at-school players, 47.5% of the at-home players).

We used regression analysis to investigate whether adult involvement was related to children's playing time, engagement, or learning. To enable the analysis, two categorical variables (the initiation of the play sessions and the decision about the play session duration) were recoded into one new variable that measured the degree to which children's playing times were controlled by the adults. High control suggests that the adult alone decided both when and how long the child should play (n = 23); moderate control suggests that the adult alone decided one of the two aspects, and the other was decided by the adult and child together or the child alone (n = 61); mild control suggests that both of these aspects were decided by the adult and child together (n = 46); and low control suggests that the child alone decided at least one of these aspects and neither of the aspects was decided by the adult alone (n = 32). According to the t-tests, the teachers controlled children's playing times more than the parents did (see Table 1).

The regression analyses were performed separately for at-school and at-home players. The results concerning playing time and engagement are reported in Table 4. None of the involvement variables could significantly predict total playing time either at school or at home. At school, the teacher's control over playing times had a marginally significant negative association with playing time (p = .074). Regarding engagement, none of the variables predicted it significantly at school. However, at home, both encouragement and control over playing times had a negative association with the child's engagement. Together, the three involvement variables predicted approximately 21% of variance in the child's engagement in GraphoGame play at home.

Table 4. Regression Model with Adult Involvement Variables as Predictors of Total Playing Time and Engagement.

	School				Home			
	B	***SE B***	β	***p***	***B***	***SE B***	β	***p***
Playing time								
Participation	11.89	30.25	.05	.695	-3.43	13.58	-.03	.802
Encouragement	-4.37	22.03	-.02	.843	9.65	15.51	.07	.536
Control	-51.51	28.46	-.21	.074	5.17	13.72	.04	.707
				R^2 = .05				R^2 = .01
Engagement								
Participation	-.06	.08	-.10	.431	.07	.06	.13	.230
Encouragement	-.06	.06	-.14	.249	-.17	.06	-.28	.010
Control	.05	.07	.08	.478	-.17	.06	-.33	.003
				R^2 = .01				R^2 = .21

Hierarchical regression analysis was used to explore the association between adult involvement and the child's reading skill (Table 5). The pretest score was entered at the first step to control its effect and the involvement variables at the second step. At school, teacher involvement was not significantly associated with the posttraining reading test score. At home, the only significant variable was participation during sessions (p = .042), which was positively associated with the children's posttraining test score.

Table 5. Hierarchical Regression Model with Adult Involvement Variables as Predictors of Reading Skill Development.

	Step 1				Step 2			
	B	***SE B***	β	***p***	***B***	***SE B***	β	***p***
School								
Reading pretest	0.89	0.10	.75	<.001	0.84	0.12	.71	<.001
Participation	-	-	-	-	0.18	1.19	.02	.880
Encouragement	-	-	-	-	0.54	0.91	.06	.553
Control	-	-	-	-	1.84	1.36	.14	.183
				R^2 =.57				R^2 = .58
Home	0.65	0.10	.68	<.001	0.62	0.11	.65	<.001
Reading pretest	-	-	-	-	2.70	1.28	.24	.042
Participation	-	-	-	-	0.64	1.38	.05	.642
Encouragement	-	-	-	-	0.95	1.14	.09	.411
Control				R^2 = .46				R^2 = .53

DISCUSSION

The results of this study suggest that GraphoGame training was more effectively put into practice at school than at home. Play sessions were more frequent and total playing time longer at school than at home. Parents' and teachers' reports revealed that difficulties in following a regular playing schedule were more common among parents than among teachers. Adult evaluations and children's self-reports suggested that at-home players were less engaged in playing the game than at-school players. Additionally, at-school players' interest in reading seemed to increase during the training, according to parental ratings, which may be because of their positive experiences with GraphoGame. These findings support earlier studies suggesting that children do not like to spend time with educational software at home (Holmes, 2011; Kerawalla & Crook, 2002, 2005).

Despite the higher playing time and engagement of at-school players, the reading skill of at-home players seemed to develop more during the training. A likely reason for this was the higher beginning level of home players, which helped them to gain more from the reading instruction that they received during the training period. The children who played at school probably had more serious issues in learning to read and therefore would have needed more intensive training to achieve gains similar to the at-home players. Earlier studies have shown

that a GraphoGame-focused intensive training produces significant learning gains (Kyle et al., 2013; Lovio et al., 2012, Saine et al., 2011), although less frequent sessions (two or three times a week) do not (Peltomaa, 2014; Uusitalo-Malmivaara, 2009). Thus, even though at-school players used GraphoGame more than at-home players, training sessions may still have been too infrequent (on average three times a week) to produce larger gains in learning. On the other hand, at-home players may have benefited from the fact that their training was in addition to the reading instruction that they received at school and that the at-home GraphoGame sessions did not interfere with any lessons at school. However, because of the absence of control groups, it is difficult to say to what extent the training helped the children's reading skills to develop or whether these results reflect only the typical development of children's reading skills during the first few months of formal instruction, particularly in a transparent language such as Finnish.

There were certain differences between at-home and at-school players at the beginning of the training, but they did not seem to explain the associations between the learning environment and the child's playing time, engagement, and learning. However, these differences may offer clues to the motivation for use of educational games in different learning environments. In this study, at-home players seemed to be less interested in reading and writing activities than at-school players, whereas at-school players seemed to be poorer readers than at-home players. This may suggest that parents decided to participate in the study because they were worried about their children's lack of interest in reading and writing; they may have expected GraphoGame to engage their children in learning more effectively than traditional ways of instruction. In contrast, teachers may have been more eager to participate because they were worried about their pupils' difficulties in reading acquisition. Teachers may have been more committed to following a regular training schedule than parents because they expected this to be important for these children's learning. At home, parents may have hoped that the game would motivate their children to play without much need for adult intervention. This may imply that parents expect, first and foremost, that digital learning games are engaging and fun and, thus, naturally motivating for those children who are not interested in the subject. This is in accord with Kerawalla and Crook (2005), who found in their interviews that parents and children considered enjoyment as the central criterion for good educational software, with educational benefits tending to receive less attention.

Similar to the observations of Kerawalla and Crook (2005), parents were generally not very actively involved in their children's learning during the GraphoGame sessions. At-home, children typically played alone and had more freedom in deciding when and how long to play than children who played at school. Parents were nevertheless quite active in encouraging children to play, and some of them used rewards as motivators, which none of the teachers did.

Teacher involvement during training was not associated with children's engagement or learning. We found only a weak negative association between the teachers' control over playing times and the total playing time. This may suggest that teachers who needed to set firm limits on playing could not allocate much time for GraphoGame sessions within their schedule. It appears that the teachers' role in the children's learning via GraphoGame at school was small, which may be because of the children's generally high engagement in using the game at school, meaning that adult encouragement and support was less needed in the classroom than at home. However, the data included only 27 teachers, and most teachers were involved with more than one child's GraphoGame use, which may have affected the results concerning the teachers' role.

Parental involvement seemed to be more strongly associated with their children's engagement and learning. Both encouragement and control over playing times were negatively associated with children's engagement. Perhaps parents were trying to make reluctant children play more by actively encouraging them and telling them when and how long to play. This may be a poor strategy in a learning environment where children are used to having more choice concerning the activities they engage in. Prior research has shown that parental involvement strategies that aim to control children's behavior tend to undermine intrinsic motivation and achievement (Pomerantz, Moorman, & Litwack, 2007). In contrast, parent's participation during sessions seemed to be positively associated with the development of the child's reading skill. The support provided by parents during sessions or their mere presence may have helped these children to gain more from the game. Equally possible, however, is that the parents of these children were generally more supportive of their children's learning, producing higher achievement in school, which would also show in the GraphoGame reading test scores. Whether young children can truly benefit from parental presence and support during the use of a learning game such as GraphoGame, designed mainly for a child's independent use, is an interesting topic for future studies.

When considering these results in the light of the self-determination theory (e.g., Ryan & Deci, 2002), it seems possible that GraphoGame sessions at school were better able to satisfy children's needs for competence, autonomy, and relatedness. First, the at-school players, children who were struggling with reading acquisition, were able to experience success through the adaptive game format, something they may have lacked in their other reading lessons. The level of reading skill was higher for children using GraphoGame at home, and perhaps they felt quite competent as readers already at the beginning of the training so the successful experiences with the game were less crucial for their self-image as learners. In addition, the experiences of success may have a stronger positive impact when they occur at school in the presence of a teacher rather than at home, where there may be no one to see the child's good performance. Second, as prior research suggests, the at-home players would be accustomed to having autonomy in choosing which activities to engage in at home, whereas the GraphoGame sessions usually were initiated, at least in part, by parents. This may have felt like a limitation of choice and decreased the children's motivation to play. When at school, children are used to less autonomy, and so an opportunity to play GraphoGame, a game in which the child is in control, may have felt like an increase in freedom and choice. Third, the presence of teachers during GraphoGame sessions, and the fact that in most of the schools in this study, some of the classmates also participated in the GraphoGame activities, may have increased each child's sense of relatedness during training. At home, the child was most likely the only person in the family who used GraphoGame, which would not support the sense of relatedness.

This study has a few limitations. Because of the correlational nature of the study, it is difficult to say anything about the cause–effect relationships. For example, parental involvement may have affected these children's engagement and learning, but it is also possible that the child's behavior prompted some parents to get involved in the training. In addition, the children were not randomly assigned into school and home player groups, which means that there may have been some other factors not controlled in this study that explain the observed differences between the two learning environments. However, as the observations concerning playing time and engagement in this study were in line with the earlier studies addressing home use of educational software, it seems quite safe to conclude that the learning environment plays

an important role in children's experiences of digital game-based learning. Moreover, the absence of a control group makes it impossible to determine to what extent the GraphoGame training affected the development of the children's learning and general reading interest.

Other shortcomings in the motivational design of the GraphoGame version used in the study are noted, such as the absence of multiple, clear goals and the shortage of opportunities for making choices (for a more detailed discussion, see Ronimus et al., 2014), which may have affected the results. Some teachers and parents also reported that the game was too difficult for some of the players. A more carefully designed game with a higher motivational appeal might have reduced the differences observed between the at-home and at-school players in this study.

There were also limitations in the measurements. Because the study was Web-based and the participants were children, the measurement of engagement needed to be simple. However, prior studies indicate that children tend to favor the positive end of the scale when rating their experiences with computer games (Read & MacFarlane, 2006; Sim, MacFarlane, & Read, 2006). Therefore, the method used for measuring the children's own experiences may have provided an overly positive impression of the children's levels of engagement and concentration. In addition, single-item measures were used in the evaluations of motivation and concentration, which may have been too simple a method to evaluate a multidimensional construct such as engagement. Finally, the measurement of adult involvement was limited. It did not gather any detailed information regarding how the adult interacted with the child during training, such as whether the support provided related more to the content of the game or to the technical features. In the future studies, the quality of support should be investigated in more detail to enable a better understanding of how parents and teachers can foster children's engagement and learning via digital game-based learning.

CONCLUSION

The results of this study suggest that the context of use is an important aspect that should not be ignored in the design of digital games for learning. Evidently, especially in the home environment, the motivational design of the game is of crucial importance, whereas the learning effectiveness seems to be the most essential aspect at school. Children seem to be eager to use educational games at school, and therefore, the games that are intended to be used at school could strictly focus on the learning content. In educational games intended for home use, it seems necessary that these games also include features that make learning seem more like play than work. Gaming aspects such as points, rewards, and goals unrelated to learning are familiar to children from their noneducational digital game experiences. Furthermore, the game features should support the child's sense of competence and autonomy. In regard to parental engagement in the child's at-home learning activities, features that would encourage parents to become more involved in the use of these educational games could be potentially effective in supporting children's engagement and learning.

ENDNOTE

1. More information on GraphoGame is available at http://info.graphogame.com

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All correspondence should be addressed to
Miia Ronimus
The Agora Center
University of Jyväskylä
P.O. Box 35
FI-40014 University of Jyvaskyla
Finland
miia.ronimus@jyu.fi

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