Effects of collaboration and motivation in game-based learning

Master Thesis

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Abstract

There is an increasing popularity of game-based learning (GBL). Besides the effectiveness, games have a motivational function. However, the use of serious games is not as motivating as expected, compared to conventional instruction methods. It is expected that collaboration can stimulate the feeling of relatedness, which leads to a higher intrinsic motivation. Additionally, collaboration leads to students who co-construct knowledge, which results in broader and deeper understanding of concepts. The use of guided collaboration improves the quality of learning outcomes. This study aims to look at connections between collaboration, motivation and learning outcomes. A quasi-experimental research with three conditions (individual, non-guided collaboration and guided collaboration) in which the guided collaborative setting used *guidance*, in form of a script with questions. The participants in this research (N = 143) were primary school children between the age of 7 and 10. The participants filled out a motivation questionnaire and knowledge test about '*safe internet*' (pre-test), played a videogame about '*safe internet*' and filled in a motivation questionnaire and knowledge test about '*safe internet*' after the game (post-test). There were no significant differences found for the three conditions on learning gain and gain in intrinsic motivation.

Keywords: Serious Games, Game-based Learning, Collaboration, Guided Collaboration, Intrinsic Motivation

Introduction

Nowadays, people spent a lot of time playing videogames. For this reason, it is plausible that the use of videogames in education will match this generation. This leads to an increasing popularity of the use of digital games in education, referred to as serious games or game-based learning (GBL). O'Neil, Wainess and Baker (2005) hypothesized that GBL addresses cognitive and affective dimensions of learning. For GBL there is a small effect on acquiring knowledge and cognitive skills, compared to conventional instruction methods (Sitzmann, 2011; Wouters, Van Nimwegen, Van Oostendorp & Van der Spek, 2013). In addition, De Freitas (2006) reported that there is a lack of empirical data to support the fact that games in learning contexts work and that there is a lack of understanding about how these games can be used most effectively in practice.

OECD (2016) reported that students in the Netherlands, compared to students from other countries, are not well-motivated. Besides the effectiveness, games have a motivational function and are able to motivate learners to stay engaged for long periods (Plass, Homer & Kinzer, 2015). According to Prensky (2003) it makes a great deal of sense to merge the content of learning and the motivational pull of games. Wouters et al. (2013) however, concluded that GBL is not more motivating than conventional instruction methods. According to the self-determination theory, motivation is determined by three basic needs: competence, autonomy and relatedness. When fulfilled, these needs foster interest, which leads to better learning outcomes (Deci & Ryan, 2000). Nowadays, people are very easily connected through different kinds of media. For this reason, it is plausible that relatedness can match this generation. The use of collaboration in education can fulfill the need of relatedness, which might lead to a higher motivation in students.

Relatedness also plays an important role in the theory of social-constructivism, which states that knowledge is constructed through interaction with peers (social context). This co-

construction of knowledge is called collaboration (Jonassen, 1991). Collaboration leads to students explaining their thoughts and co-construct knowledge (Ter Vrugte & De Jong, 2017), which results in broader and deeper understanding of concepts (O'Donnell & O'Kelly, 1994). But not all kinds of collaboration are automatically more effective. Various activities, such as giving explanations, asking questions and elaborating on content, are known to be effective for learning, which generally do not occur spontaneously in collaboration. Scripted collaboration focus on these activities by structuring group interaction (King, 2007). For this reason, collaboration with the use of scripts improves the quality of learning outcomes (Hummel, Van Houcke, Nadolski, Van der Hiele, Kurvers & Löhr, 2011).

The present study aims to shed light on how collaboration can be used to make the use of GBL more effective and more motivating (see figure 1), in which there will be a focus on games played in a collaborative setting. The software design of the game does not entail collaboration, so the collaboration is face-to-face instead of online (Ter Vrugte & De Jong, 2017). This collaborative setting is divided in two learning settings: non-guided collaboration and guided collaboration. The guided collaborative setting will use a script to examine if the use of a script leads to higher motivation and higher learning outcomes than non-guided collaboration.

Theoretical framework

In this section the definition of GBL and the effects of GBL on motivation and learning are described. Furthermore, the self-determination theory and the theory of constructivism are described, and a link is made between these two theories and collaboration (see figure 1). This section ends with the research questions and hypotheses of the present study.

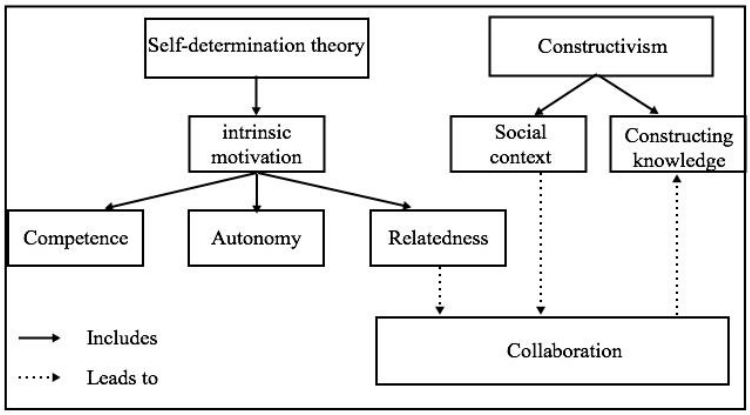

Figure 1: Overview theoretical framework

Game-Based Learning and the effects on learning and motivation

For the purpose of this study, the definition used for GBL is learning through the use of games in which games are interactive environments, based on a set of rules and constraints, providing immediate feedback and directed towards a clear goal (Wouters et al., 2013).

Li and Tsai (2013) concluded that there are still gaps between theory and game design practice. According to Girard, Ecalle and Magnan (2013) only a few games resulted in improved learning, while other games did not have a positive effect on knowledge and skill acquisition, compared to more traditional methods of teaching. However, Wouters et al. (2013) concluded that GBL is more effective than more traditional learning methods, when it comes to learning and retention. In addition, GBL can best be used in groups (instead of individual) and combined with other instructional methods. Their meta-analysis shows that GBL does not lead to higher motivation. It can be concluded that the effect of GBL on learning and engagement is still not proven and that further research is needed.

Motivation

The increasing interest in playing games suggests that videogames affect the motivational processes (Przybylski, Rigby & Ryan, 2010). Motivation can generally be divided in intrinsic motivation and extrinsic motivation. When a person is intrinsically motivated, he does something because he finds it inherently interesting and enjoyable. On the

other hand, when a person does something because it leads to a desired consequence (obtain a reward or avoid a punishment), it is seen as extrinsic motivation (Deci & Ryan, 2000). Intrinsic motivation leads to high-quality learning and creativity (Ryan & Deci, 2000a). Some empirical evidence suggests that greater intrinsic motivation in GBL leads to better learning outcomes (Chen & Law, 2016).

The self-determination theory focuses on the innate needs for competence, autonomy and relatedness to foster intrinsic motivation (Deci & Ryan, 2000). Competence is described as the reach of a person's capacity for an activity. Autonomy relates to the opportunity to be self-responsible and that there are no external forces to do an activity. Relatedness refers to feeling connected to others who are part of the context in which an activity takes place. These needs must be met to foster intrinsic motivation (Deci & Ryan, 2000). The feeling of competence can be met by a balance of challenge and skill, (Ryan & Deci, 2000a). A good balance leads to a feeling of flow, which is an experience of being completely absorbed in an activity (Csikszentmihalyi, 1990). The feeling of autonomy can be met by giving students opportunities for choices (Black & Deci, 2000). The feeling of relatedness can be increased by giving students the opportunity to develop social bonds and allowing them to cooperate (Przybylski, Rigby & Ryan, 2010). Yee (2006) concluded that social (interaction with other humans) and immersion (being absorbed in the virtual environment) motives were linked to more hours of gameplay. In addition, Sherry and Lucas (2003) found that videogames used to socialize with friends lead to more hours of gameplay.

In summary, socializing, cooperation and social interactions create a feeling of relatedness, which can be seen as a motivational factor to play games, alongside the factors competence and autonomy. Therefore, it can be assumed that when social interactions are implemented in a game, the feeling of relatedness increase, which lead to higher motivation to play the game.

Collaboration

Wouters and Van Oostendorp (2017) provide an overview of instructional techniques in GBL that have an effect on learning. One of these instructional techniques is collaboration. When two or more people engage in problem-solving and co-construct knowledge, it can be seen as collaboration (Jonassen, 1991). Wouters and Van Oostendorp (2017) concluded that collaboration may be an effective method to incite additional learning activities. This is in line with the finding that discussing game play with peers positively affects social problem-solving ability (Kim, Park & Baek, 2009). In collaborative environments students can explain their thoughts to other students and foster explicit knowledge (Ter Vrugte & De Jong, 2017). Communication, intellectual exchange and task-oriented cooperation occurs in collaborative groups, which results in broader and deeper understanding of concepts (O'Donnell & O'Kelly, 1994).

Collaborative learning, compared to individual learning, has numerous benefits according to Laal and Ghodsi (2012), such as higher achievement, greater productivity, supportive and committed relationships, greater psychological health, social competence and self-esteem. In collaboration, activities should be developed to foster developmental interactions between group members (Doolittle, 1997). Vygotsky (1978) describes in his theory of cognitive development that through social interactions with more knowledgeable others (peers and adults), children develop higher mental functions as problem-solving skills, moral reasoning and memory schemas.

However, not all research on collaboration shows positive effects on learning outcomes. Some empirical evidence suggests that collaboration without consistent support usually fails in achieving productive learning interactions (Ter Vrugte & de Jong, 2017; Meluso, Zheng, Spires & Lester, 2012; Van der Meij, Albers & Leemkuil, 2011). Ter Vrugte and De Jong (2017) concluded from several studies that discussion (providing feedback on

explanations) in collaboration needs to be guided to be effective. Otherwise, there is a lack of depth in the dialogues between students. A solution for this problem might be scripted collaboration or questions that can focus the discussion (Van der Meij et al., 2011; Ter Vrugte & De Jong, 2017). Guidance during collaboration should be designed in a way it does not disturb the feeling of flow, which is positively correlated to learning (Csikszentmihalyi, 1990; Webster, Trevino & Ryan, 1993).

In GBL, gameplayers learn how to take information from different sources, create strategies, learn to make decisions quickly, use experimentation to understand complex systems and learn how to collaborate with others (Prensky, 2003). In sum, collaboration can be seen as a solution for GBL to be more effective in both learning outcomes and motivation. It is important to keep in mind that guidance in collaboration might be needed to have a positive effect.

Present research

There is more research necessary to investigate whether the increase in learning motivation, caused by the use of GBL, has an impact on the cognitive aspects of learning (Li & Tsai, 2013). The benefits of the use of collaboration in GBL is not always confirmed. More research is required to investigate whether scripted collaboration in GBL improves learning and stimulates motivation (Van der Meij et al., 2011).

This study aims to look at the connections between collaboration (guided and non-guided), motivation and learning outcomes and to answer the following research question: To what extent does a non-guided collaborative learning setting and a guided collaborative learning setting in GBL leads to higher intrinsic motivation and higher learning outcomes compared to an individual learning setting? Figure 2 gives an overview of the concepts used in this study and the connections between them.

Based on the theories described above, the following sub questions are formulated:

Question 1: *Does game-based learning lead to learning gain and to what extent does a guided collaborative learning setting and a non-guided collaborative learning setting in game-based learning lead to higher learning gain compared to an individual learning setting?*

Hypothesized is that game-based learning leads to learning gain (H1.1). In addition, it is hypothesized that a guided collaborative learning setting leads to higher learning gain compared to a non-guided collaborative learning setting and that a non-guided collaborative learning setting leads to higher learning gain compared to an individual learning setting (H1.2).

Question 2: *To what extent does a guided collaborative learning setting and a non-guided collaborative learning setting in game-based learning lead to an increase in intrinsic motivation compared to an individual learning setting?*

Hypothesized is that a guided collaborative learning setting leads to a greater increase in intrinsic motivation when compared to a non-guided collaborative learning setting and that a non-guided collaborative learning setting leads to a greater increase in intrinsic motivation in comparison to an individual learning setting (H2).

Question 3: *To what extent does gain in intrinsic motivation have a mediating effect on learning gain for the non-guided collaborative learning setting and the guided collaborative learning setting?*

Hypothesized is that a guided collaborative learning setting leads to higher gain in intrinsic motivation and thereby higher learning gain, compared to a non-guided collaborative learning setting (there is a mediating effect) (H3).

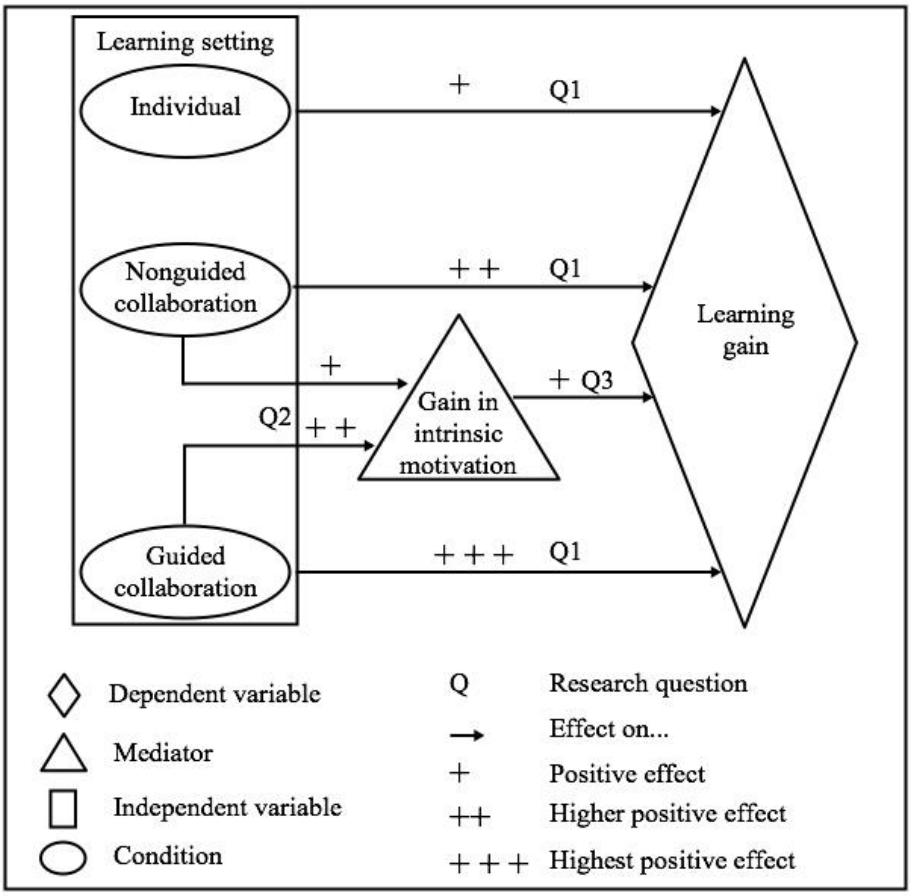

Figure 2: Research-model

Method

Design

This study is a quasi-experimental research with three conditions (see figure 2). The dependent variables are *learning gain* and *gain in intrinsic motivation*, where *gain in intrinsic motivation* is also the mediation variable. The independent variable is *learning setting*, in which there are three conditions: individual learning setting (N = 40), non-guided collaborative learning setting (N = 53) and guided collaborative learning setting (N = 50). All participants (N = 143) were allocated in the conditions randomly. For a medium effect size with α = .05 and a power of .80, a power analysis revealed that 143 participants were required (G*Power; Faul, Erdfelder, Lang & Buchner, 2007).

Participants

At the start of this study, 149 primary school children participated. Six participants were not present during the experiment and post-test. Eventually, 143 primary school children between the age of 7 and 10 participated in this study. 71 were female and 72 were male. 69 participants went to school 1 and 74 participants went to school 2 in Utrecht, the Netherlands. Eight different classrooms were involved, in which 89 participants were in 'group 5' and 54 participants were in 'group 6'. Because the participants were younger than 18 years old, the parents received an informed consent to give permission (appendix E) and filled out an informed consent themselves (appendix F).

Instrument

Domain. The game that is used is the game 'Diploma Veilig Internet' (DVI) (https://www.diplomaveiliginternet.nl/landing/#/). The game is about *safe internet*, which aims to teach how to act when you go online. The game consists of five domains: surfing on internet, reliability, searching, identity and digital bullying (see table 1).

Table 1: The domains of the game 'Diploma Veilig Internet'.

Domain	Description
Surfing on internet	About what internet is and the possibilities on the internet
Reliability	About who and what you can trust on the internet
Searching	About how to look for information on the internet
Identity	About who you are, which information you share, and which passwords are safe to use
Digital bullying	About bullying on the internet and how to react on it

Motivation. To measure the intrinsic motivation of students to play games, the Intrinsic Motivation Inventory (IMI) was used (Ryan & Deci, 2000b), which originally

consists of seven factors. For the purpose of this study four factors were used: ‘interest/enjoyment’ (overall intrinsic motivation), ‘perceived competence’, ‘perceived choice’ (autonomy) and ‘relatedness’. The questions for these factors were translated into Dutch and a native English speaker translated the questions back. After this, a few adjustments were made to remove uncertainties. An example is that in the question ‘*Ik vind dit spel best aangenaam’* the word ‘*aangenaam*’ was adapted in ‘*plezierig*’ and the question ‘*Ik heb geen keuze in het doen van dit spel*’ was changed in ‘*Ik heb niet echt een keuze bij het doen van dit spel*’.

The factor ‘interest/enjoyment’ consists of seven questions and an example is: *Ik vind het leuk om dit spel te doen*. The factor ‘perceived competence’ consists of six questions and an example is: *Ik denk dat ik best goed ben in dit spel*. The factor ‘perceived choice’ consists of seven questions and an example is: *Ik geloof dat ik een keuze heb in het doen van dit spel*. The factor ‘relatedness’ consists of eight questions and an example is: *Tijdens het spelen van een spel voel ik mij heel afstandelijk van een ander persoon*.

Since the age of the participants is low, a scale with a high number of points might cause the young participants not to know the differences between the scores. Therefore a 5-point Likert scale with smileys is chosen to be used (☹ = I totally disagree, 🙁 = I disagree a little, 😐 = I do not agree and do not disagree, 😀 = I agree a little bit , 😁 = I totally agree). The smileys were used by Aarts (2015) and were determined successfully. The questionnaire was on paper and participants needed to answer the questions individually. For the pre-test the participants were told to think about games they play in the classroom while filling out this questionnaire. For the post-test the participants were told to think about the game DVI they just played while filling in the questionnaire. The questionnaire is added in appendix A.

Learning outcomes. A knowledge test is used to measure the learning outcomes of the students on the domain *safe internet*. The knowledge test is based on the questions of the

test of DVI (https://www.diplomaveiliginternet.nl/public/toets/begin). The test consists of 15 questions and an example is: *Nienke schrijft op Facebook: 'De juf deed vandaag echt heel dom. School is saaaaaaai! Gaap!!'. Is dat slim van Nienke?*. The questions could be answered by choosing between four possible answers (a, b, c or d). All questions were used in the pre-test and in the post-test, but in a different order. The knowledge test was on paper and participants needed to answer the questions individually (appendix B).

Guidance. For the participants in the guided collaborative learning setting, a script was used. This script was based on the MURDER script described by Kobbe, Weinberger, Dillenbourg, Harrer, Hämäläinen, Häkkinen and Fischer (2007). In this approach the participants are divided in pairs and within each pair one participant has the role of summarizer and the other participant has the role as listener. In the MURDER script there are six activities: a) relaxing, focusing, b) reading, monitoring comprehension, c) summarizing, explaining, d) monitoring, giving feedback, e) elaborating and f) reviewing, reflecting.
To implement this script a questionnaire was developed. This questionnaire consists of three questions to guide the collaboration and can be found in appendix C.

Environment

The game that is used is the game 'Diploma Veilig Internet' (DVI). The game is about four children who need to rescue 'uncle Ap', who is trapped in a cage on the internet. The four children in the game need the help of the gameplayer. There are five levels in the game: Each level is designed as a room in which there are various objects that have something to do with *safe internet*. The player needs to answer questions about *safe internet*, which appear by clicking on various objects. When the questions are answered correctly, the player earns stars. When all stars in a level are earned, the player receives a key. In total, five levels need to be played and five keys need to be received. The game is finished when uncle Ap is freed from the internet.

The game was played on tablets and computers. When possible, the game was played in the classroom of the participants. If not, participants played the game in another classroom. When participants played the game collaborative, one screen was used (tablet or computer). Figure 3, 4 and 5 are screenshots of the game DVI.

Figure 3: screenshot 1 DVI; The home screen of the game

Figure 4: Screenshot 2 DVI; The room in the level 'Speurneuzen'

Figure 5: Screenshot 3 DVI; An example of the questions in the game

Pilot. A pilot of the motivation questionnaires and the knowledge test was done to measure if the questions were clearly formulated and if the participants were able to answer them. Ten participants (N = 10), who did not participate in this study, answered the questionnaires. The difficulty level of the knowledge questions was calculated. All questions that scored 90% or higher (indicating that they were too easy) were excluded, which were five questions. 15 questions remained in the knowledge test. In the motivation questionnaire a few adjustments were made. In four questions, a sentence was added to make them more understandable. An example is: *Ik voel mij verbonden met een ander persoon tijdens het spelen van een spel (verbonden = bij elkaar, samen)*.

The knowledge test was reviewed by an expert, namely a teacher of class five. The expert concluded that the questions were clear and that they aligned with the level of the students. The researcher, also a teacher, examined if the questions measure the knowledge of the domain *safe internet*.

Procedure

Participants. The experiment started with a pilot for the motivation questionnaire and the knowledge test. After that, schools who were willing to participate in this study were

collected. The purpose of the study and its research-design were introduced during a headmaster meeting and two headmasters that wanted to participate were chosen. After that, the teachers of the participating classrooms were informed and the consent forms for the parents were handed over (appendix E). The teachers handed out the forms to the parents of the children in their classroom in week 8. The parents had to return the signed forms to the teacher within two weeks. In week 10 the signed consent forms were collected at the schools and the participating children were counted. All children who had permission from their parents and wanted to participate in this research filled in an informed consent themselves before the pre-test (appendix F).

Experiment. The experiment started with a pre-test. The participants of school 1 filled out the motivation questionnaire and knowledge test in week 11 and the participants of school 2 filled out the motivation questionnaire and knowledge test in week 12. Filling out the questionnaires took 35 minutes. After the pre-test the classes were randomly assigned to one of the three learning settings (individual, non-guided collaborative and guided collaborative). Participants from school 1 played the game DVI in week 13 and participants from school 2 played the game DVI in week 14 on a regular school day. The game was played on tablets and computers in the classrooms for 50 minutes. Before the participants started to play the game, they received an instruction by the researcher (appendix D). The participants in the collaborative learning settings were told to make pairs by themselves. If this was a problem, the teacher divided the group in pairs. The guided collaborative learning setting received the script questions after they finished a level. Directly after playing the game, all participants filled out the motivation questionnaire post-test and the knowledge test. This was done individually in the classrooms. Filling out the questionnaires took 35 minutes. A timetable for the procedure is added in appendix G. Additionally, a risk analysis is added in appendix H.

Analysis

For hypothesis 1.1 a paired sample T-test was used, with *knowledge pre-test* and *knowledge post-test* as paired variables. For hypothesis 1.2 a one-way between groups analysis of variance (ANOVA) was used with *learning setting* as independent variable and *learning gain* (post-test minus pre-test) as dependent variable. Another ANOVA was used with *learning setting* as independent variable and *gain in intrinsic motivation* (post-test minus pre-test) as dependent variable for hypothesis 2. For hypothesis 3 PROCESS (Hayes, 2015) was used with *type of collaboration* (non-guided and guided) as independent variable, *learning gain* (post-test minus pre-test) as dependent variable and *gain in intrinsic motivation* (post-test minus pre-test) as mediation variable. For all analyses a significance level of 5% was used.

Data

Each participant was linked to a code, to ensure anonymity. Each classroom was assigned a letter and all participants in that classroom had a number. The collected data was stored on a secured server, YoDa, to ensure privacy.

Cronbach's alpha for the intrinsic motivation questionnaire is determined for the four factors: interest (α = .80), perceived competence (α = .66), perceived choice (α = .73) and relatedness (α = .60). The knowledge test consists of fifteen items and scored a Cronbach's alpha of .72. A Cronbach's alpha above .60 is seen as sufficient, where a Cronbach's alpha above .70 is seen as good (Evers, Lucassen, Meijer & Sijtsma, 2009). In total, the scores of 11 items of the motivation questionnaire were reversed, by recoding 1 as 5, 2 as 4, 4 as 2 and 5 as 1.

Results

Table 1: Mean scores and standard deviations (between brackets) of knowledge, intrinsic motivation and feeling of relatedness

	Individual	Non-guided collaboration	Guided collaboration
N	40	53	50
Knowledge pre-test	7.10	8.45	8.52
	(2.31)	(3.02)	(2.94)
Knowledge post-test	8.13	9.09	8.98
	(2.85)	(3.18)	(3.47)
Learning gain	1.03	0.64	0.46
	(1.93)	(2.15)	(2.22)
Intrinsic motivation pre-test	3.64	3.66	3.71
	(0.35)	(0.49)	(0.44)
Intrinsic motivation post-test	3.77	3.76	3.88
	(0.35)	(0.55)	(0.45)
Gain of intrinsic motivation	0.13	0.10	0.17
	(0.58)	(0.55)	(0.55)
Feeling of relatedness pre-test*	3.43	3.49	3.37
	(0.50)	(0.68)	(0.63)
Feeling of relatedness post-test*	3.37	3.60	3.89
	(0.69)	(0.68)	(0.70)
Gain of feeling of relatedness*	-0.06	0.11	0.52
	(0.78)	(0.73)	(0.82)

* Subscale feeling of relatedness of intrinsic motivation

Data inspection. Before analyzing the data, inspection of the skewness, kurtosis and Shapiro-Wilk statistics was conducted for knowledge post-test, *learning gain* and *gain in intrinsic motivation*. Furthermore, eight outliers were found in the dataset. Because removing these outliers did not influence the results, the outliers were not removed from the dataset. The Shapiro-Wilk test was significant for learning gain for the non-guided learning setting (p = .026) and guided collaborative learning setting (p = .020) and for the gain of feeling of relatedness for the guided collaborative learning setting (p = .016), which indicates that these groups are not normally distributed. The normal Q-plots show that the scores lie on the line, which indicates that the data is normally distributed for all groups. Based on these results, it is assumed that the data is normally distributed. The Test of Homogeneity of Variances shows that Levene's statistics is non-significant for *learning gain* (p = .553), *gain in intrinsic motivation* (p = .797) and *gain in feeling of relatedness* (p = .882). It can be concluded that the assumption of homogeneity of variance has not been violated.

Hypothesis 1.1: *Game-based learning leads to an increase in learning gain.*

A paired sample t-test with an α of .05 was used to compare the knowledge pre-test to the knowledge post-test. Overall the post-test scores were significantly higher (M = 8.78, SD = 3.20) than the pre-test scores (M = 8.10, SD = 2.86), $t(143) = -3.88$, $p < .001$, indicating that the participants learned from playing the game.

Hypothesis 1.2: *A guided collaborative learning setting leads to higher learning gain compared to a non-guided collaborative learning setting and a non-guided collaborative learning setting leads to higher learning gain compared to an individual learning setting.*

An ANOVA was used with *learning setting* as independent variable and *learning gain* as dependent variable. The ANOVA was statistically non-significant, indicating that there is no difference between the three conditions on *learning gain*, $F(2,140) = 0.81$, p = .446.

Hypothesis 2: *A guided collaborative learning setting leads to a greater increase in intrinsic motivation when compared to a non-guided collaborative learning setting and a non-guided collaborative learning setting leads to a greater increase in intrinsic motivation in comparison to an individual learning setting.*

An ANOVA was used with *learning setting* as independent variable and *gain in intrinsic motivation* as dependent variable. The ANOVA was statistically non-significant, indicating that there is no difference between the three learning settings on *gain in intrinsic motivation*, $F(2, 140) = 0.20$, $p = .818$.

Another analysis is conducted to determine if collaboration does have effect on one of the subscales of intrinsic motivation, namely feeling of relatedness, because it was expected that collaboration would lead to higher feeling of relatedness. An ANOVA was used with *learning setting* as independent variable and *gain in feeling of relatedness* as dependent variable. The ANOVA was statistically significant, indicating there is a difference between the three conditions on *gain in feeling of relatedness*, $F(2, 140) = 6.83$, $p = .001$. Post hoc analyses with Tukey's HSD ($\alpha = .05$) revealed that participants who played the game in a guided collaborative learning setting ($M = 0.52$, $SD = 0.81$) had a significantly higher *gain in feeling of relatedness* than the participants who played the game individually ($M = -0.06$, $SD = 0.78$) ($p = .002$) and the participants who played the game in a non-guided collaborative learning setting ($M = 0.11$, $SD = .73$) ($p = .022$). There was no significant difference between the non-guided collaborative learning setting and the individual learning setting ($p = .565$).

Hypothesis 3: *A guided collaborative learning setting leads to higher gain in intrinsic motivation and thereby higher learning gain, compared to a non-guided collaborative learning setting (there is a mediating effect).*

PROCESS was used to investigate the effects of *type of collaboration* (non-guided or guided) and *gain in intrinsic motivation* on *learning gain*, with *type of collaboration* as

independent variable (X variable), *gain in intrinsic motivation* as mediator variable and *learning gain* as dependent variable (Y variable) (see figure 6).

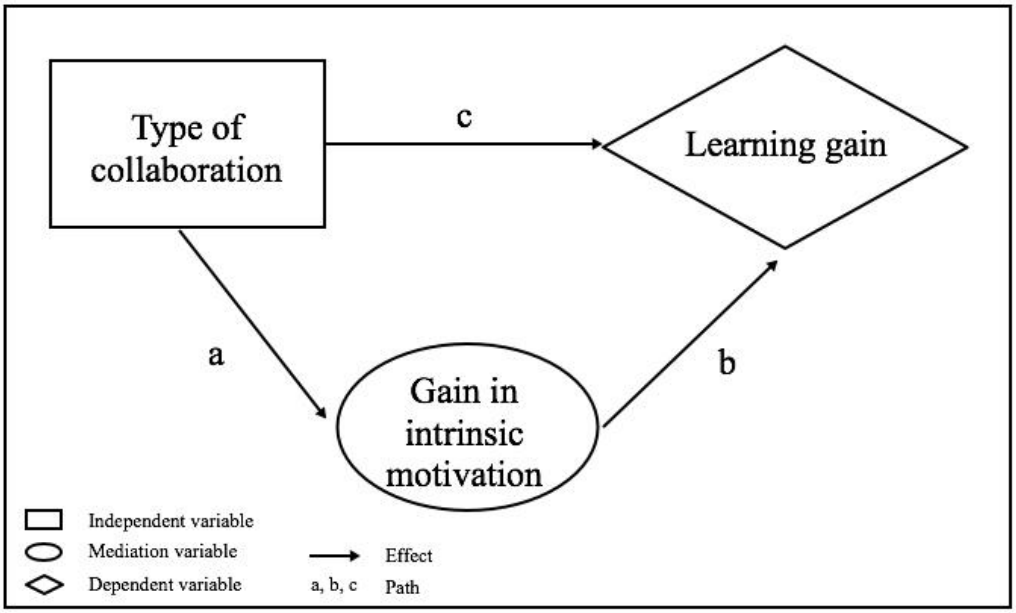

Figure 6: Mediation analysis Process (a = effect of type of collaboration on intrinsic motivation gain, b = mediation effect of intrinsic motivation gain on learning gain, c = direct effect of type of collaboration on learning gain)

Step 1 of the mediation model showed that the effect of *type of collaboration* (ignoring the mediator) on *learning gain* was non-significant, $F(1,101) = 0.72$, $p = .399$, $R^2 = .00$, with $b = -0.17$, $t(101) = -.85$, $p = .399$ (path c). This result indicates there is no mediation effect.

Step 2 of the mediation model showed that the *type of collaboration* on the mediator, *gain in intrinsic motivation*, was also non-significant, $F(1,101) = 0.29$, $p = .590$, $R^2 = 0.00$ with $b = 0.03$, $t(101) = 0.54$, $p = .590$ (path a). Step 3 showed that the mediator (*gain in intrinsic motivation*), controlling for *type of collaboration* was non-significant predictor for *learning gain*, $b = -.17$, $t(100) = -.84$, $p = .404$. Step 4 of the analysis show that, controlling for the mediator (*gain in intrinsic motivation*), *type of collaboration* was a non-significant predictor for *learning gain*, $b = -0.03$, $t(100) = -0.07$, $p = .948$. These results show there is no mediation effect.

Conclusion. Based on the results it can be concluded that the participants did have a positive learning gain, which leads to accepting hypothesis 1.1. There were no significant differences between the three conditions (individual, non-guided collaborative and guided collaborative) on *learning gain*, therefore hypothesis 1.2 has been rejected. Additionally, there were no significant differences between the three learning settings (individual, non-guided collaborative and guided collaborative) on *gain in intrinsic motivation*, therefore hypothesis 2 has been rejected.

However, significant differences were found between the three learning settings (individual, non-guided collaborative and guided collaborative) on *gain in feeling of relatedness*. The guided collaborative learning setting scored 0.58 higher than the individual learning setting and 0.41 higher than the non-guided collaborative learning setting.

Moreover, *gain in intrinsic motivation* and *type of collaboration* are non-significant predictors for *learning gain*, therefore hypothesis 3 has been rejected.

Explorative analysis. A factor that could have influenced the intrinsic motivation of the participants was the way pairs were created. Self-placed participants (N = 53) were allowed to make pairs by themselves and teacher-placed participants (N = 50) were placed in pairs by the teacher. To investigate if this had an effect, an explorative analysis was conducted. An ANOVA was used with *type of collaboration and duo (1 = non-guided self-placed, 2 = non-guided teacher-placed, 3 = guided self-placed and 4 = guided teacher-placed)* as independent variable and *gain in intrinsic motivation* as dependent variable. The ANOVA was statistically non-significant, indicating there is no difference between the four groups, $F(3, 99) = 0.28$, $p = .842$.

This explorative analysis shows that there is no difference in *gain in intrinsic motivation* between participants who chose their own partners and participants who were placed in pairs by the teacher.

Conclusion and discussion

Previous studies have shown that GBL has a positive effect on acquiring knowledge and cognitive skills when compared to conventional instruction methods, but is does not seem to be as motivational as predicted (Sitzmann, 2011; Wouters et al., 2013). This present research investigated whether the intrinsic motivation to play educational games and the learning gain of children could be increased with the use of collaboration, to answer the following research question: *To what extent does a non-guided collaborative learning setting and a guided collaborative learning setting in GBL leads to higher intrinsic motivation and higher learning outcomes compared to an individual learning setting?*

Learning gain. The first sub question was: *Does game-based learning leads to learning gain and to what extent does a guided collaborative learning setting and a non-guided collaborative learning setting in game-based learning leads to higher learning gain compared to an individual learning setting?*

The results show that the participants scored higher on the knowledge test after plating the game. Wouters et al. (2013) and Sitzmann (2011) concluded that, compared with more traditional learning methods, GBL is a more effective when it comes to learning. Based on the results it can be concluded that the use of GBL is an effective method to obtain learning gain.

However, there are no significant differences between the individual learning setting, the non-guided collaborative learning setting and the guided collaborative learning setting on learning gain. These results are not in line with the conclusions of Wouters and Van Oostendorp (2017), namely that collaboration in GBL improves learning compared to GBL without collaboration. A possible explanation for the result that the guided collaborative learning setting did not score higher on learning gain compared to the non-guided collaborative learning setting and the individual learning setting might be that the participants in the guided collaborative learning setting did not receive a training for working with the

script. The participants received an instruction before they started to play the game but were not used working with the script. It is possible that not knowing how to work with the script resulted in lower learning gain.

Furthermore, the script that is used for the guided collaborative learning setting might not have encouraged the participants enough to discuss the levels. In the forms of the scripts that the participants filled in, it can be seen that some of the participants answered the questions with answers like '*nothing'* and '*no'*. It seems that not all participants took the time to discuss the questions. This might have resulted in a lack of depth in the dialogues between the participants, which can be caused by lack of consistent support (Ter Vrugte & de Jong, 2017; Meluso et al. 2012; Van der Meij et al., 2011). In this study, the dialogues between the participants were not recorded. For this reason, the dialogues could not be analyzed. Additionally, the participants had to stop playing the game to answer the questions of the script. It is possible that the guidance was designed in a way that disturbed the feeling of flow. The feeling of flow is positively correlating to learning (Csikszentmihalyi, 1990; Webster, Trevino & Ryan, 1993; Hamari, Shernoff, Rowe, Coller, Asbell-Clarke & Edwards, 2015). Although Ter Vrugte and De Jong (2017) advised scripted collaboration and questions that can focus the discussion to be a solution for the lack of depth in dialogues, this was not confirmed in this research.

In addition, Crook (1998) states that younger children find collaborative learning intrinsically difficult and that children lack the necessary socio-cognitive resources to learn effectively from collaborative learning. It is possible that the participants in the non-guided collaborative learning setting and the guided collaborative learning setting had a lack of socio-cognitive resources, which affected their learning gain.

Intrinsic motivation. The second sub question was: *To what extent does a guided collaborative learning setting and a non-guided collaborative learning setting in game-based*

learning lead to an increase in gain in intrinsic motivation compared to an individual learning setting? And the third sub question was: *To what extent does gain in intrinsic motivation have a mediating effect on learning gain for the non-guided collaborative learning setting and the guided collaborative learning setting?*

Based on the results it can be concluded that there was no significant difference between the three conditions on *gain in intrinsic motivation* and that *gain in intrinsic motivation* had no mediating effect on *learning gain*.

During the experiment the researcher walked around the classroom and observed the participants while they were playing the game and answering the questions of the script. A few participants in the guided collaborative learning setting have declared that they did not like answering the questions of the script after finishing a level. The participants had to answer these questions and by not answering the questions, they could no longer participate in this study. By giving students opportunities for choices, for example when to study and the way of solving problems, the feeling of autonomy can be met (Black & Deci, 2000). This was not the case in this study, because the participants had to play a mandatory game at a mandatory point of time and additionally, they had no choice in using the script. This might be an explanation for a smaller increase in *gain in intrinsic motivation* for the guided collaborative learning setting than expected.

Theoretical and practical implications

These findings have important theoretical implications. First, the results are in line with the findings of Van der Meij et al. (2011), who concluded that collaboration did not affect game motivation and individual knowledge test scores. Additionally, the results of *gain in feeling of relatedness* are in line with the self-determination theory, which states that the feeling of relatedness can be met by giving students the opportunity to develop social bonds and allowing them to cooperate (Przybylski, Rigby & Ryan, 2010). Finally, the conclusion

that GBL leads to learning gain is of added value for the findings of Wouters et al. (2013) and Sitzmann (2011) conclusion, namely that compared with more traditional learning methods, GBL is a more effective when it comes to learning.

A practical implication is that teachers can use these results by implementing games and collaboration in their classrooms. The use of collaboration leads to greater feeling of relatedness, which could lead to higher intrinsic motivation in students. Additionally, the results show that collaboration needs to be guided in a way it fits the population and that collaboration without consistent support usually fails in achieving productive learning interactions (Ter Vrugte & de Jong, 2017; Meluso, Zheng, Spires & Lester, 2012; Van der Meij et al., 2011).

Limitations

In this study, the game was played in a collaborative learning setting (guided or non-guided). The game itself did not entail collaboration. This means that the software was not designed in a way it could be used for collaboration in online gameplay (Ter Vrugte & De Jong, 2017). A game that does entail collaboration, in which the participants could play the game online with others on their own device, might be a better game to use for collaboration. In addition, the game DVI might not have been challenging enough for the participants to achieve the feeling of flow. This feeling can be met through a balance between challenge and competence and is positively correlating to learning (Csikszentmihalyi, 1990; Webster, Trevino & Ryan, 1993; Hamari, Shernoff, Rowe, Coller, Asbell-Clarke & Edwards, 2015). Due to organizational reasons, the game was played for only fifty minutes. Very few participants could finish all five levels of the game. This might have led to lower learning gain. Moreover, the participants did not play the game before and did not know how to play the game at the start of the experiment. This could have been prevented by using multiple

training sessions. Wouters et al. (2013) state that multiple training sessions lead to becoming used to a complex learning environment and this has a positive effect on learning.

Another limitation of the present study is that this research is solely based on children in class five and six, derived from two primary schools. Due to this fact, the results cannot be generalized for all primary school children.

Another critical comment can be made on the measurement of intrinsic motivation. The questionnaire is filled out right after playing the game, but it is possible that measuring the intrinsic motivation during gameplay would lead to different scores. Furthermore, other techniques could be used to measure intrinsic motivation, for example using an infrared camera (Wouters & Van Oostendorp, 2017). With the use of this camera the engagement someone experiences can be measured during an activity.

Future research

Further research is needed to investigate the effect of collaboration on learning gain with the use of a game that entails collaboration. Therefore, a similar research can be conducted with the use of another game. Moreover, it can be examined if guided collaboration in the way it was used in this research could be effective in another age range or if the guidance could be designed in a way it fits this population better and does not disturb the feeling of flow. For example, the questions could be implemented in the game or the guidance is supervised by a teacher.

It can be interesting to investigate if collaboration between partners with different prior knowledge (heterogeneous partners) in GBL leads to higher learning gains and higher intrinsic motivation compared to collaboration between partners with approximately the same prior knowledge (homogeneous partners).

This present research gives insight in the use of collaboration in GBL and the effects

on intrinsic motivation and learning gains. Although there are no significant differences found between the individual learning setting and the collaborative learning settings, the present study shows that the feeling of relatedness can be improved by the use of collaboration.

References

Aarts, M. (2015). Het effect van wijzigingen in de manier van begeleiding op de intrinsieke motivatie van plusleerlingen op de basisschool. *Bachelorthesis, Universiteit Utrecht*.

Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education*, *84*(6), 740-756.

Crook, C. (1998). Children as computer users: The case of collaborative learning. *Computers & Education*, *30*(3-4), 237-247.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience.* New York: Harper-Perennial.

Deci, E. L., & Ryan, R. M. (2000). The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological inquiry*, *11*(4), 227-268.

De Freitas, S. (2006). Learning in immersive worlds: A review of game-based learning.

Doolittle, P. E. (1997). Vygotsky's zone of proximal development as a theoretical foundation for cooperative learning. *Journal on Excellence in College Teaching*, *8*(1), 83-103.

Evers, A. V. A. M., Lucassen, W., Meijer, R., & Sijtsma, K. (2009). COTAN beoordelingssysteem voor de kwaliteit van tests (geheel herziene versie). *Amsterdam: NIP*.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior research methods*, *39*(2), 175-191.

Girard, C., Ecalle, J., & Magnan, A. (2013). Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. *Journal of Computer Assisted Learning*, *29*(3), 207-219.

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. (2016). Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning. *Computers in human behavior*, *54*, 170-179.

Hayes, A. F. (2015). The PROCESS macro for SPSS and SAS. From http://processmacro.org/index

Hummel, H. G., Van Houcke, J., Nadolski, R. J., Van der Hiele, T., Kurvers, H., & Löhr, A. (2011). Scripted collaboration in serious gaming for complex learning: Effects of multiple perspectives when acquiring water management skills. *British Journal of Educational Technology*, *42*(6), 1029-1041.

Jonassen, D. H. (1991). Evaluating constructivistic learning. *Educational Technology*, *31*(9), 28-33.

Kim, B., Park, H., & Baek, Y. (2009). Not just fun, but serious strategies: Using meta cognitive strategies in game-based learning. *Computers & Education*, *52*(4), 800-810.

King, A. (2007). Scripting collaborative learning processes: A cognitive perspective. In *Scripting computer-supported collaborative learning* (pp. 13-37). Springer, Boston, MA.

Kobbe, L., Weinberger, A., Dillenbourg, P., Harrer, A., Hämäläinen, R., Häkkinen, P., & Fischer, F. (2007). Specifying computer-supported collaboration scripts. *International Journal of Computer-Supported Collaborative Learning*, *2*(2-3), 211-224.

Laal, M., & Ghodsi, S. M. (2012). Benefits of collaborative learning. *Procedia-social and behavioral sciences*, *31*, 486-490.

Li, M. C., & Tsai, C. C. (2013). Game-based learning in science education: A review of relevant research. *Journal of Science Education and Technology*, *22*(6), 877-898.

Meluso, A., Zheng, M., Spires, H. A., & Lester, J. (2012). Enhancing 5th graders' science

content knowledge and self-efficacy through game-based learning. *Computers & Education*, *59*, 497–504. doi:10.1016/j.compedu.2011.12.019.

O'Donnell, A. M., & O'Kelly, J. (1994). Learning from peers: Beyond the rhetoric of positive results. *Educational Psychology Review*, *6*(4), 321-349

OECD (2016). *Netherlands 2016: Foundations for the Future*. Reviews of National Policies for Education, OECD Publishing, Paris. Doi: http://dx.doi.org/10.1787/9789264257658-en

O'Neil, H. F., Wainess, R., & Baker, E. L. (2005). Classification of learning outcomes: Evidence from the computer games literature. *Curriculum Journal*, *16*, 455–474. doi:10.1080/09585170500384529

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist*, *50*(4), 258-283.

Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment (CIE)*, *1*(1), 21-21.

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of general psychology*, *14*(2), 154.

Ryan, R. M., & Deci, E. L. (2000a). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary educational psychology*, *25*(1), 54-67.

Ryan, R. M., & Deci, E. L. (2000b). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist*, *55*(1), 68.

Sherry, J., & Lucas, K. (2003). *Video game uses and gratifications as predictors of use and game preference*. Presented at the Mass Communication Division, International Communication Association Annual Convention, San Diego, CA.

Sitzmann, T. (2011). A meta-analytic examination of the instructional effectiveness of computer-based simulation games. *Personnel psychology*, *64*(2), 489-528.

Ter Vrugte, J., & De Jong, T. (2017). Self-explanations in game-based learning: From tacit to transferable knowledge. In *Instructional techniques to facilitate learning and motivation of serious games* (pp. 141-159). Springer, Cham.

Van der Meij, H., Albers, E., & Leemkuil, H. (2011). Learning from games: Does collaboration help? *British Journal of Educational Technology, 42*, 655–664. doi:10.1111/j.1467-8535.2010.01067.x.

Vygotsky, L.S. (1978) Mind in Society. *The Development of Higher Psychological Processes*. Edited by M. Cole, V. John-Steiner, S. Scribner & E. Souberman. Cambridge, Massachusetts: Harvard University Press.

Webster, J., Trevino, L. K., & Ryan, L. (1993). The dimensionality and correlates of flow in human-computer interactions. *Computers in human behavior*, *9*(4), 411-426.

Wouters, P., Van Nimwegen, C., Van Oostendorp, H., & Van Der Spek, E. D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of educational psychology*, *105*(2), 249.

Wouters, P., & Van Oostendorp, H. (2017). Instructional techniques to facilitate learning and motivation of serious games. In Wouters, P., & Van Oostendorp, H. (Eds.). *Instructional techniques to facilitate learning and motivation of serious games* (Advances in game-based learning) (pp. 1-16). Cham, Switzerland: Springer. doi:10.1007/978-3-31939298-1

Yee, N. (2006). The demographics, motivations and derived experiences of users of massively multiuser online graphical environments. *PRESENCE: Teleoperators and Virtual Environments*, *15*, 309–329.

Appendix A – Motivation questionnaire

Code:

School:

Beste leerling,

Hieronder staan 28 stellingen. Deze stellingen gaan over spellen die je op de computer/tablet speelt in de klas/het spel op de computer/tablet dat je hebt gespeeld. Lees de stelling goed en beantwoord de vraag door een kruis te zetten door een van de smileys. Geef antwoord op elke stelling. Als je niet weet welk antwoord je moet geven, kies dan toch een van de smileys.

Dit zijn de smileys waaruit je kunt kiezen:

= helemaal mee oneens

= een beetje oneens

= niet mee eens en niet mee oneens

= een beetje eens

= helemaal mee eens

Antwoorden doe je op de volgende manier: . Als je na het doorkruisen van een smiley toch een anderen wilt kiezen, geef je met een pijl aan welke antwoord het juiste antwoord is. Dit doe je op de volgende manier:

1. Ik vind het heel leuk om dit spel te doen

2. Ik denk dat ik dit spel best goed doe, vergeleken met andere kinderen

3. Ik geloof dat ik een keuze heb bij het doen van dit spel

4. Ik heb het gevoel dat ik dit spel moet doen

5. Ik vind dit spel best plezierig

6. Tijdens het spelen van een spel voel ik mij heel afstandelijk van een ander persoon

   (afstandelijk = alsof je het alleen moet doen, zonder contact met anderen)

7. Dit spel is leuk om te doen

8. Nadat ik dit spel een tijdje speel, heb ik het gevoel dat ik er best goed in ben

9. Ik heb niet echt een keuze bij het doen van dit spel

10. Ik voel mij verbonden met een ander persoon tijdens het spelen van een spel

    (verbonden = bij elkaar, samen)

11. Dit spel kan mijn aandacht helemaal niet houden

12. Tijdens het spelen van een spel heb ik het gevoel dat ik een ander persoon echt kan vertrouwen

    (vertrouwen = geloven dat iemand eerlijk is, je kan op iemand rekenen)

13. Ik ben best handig in dit spel

14. Ik vind dit spel saai

15. Ik doe dit spel omdat ik dat moet

16. Tijdens het spelen van een spel heb ik niet het gevoel dat ik een ander persoon echt kan vertrouwen

    (vertrouwen = geloven dat iemand eerlijk is, je kan op iemand rekenen)

17. Ik zou in de toekomst echt liever geen contact hebben met een ander persoon tijdens het spelen van een spel

18. Terwijl ik dit spel speel, denk ik aan hoe plezierig ik het vind

19. Dit is een spel dat ik niet heel goed kan doen

20. Het is mogelijk dat een ander persoon en ik vrienden zouden kunnen worden als we veel contact hebben tijdens het spelen van een spel

21. Ik zou dit spel omschrijven als erg interessant

22. Ik heb het gevoel dat het niet mijn eigen keuze is dit spel te spelen

    ☹️ 🙁 😐 😀 😁

23. Tijdens het spelen van een spel weet ik niet of de andere persoon en ik ooit vrienden zullen zijn

    ☹️ 🙁 😐 😀 😁

24. Ik denk dat ik best goed ben in dit spel

    ☹️ 🙁 😐 😀 😁

25. Ik ben tevreden met hoe ik presteer in dit spel

    ☹️ 🙁 😐 😀 😁

26. Ik doe dit spel omdat ik geen keuze heb

    ☹️ 🙁 😐 😀 😁

27. Ik zou graag de kans krijgen vaker contact te hebben met een ander persoon tijdens het spelen van een spel

    ☹️ 🙁 😐 😀 😁

28. Ik doe dit spel omdat ik dat wil

    ☹️ 🙁 😐 😀 😁

Vraagverdeling:

Enjoyment/interest: 1, 5, 7, 11, 14, 18, 21

Perceived competence: 2, 8, 13, 19, 24, 25

Perceived choice (autonomy): 3, 4, 9, 15, 22, 26, 28

Relatedness: 6, 10, 12, 16, 17, 20, 23, 27

Appendix B – Knowledge test

Code:

School:

Hieronder staan 15 vragen over mediawijsheid. Beantwoord de vragen door a, b, c of d te omcirkelen. Geef op alle vragen een antwoord.

1. Lotte moet een nieuw wachtwoord bedenken. Haar vriendinnen geven verschillende tips. Welke tip is het beste?
    a. Gebruik je geboortedatum
    b. Gebruik een naam die iets te maken heeft met je hobby's
    c. Gebruik je eigen naam achterstevoren
    d. Gebruik iets met cijfers en letters wat niets met jou te maken heeft en je goed kan onthouden
2. Wat is spam?
    a. E-mails die te groot zijn voor je computer
    b. E-mails met reclame waar je niet om hebt gevraagd
    c. E-mails die naar een verkeerd adres zijn gestuurd
    d. E-mails met inlogcodes voor games
3. Eddie heeft een eigen website. Kan hij iets op zijn website zetten wat helemaal niet waar is?
    a. Nee, dat gaat echt niet
    b. Ja, maar meestal lukt dat niet
    c. Nee, dan wordt het veranderd zodra hij het erop zet
    d. Ja, dat kan hij gewoon doen
4. Fatima wil meer weten over krokodillen. Ze typt het zoekwoord 'krokodil' in en klikt dan op 'Google zoeken'. Wat krijgt ze te zien als zoekresultaten?
    a. Een lijst met websites waarop het woord krokodil staat
    b. Uitleg van het woord krokodil
    c. Een website met uitleg hoe je een krokodil als huisdier kunt houden
    d. Een bestelformulier voor een krokodil

5. Eddie chat met kinderen uit heel Nederland. Iemand vraagt of hij een foto van zichzelf wil opsturen. Wat kan Eddie het beste doen?
    a. Geen foto sturen, Eddie heeft de andere chatter niet in het echt gezien
    b. Een foto sturen, zo maak je nieuwe vrienden
    c. Alleen een foto sturen als de andere chatter ook een foto stuurt
    d. Een foto van iemand anders sturen
6. In welk antwoord staat een internetadres?
    a. http://www.kennisnet.nl
    b. www@kennisnet.nl
    c. www/kennisnet.nl
    d. kennisnet://http
7. Fatima is een spel aan het spelen. Iemand in het spel is heel vervelend aan het doen tegen haar. Wat moet ze doen?
    a. Ze moet gewoon terugschelden
    b. Ze moet het melden bij de beheerder van het spel
    c. Ze moet niets doen
    d. Ze moet vragen waarom hij of zij dat doet
8. Jip moet een nieuw wachtwoord maken. Wat is het veiligste wachtwoord?
    a. Jip
    b. voetbalisheelleuk
    c. XzGiMa12
    d. wittepet
9. Merel is op bezoek bij Lotte. Ze zijn aan het chatten in een spelletje op internet met het account van Merel. Merel moet weer naar huis. Wat moet ze niet vergeten?
    a. Uitloggen uit het spelletje
    b. Een bericht versturen dat ze weg moet
    c. Vragen of Lotte de volgende keer bij haar komt
    d. Een bericht versturen dat ze offline is

10. Waar moet je op letten als je een webcam hebt?

    a. Dat je haar wel goed zit, want anders word je uitgelachen
    b. Dat er geen stof op de lens van de webcam zit, want dan ben je niet goed te zien
    c. Dat iemand anders de beelden op kan nemen, dus dat je geen gekke dingen doet
    d. Dat je gezicht dicht genoeg bij het scherm is, anders word je niet herkend
11. Lotte kent Eddie van internet. Ze vindt het heel gezellig. Is het verstandig als Lotte haar telefoonnummer doorgeeft?
    a. Ja, maar alleen als ze het telefoonnummer van Eddie ook krijgt
    b. Ja, want Eddie is heel aardig
    c. Nee, want ze heeft Eddie niet in het echt gezien
    d. Nee, want internet verwijdert alle berichten met een telefoonnummer er in
12. Fatima zoekt naar informatie over konijnen. Ze vindt informatie op internet, maar twijfelt of de informatie wel klopt. Wat kan zij het beste doen?
    a. Ze kan het beste aan haar klasgenoot vragen of het klopt
    b. Ze kan kijken wanneer de website is gemaakt
    c. Ze kan het beste een e-mail sturen naar het e-mailadres op de website
    d. Ze kan het beste op tenminste twee andere websites zoeken naar informatie over konijnen
13. Lotte houdt een spreekbeurt over internet. Hoe kan ze het beste uitleggen wat een zoekmachine is?
    a. Een speciale website waarmee je kunt zoeken op internet
    b. Een robot die je aanzet en die voor jou gaat zoeken in de bibliotheek
    c. Een website die voor jou op zoek gaat naar ‘veilige’ websites
    d. Een machine die met een telescoop zoekt naar informatie

14. Lotte krijgt dit bericht per e-mail. Wat moet zij doen?

ING

Geachte klant,

ING Bank is het controleren op veiligheid validatie
en wij ontdekken dat uw account moet worden te controleren.
Om deze reden wordt u geadviseerd om uw accountgegevens te bevestigen.

Volg deze link om uw gegevens te bevestigen
Online Banking Beheer
ING Bank veiligheid.

    a. Ze moet het e-mailtje doorsturen naar al haar vrienden, het is een waarschuwing
    b. Op de link klikken en de bankgegevens van haar ouders invoeren
    c. De e-mail weggooien en vooral niet klikken op de link. Dit is nep.
    d. Ze moet een reply sturen op de e-mail en daarin haar accountgegevens zetten

15. Tessa maakt een werkstuk over Vogels. Ze wil meer weten over de parkiet. Wat moet Tessa in elk geval doen?
    a. Ze moet alleen zoeken via www.google.nl
    b. Ze moet de informatie die ze vindt controleren op een andere website
    c. Ze moet de tekst van internet letterlijk overnemen
    d. Ze moet een eigen website maken over vogels

Appendix C – Script

The questions in this script were conducted to guide the collaboration. The script is based on the MURDER script described by Kobbe, Weinberger, Dillenbourg, Harrer, Hämäläinen, Häkkinen and Fischer (2007). In this approach one participants has the role of summarizer and the other participant has the role of listener. During six activities the participants use this role: a) relaxing, focusing, b) reading, monitoring comprehension, c) summarizing, explaining, d) monitoring, giving feedback, e) elaborating and f) reviewing, reflecting. Within each pair, both participants need to set the mood for studying and read the material for understanding. In the next phase, the summarizer recalls the material and the listener detect errors and gives feedback. Both participants elaborate on the learning material and review the learning material and what they learned Kobbe, Weinberger, Dillenbourg, Harrer, Hämäläinen, Häkkinen and Fischer (2007).

The questions in this script were conducted to guide the participants in using the script and to achieve the activities of the MURDER script.

Vraag 1: Waar ging het over in dit level?

……
……
……
……
……
……
……

Vraag 2: Wat vonden jullie moeilijk in dit level?

……
……
……
……
……
……
……

Vraag 3: Wat hebben jullie geleerd in dit level? (Noem 3 dingen)

1. ……
2. ……

3. ……

Appendix D – Instruction

Individuele setting
Het spel dat jullie zo gaan spelen gaat over mediawijsheid en heet 'Diploma Veilig Internet'. Jullie spelen het spel ieder op een eigen scherm. Jullie krijgen een tablet of computer aangewezen. Tijdens het spelen van het spel is het de bedoeling dat jullie het spel helemaal zelf spelen. Je mag daarbij niet overleggen met de andere kinderen in het lokaal. Ik loop rond en wanneer jullie vragen hebben steken jullie je vinger op. Zijn er vragen? [Eventuele vragen worden beantwoord].

[De tablets waarop het spel klaar is gezet worden uitgedeeld en eventueel worden extra computers in de klas gebruikt]

[Alle participanten worden geleid naar het startscherm]. Klik op 'Speel de game zonder in te loggen'. [Wacht tot alle participanten klaar zijn om te beginnen]. Jullie hebben een uur de tijd. Probeer zo ver mogelijk te komen in het spel en lees de vragen goed. Klik op 'OK' en het spel gaat beginnen.

[Participanten spelen het spel gedurende 60 minuten. Onderzoeker loopt rond en helpt waar nodig]

De 60 minuten zijn voorbij. Jullie mogen de vraag afmaken en het spel afsluiten en terugkeren naar jullie plek in de klas. [Wacht tot alle participanten het spel hebben gesloten en zijn teruggekeerd op de juiste plek].

Nu krijgen jullie twee vragenlijsten om in te vullen. Dit duurt ongeveer 30 minuten. [Deelt motivatie vragenlijst uit. Wanneer de participanten klaar zijn met het invullen van deze vragenlijst krijgen zijn de kennistoets].

Non-guided collaboratieve setting
Het spel dat jullie zo gaan spelen gaat over mediawijsheid en heet 'Diploma Veilig Internet'. Jullie spelen het spel in tweetallen achter een scherm. Jullie krijgen per tweetal een tablet of computer aangewezen. Tijdens het spelen van het spel is het de bedoeling dat jullie overleggen en samen antwoorden op de vragen. Ik loop rond en wanneer jullie vragen hebben steken jullie je vinger op. Zijn er vragen? [Eventuele vragen worden beantwoord].

[De participanten worden verdeeld over de computers en tablets]

[Alle participanten worden geleid naar het startscherm]. Klik op 'Speel de game zonder in te loggen'. [Wacht tot alle participanten klaar zijn om te beginnen]. Jullie hebben een uur de tijd. Probeer zo ver mogelijk te komen in het spel en lees de vragen goed. Klik op 'OK' en het spel gaat beginnen.

[Participanten spelen het spel gedurende 60 minuten. Onderzoeker loopt rond en helpt waar nodig]

De 60 minuten zijn voorbij. Jullie mogen de vraag afmaken en het spel afsluiten en terugkeren naar jullie plek in de klas. [Wacht tot alle participanten het spel hebben gesloten en zijn teruggekeerd op de juiste plek].

Nu krijgen jullie twee vragenlijsten om in te vullen. Dit duurt ongeveer 30 minuten. [Deelt motivatie vragenlijst uit. Wanneer de participanten klaar zijn met het invullen van deze vragenlijst krijgen zijn de kennistoets].

Guiged collaboratieve setting
Het spel dat jullie zo gaan spelen gaat over mediawijsheid en heet 'Diploma Veilig Internet'. Jullie spelen het spel in tweetallen achter een scherm. Jullie krijgen per tweetal een tablet of computer aangewezen. Tijdens het spelen van het spel is het de bedoeling dat jullie overleggen en samen antwoorden op de vragen. Het spel bestaat uit 5 levels. Nadat jullie een level hebben uitgespeeld vullen jullie deze vragen in [laat scriptvragen zien]. Het is de bedoeling dat jullie samen nadenken over de vragen die hier staan en erover praten. Nadat jullie het formulier hebben ingevuld, gaan jullie door na het volgende level en vullen jullie na dit level opnieuw dit formulier in. Ik loop rond en wanneer jullie vragen hebben steken jullie je vinger op. Zijn er vragen? [Eventuele vragen worden beantwoord].

[De participanten worden verdeeld over de computers en tablets en de kaartjes worden uitgedeeld]

[Alle participanten worden geleid naar het startscherm]. Klik op 'Speel de game zonder in te loggen'. [Wacht tot alle participanten klaar zijn om te beginnen]. Jullie hebben een uur de tijd. Probeer zo ver mogelijk te komen in het spel en lees de vragen goed. Klik op 'OK' en het spel gaat beginnen.

[Participanten spelen het spel gedurende 60 minuten. Onderzoeker loopt rond en helpt waar nodig]

De 60 minuten zijn voorbij. Jullie mogen de vraag afmaken en het spel afsluiten en terugkeren naar jullie plek in de klas. [Wacht tot alle participanten het spel hebben gesloten en zijn teruggekeerd op de juiste plek].

Nu krijgen jullie twee vragenlijsten om in te vullen. Dit duurt ongeveer 30 minuten. [Deelt motivatie vragenlijst uit. Wanneer de participanten klaar zijn met het invullen van deze vragenlijst krijgen zijn de kennistoets].

Appendix E – Informed consent parents

Beste ouders/verzorgers,

Mijn naam is Mirjam Aarts en ik ben werkzaam als leerkracht in groep 1/2 op de KSU-school Op De Groene Alm. Naast mijn werk als leerkracht studeer ik momenteel aan de Universiteit Utrecht, waar ik de masteropleiding 'Educational Science' volg. Momenteel ben ik bezig met het uitvoeren van een scriptieonderzoek. Mijn begeleider is P.J.M. Wouters.

Het onderzoek
Binnen het onderwijs wordt steeds meer gebruik gemaakt van educatieve games (game-based learning) om te leren. Uit onderzoek is namelijk gebleken dat het spelen van games leidt tot hogere leeruitkomsten en daarnaast hebben games een motiverende werking. Ik doe onderzoek naar de invloed van **samenwerking** op de motivatie en leerprestaties van kinderen in game-based learning.

Het spel
Het spel dat wordt gebruikt in dit onderzoek is 'Diploma Veilig Internet'. Dit spel is ontwikkeld door de bibliotheek en gaat over mediawijsheid. In het spel is oom Ap opgesloten in het internet. Vijf kinderen proberen de oom te bevrijden en hebben daarbij de hulp van de kinderen nodig. U kunt de game bekijken op www.diplomaveiliginternet.nl (Let erop dat uw kind de game nog niet ziet. Dit kan het onderzoek beïnvloeden).

Procedure
Voorafgaande aan het spelen van het spel vullen de kinderen 2 vragenlijsten in om de motivatie en voorkennis op gebied van mediawijsheid te onderzoeken (ongeveer 30 minuten). Op een andere dag spelen de kinderen het spel 'diploma veilig internet' op een tablet of computer voor ongeveer 60 minuten. Een aantal kinderen doen dit spel individueel en een aantal kinderen doen dit spel samen met een ander kind. Na afloop van het spel vullen de leerlingen opnieuw de 2 vragenlijsten in over motivatie en kennis op gebied van mediawijsheid.

Privacy en vertrouwelijkheid
Alle gegevens worden vertrouwelijk behandeld en anoniem verwerkt. De docent krijgt de antwoorden van de leerlingen niet te zien. De gegevens worden alleen voor opleidings- en onderzoeksdoeleinden gebruikt. Leerlingen kunnen zelf ook aangeven of ze wel of niet mee willen doen en kunnen op elk moment stoppen met deelname aan het onderzoek.

Mogelijkheid tot vragen, informatie en toestemming
Als u nog vragen heeft over het onderzoek of als u op de hoogte gehouden wilt worden over dit onderzoek, stuur dan een mail aan: **Mirjam Aarts** (M.Aarts1@students.uu.nl). Voor verdere vragen over de cursus en opdracht die wij maken kunt u contact opnemen met: **P.J.M. Wouters** (P.J.M.Wouters@uu.nl).

Deelname
Naast dat de kinderen een leuke leerervaring hebben leren ze tijdens dit onderzoek ook nieuwe dingen over mediawijsheid. Voor het uitvoeren van het onderzoek heb ik kinderen nodig mogen deelnemen. Ik wil hiervoor kinderen gebruiken die in groep 5 en groep 6 zitten. Ik wil u daarom toestemming vragen voor het deelnemen van uw kind aan dit onderzoek. Als u akkoord gaat met deelname kunt u de achterzijde invullen de deze brief inleveren bij de leerkracht van uw kind. U kunt deze brief ook inscannen en mailen naar: M.Aarts1@students.uu.nl.

Met vriendelijke groet,

M. Aarts, Dr. P.J.M. Wouters

Hierbij geef ik toestemming voor het deelnemen aan het onderzoek van Mirjam Aarts.

Uw naam: ……..

Naam kind: …… Jongen/meisje

Leeftijd kind: ……. Groep 5/Groep 6

School: ……...

Datum: ……

Handtekening ouder/verzorger: ……..

Appendix F – Informed consent participants

Beste leerling,

Wie ben ik?
Mijn naam is Mirjam Aarts en ik ben werkzaam als leerkracht in groep 1/2 op de KSU-school Op De Groene Alm. Naast mijn werk als leerkracht studeer ik aan de Universiteit Utrecht, waar ik de masteropleiding 'Educational Science' volg. Ik ben bezig met het uitvoeren van een scriptieonderzoek. Mijn begeleider is P.J.M. Wouters

Wat is het doel van het onderzoek?
Mijn onderzoek gaat over game-based learning in het basisonderwijs. Ik doe onderzoek naar samenwerken tijdens het spelen van een computerspel. Ik kijk dan naar hoe leuk je het vindt om het spel te spelen en of je er iets van hebt geleerd.

Wat houdt het onderzoek in?
Eerst vul je 2 vragenlijsten in. Dit duurt ongeveer 30 minuten. Na 2 weken kom ik terug en spelen jullie een computerspel voor ongeveer een uur. Na het spelen van het spel vul je opnieuw 2 vragenlijsten in. Dit duurt ongeveer 30 minuten.

Privacy en vertrouwelijkheid
Alle gegevens worden vertrouwelijk behandeld en anoniem verwerkt. Dat wil zeggen dat straks in de uitkomsten van het onderzoek niet te zien is welke antwoorden jij gegeven hebt. De gegevens worden alleen voor onderzoeks- en opleidingsdoeleinden gebruikt. Jouw docent krijgt jouw vragenlijsten niet te zien. Je krijgt ook geen cijfer voor de toets.

Mogelijkheid tot vragen, informatie en toestemming
Als je vragen hebt over het onderzoek kun je deze aan mij stellen of aan je juf of meester. Je kan later altijd nog besluiten dat je niet mee wil doen met het onderzoek. Als je mee wilt doen aan het onderzoek, **vul dan het formulier op de achterzijde in**.

Met vriendelijke groet,

M. Aarts, Dr. P.J.M. Wouters,

TOESTEMMINGSVERKLARING
voor deelname aan wetenschappelijk onderzoek

Ik heb uitleg gekregen over het onderzoek. De informatie over het onderzoek heb ik goed gelezen. Ik heb mijn eventuele vragen over het onderzoek gesteld. Ik heb goed nagedacht over of ik aan het onderzoek wil deelnemen. Ik mag op ieder moment stoppen met het onderzoek als ik dat wil. Ik hoef niet uit te leggen waarom ik wil stoppen.

☐ Ik doe wel mee aan het onderzoek

☐ Ik doe niet mee aan het onderzoek

Zet hiernaast een kruisje in het vakje dat voor jou van toepassing is

Naam :_____

School :_____

Klas :_____

Geboortedatum :_____

Datum :_____

Handtekening :_____

Appendix G – Planning

Week	Date	Action
4	24 January	Submitting research plan
7	11 February	Expert consultancy on motivation questionnaire and knowledge test
8	20 February	Pilot knowledge test and motivation questionnaire Handing over consent forms to teacher
10	6 March	Collecting signed consent forms and count participants
11	13 March	Filling in questionnaires school 1 pretest
12	20 March	Filling in questionnaires school 2 pretest
13	27 March	Playing game DVI and filling in questionnaires school 1 posttest
14	3 April	Playing game DVI and filling in questionnaires school 2 posttest

Appendix H – Risk analysis

Risk	**Change**	**Impact**	**Solution**
Not enough participants (n < 120)	M	H	Adding another school for the experiment
Technical failure during the experiment	L	H	Technical check before start of the experiment. When there is a technical failure, agreement with the school for an additional date for the experiment
The planning does not match with the planning of the school	H	M	Agreement with the school for an additional date for the experiment
Personal circumstances	L	H	Wide planning

L = low, M = moderate, H = high

Appendix I – FETC form

Universiteit Utrecht

APPLICATION FORM FOR THE ASSESSMENT OF A RESEARCH PROTOCOL BY THE FACULTY ETHICS REVIEW BOARD (FERB) OF THE FACULTY OF SOCIAL AND BEHAVIOURAL SCIENCES

General guidelines for the use of this form

1. This form can be used for a single research project or a series of related studies (hereinafter referred to as: "research programme"). Researchers are encouraged to apply for the assessment of a research programme if their proposal covers multiple studies with related content, identical procedures (methods and instruments) and contains informed consent forms and participant information, with a similar population. For studies by students, the FERB recommends submitting, in advance, a research programme under which protocol multiple student projects can be conducted so that their execution will not be delayed by the review procedure. The application of such a research programme must include a proper description by the researcher(s) of the programme as a whole in terms of the maximum burden on the participants (e.g. maximum duration, strain/efforts, types of stimuli, strength and frequency, etc.). If it is impossible to describe all the studies within the research programme, it should, in any case, include a description of the most invasive study known so far.
2. Solely the first responsible senior researcher(s) (from post-doctoral level onwards) may submit a protocol.
3. Any approval by the FERB is valid for 5 years or until the information to be provided in the application form below is modified to such an extent that the study becomes more invasive. For a research programme, the term of validity is 2 years and any extension is subject to approval. The researcher(s) and staff below commit themselves to treating the participants in accordance with the principles of the Declaration of Helsinki and the Dutch Code of Conduct for Scientific Practices as determined by the VSNU Association of Universities in the Netherlands (which can both be downloaded from the FERB site on the Intranet[1]) and guarantee that the participants (whether decisionally competent or incompetent and/or in a dependent relationship vis-a-vis the researcher or not) may at all times terminate their participation without any further consequences.
4. The researcher(s) commit themselves to maximising the quality of the study, the statistical analysis and the reports, and to respect the specific regulations and legislation pertaining to the specific methods.
5. The procedure will run more smoothly if the FERB receives all the relevant documents, such as questionnaires and other measurement instruments as well as literature and other sources on studies using similar methods which were found to be ethically acceptable and that testify to the fact that this procedure has no harmful consequences. Examples of studies where the latter will always be an issue are studies into bullying behaviour, sexuality, and parent-child relationships. The FERB asks the researcher(s) to be as specific as possible when they answer the relevant

[1] See: https://intranet.uu.nl/facultaire-ethische-toetsingscommissie-fetc

questions while limiting their answers to 500 words maximum per question. It is helpful to the FERB if the answers are brief and to the point.

6. **Our FAQ document that can be accessed through the Intranet provides background information with regards to any questions.**
7. The researcher(s) declare to have described the study truthfully and with a particular focus on its ethical aspects.

Signed for approval[2]:
Date:

[2] The senior researcher (holding at least a doctoral degree) should sign here.

A. GENERAL INFORMATION/PERSONAL DETAILS

1.

a. a. Name(s), position(s) and department(s) of the responsible researcher(s):

P.J.M. Wouters, Lecturer
University Utrecht

b. Name(s), position(s) and department(s) of the executive researcher(s):

Mirjam Aarts, student Educational Science at Educational Sciences,
University Utrecht

2. Title of the study or research programme - Does it concern a single study or a research programme? Does it concern a study for the final thesis in a bachelor's or master's degree course?:

Effects of collaboration and motivation in game-based learning
Single study
Final thesis master's degree

3. Type of study (with a brief rationale):

Quasi-experimental research, with a dependent variable (learning outcomes), independent variable (learning setting), in which there are three conditions: individual, non-guided collaborative and guided collaborative. Besides, intrinsic motivation is the mediator.

4. Grant provider:

No grant is provided

5. Intended start and end date for the study:

Start date: 14-11-2018. End date: 11-06-2019

6. Research area/discipline:

Education, game-based learning, collaboration, motivation

7. For some (larger) projects it is advisable to appoint an independent contact or expert whom participants can contact in case of questions and/or complaints. Has an independent expert been appointed for this study?[3]:

[3] This contact may, in principle, also be a researcher (within the same department, or not) who is able to respond to the question or complaint in detail. Independent is to say: not involved in the study themselves. The FERB upholds that an independent contact is not obligatory, but will be necessary when the study is more invasive.

No

8. Does the study concern a multi-centre project, e.g. in collaboration with other universities, a GGZ mental health care institution, a university medical centre? Where exactly will the study be conducted? By which institute(s) are the executive researcher(s) employed?:

No

9. Is the study related to a prior research project that has been assessed by a recognised Medical Ethics Review Board (MERB) or FERB?

No

If so, which? Please state the file number: *x*

B. SUMMARY OF THE BACKGROUND AND METHODS

Background
1. What is the study's theoretical and practical relevance? (500 words max.):

OECD (2016) reported that students in the Netherlands, compared to students from other countries, are not well-motivated. Nowadays, people spent a lot of time playing videogames. For this reason, it is plausible that the use of videogames in education will match this generation. This leads to an increasing popularity of the use of digital games in education, referred to as serious games or game-based learning (GBL). Wouters, Van Nimwegen, Van Oostendorp and Van der Spek (2013) however, concluded that the use of serious games is not more motivating than conventional instruction methods. Nowadays, people are connected very easily through different kinds of media, for example social media and chats. For this reason, it can be assumed that relatedness can match this generation. The feeling of relatedness plays an important role in the theory of social-constructivism, which states that knowledge is constructed through interaction with peers. This co-construction of knowledge is called collaboration (Jonassen, 1991). The use of collaboration in education can stimulate the need of relatedness, which might lead to a higher motivation in students. Additionally, collaboration leads to students who explain their thoughts and co-construct knowledge (Ter Vrugte & De Jong, 2017), which results in broader and deeper understanding of concepts (O'Donnell & O'Kelly, 1994).
Some empirical evidence suggested that collaboration without consistent support usually fail in
achieving productive learning interactions (Ter Vrugte & De Jong, 2017; Meluso, Zheng, Spires & Lester, 2012; Van der Meij, Albers & Leemkuil, 2011). Ter Vrugte and De Jong (2017) concluded from several studies that discussion (providing feedback on explanations) in collaboration needs to be guided to be effective. Otherwise, there is a lack of depth in the

dialogues between students and a solution for this problem might be scripted collaboration or questions that can focus the discussion (Van der Meij, Albers & Leemkuil, 2011; Ter Vrugte & De Jong, 2017).

2. What is the study's objective/central question?:

To what extent does a non-guided collaborative learning setting and a guided collaborative learning setting in GBL leads to higher intrinsic motivation and higher learning outcomes compared to an individual learning setting?
Three sub questions:

1. *Does game-based learning leads to learning gain and to what extent does a guided collaborative learning setting and a non-guided collaborative learning setting in game-based learning leads to higher learning gain compared to an individual learning setting?*
2. *To what extent does a guided collaborative learning setting and a non-guided collaborative learning setting in game-based learning lead to an increase in gain in intrinsic motivation compared to an individual learning setting?*
3. *To what extent does gain in intrinsic motivation have a mediating effect on learning gain for the non-guided collaborative learning setting and the guided collaborative learning setting?*

3. What are the hypothesis/hypotheses and expectation(s)?:

H1.1: Game-based learning leads to an increase in learning gain.
H1.2: A guided collaborative learning setting leads to higher learning gain compared to a non-guided collaborative learning setting and a non-guided collaborative learning setting leads to higher learning gain compared to an individual learning setting.

H2: A guided collaborative learning setting leads to a greater increase in intrinsic motivation when compared to a non-guided collaborative learning setting and a non-guided collaborative learning setting leads to a greater increase in intrinsic motivation in comparison to an individual learning setting.

H3: A guided collaborative learning setting leads to higher gain in intrinsic motivation and thereby higher learning gain, compared to a non-guided collaborative learning setting (there is a mediating effect).

Design/procedure/invasiveness
4. What is the study's design and procedure? (500 words max.):

The design is a quasi-experimental research with a pre-test and a post-test and three different conditions: individual, non-guided collaborative and guided collaborative. The dependent variable is learning gain, the independent variable is learning setting and gain in intrinsic motivation and the mediator is intrinsic motivation. Participants fill in a motivation questionnaire and a knowledge test (pre-test). After a week they play a game for fifty

minutes. After the game they fill in a motivation questionnaire and the knowledge test (post-test).

5.

a. Which measurement instruments, stimuli and/or manipulations will be used?[4]:

A questionnaire to measure motivation, based on the IMI
A knowledge test to measure the knowledge about the domain, based on the knowledge test of www.diplomaveiliginternet.nl
The game Diploma Veilig Internet', produced by the 'Royal Library' of The Netherlands
A script to guide collaboration

b. What does the study's burden on the participants comprise in terms of time, frequency and strain/efforts?:

Participating in this study takes 1 hour to fill in the questionnaires (two times 30 minutes) and 1 hour to play the game during class time.

c. Will the participants be subjected to interventions or a certain manner of conduct that cannot be considered as part of a normal lifestyle?:

No

d. Will unobtrusive methods be used (e.g. data collection of uninformed subjects by means of observations or video recordings)?:

No

e. Will the study involve any deception? If so, will there be an adequate debriefing and will the deception hold any potential risks?:

No

6. Will the participants be tested beforehand as to their health condition or according to certain disorders? Are there any inclusion and/or exclusion criteria or specific conditions to be met in order for a participant to take part in this study?:

No
The only inclusion criteria is an age between 7 and 10 years (groep 5 of 6)

[4] Examples: invasive questionnaires; interviews; physical/psychological examination, inducing stress, pressure to overstep important standards and values; inducing false memories; exposure to aversive materials like a unpleasant film, video clip, photos or electrical stimulus; long-term of very frequent questioning; ambulatory measurements, participation in an intervention, evoking unpleasant psychological or physical symptoms in an experiment, denial, diet, blood sampling, fMRI, TMS, ECG, administering stimuli, showing pictures, etc. In case of the use of a device (apparatus) or administration of a substance, please enclose the CE marking brochure for the relevant apparatus or substance, if possible.

7. Risks for the participants -

a. Which risks does the study hold for its participants?:

No risks

b. To what extent are the risks and objections limited? Are the risks run by the participants similar to those in daily life?:

No

8. How does the burden on the participants compare to the study's potential scientific contribution (theory formation, practical usability)?:

By participating the participant helps research in game-based learning. More research need to be done to know how games works best in education.

9. Will a method be used that may, by coincidence, lead to a finding of which the participant should be informed?[5] If so, what actions will be taken in the case of a coincidental finding?:

No

Analysis/power

10. How will the researchers analyse the data? Which statistical analyses will be used?:

Paired sample t-test
Independent sample t-test
ANOVA
PROCESS

11. What is the number of participants? Provide a power analysis and/or motivation for the number of participants. The current convention is a power of 0.80. If the study deviates from this power, the FERB would like you to justify why this is necessary:

N = 143
*For a medium effect size with $\alpha = .05$ and a power of .80, a power analysis revealed that 143 participants were required (G*Power; Faul, Erdfelder, Lang & Buchner, 2007).*

[5] For instance: dementia, dyslexia, giftedness, depression, extremely low heartbeat in an ECG, etc. If coincidental findings may be found, this should be included in the informed consent, including a description of the actions that will be taken in such an event.

C. PARTICIPANTS, RECRUITMENT AND INFORMED CONSENT PROCEDURE

1. The nature of the research population (please tick):

1. General population without complaints/symptoms
2. General population with complaints/symptoms
3. Patients or population with a diagnosis (please state the diagnosis)

2. Age category of the participants (please tick):

- 18 years or older
- 16-17 years
- 13-15 years
- ***12 years or younger***

3. Does the study require a specific target group? If so, justify why the study cannot be conducted without the participation of this group (e.g. minors):

Because the game match this age. When this study will be done in another group of participants another game should be used.

4. Recruitment of participants -

a. How will the participants be recruited?:

Two schools will be selected. In the classrooms 5 and 6 children will be asked if they want to participate. When children want to participate, they receive a letter, which should be signed by parents.

b. How much time will the prospective participants have to decide as to whether they will indeed participate in the study?:

2 hours, which they normally spend on school

5. Does the study involve informed consent or mutual consent? Clarify the design of the consent procedure (who gives permission, when and how). Does the study involve active consent or passive consent? If no informed consent will be sought, please clarify the reason:

A letter for parents is made. Parents should sign the letter and return is to the researcher (active consent)

6. Are the participants fully free to participate and terminate their participation whenever they want and without stating their grounds for doing so?:

Yes. In this informed consent parents can discuss with their children if the children want to participate. This will be checked before the experiment.

7. Will the participants be in a dependent relationship with the researcher?:
No

8. Compensation
   a. Will the participants be compensated for their efforts? If so, what is included in this recompense (financial reimbursement, travelling expenses, otherwise). What is the amount?

No

   b. Will this compensation depend on certain conditions, such as the completion of the study?

No

D. PRIVACY AND INFORMATION

1.
   a. Will the study adhere to the requirements for anonymity and privacy, as referred to in the Faculty Protocol for Data Storage[6]?:
      - anonymous processing and confidential storage of data (i.e. storage of raw data separate from identifiable data): yes~~/no~~
      - the participants' rights to inspect their own data: yes~~/no~~
      - access to the data for all the researchers involved in the project: yes~~/no~~

   If not, please clarify.

   b. Has a Data Management Plan been designed?

   No

2.
   a. Will the participant be offered the opportunity to receive the results (whether or not at the group level)?:

   Yes

   b. Will the results of the study be fed back to persons other than the participants (e.g. teachers, parents)?:

   No

[6] This can be found on the Intranet: https://intranet.uu.nl/wetenschappelijke-integriteit-facultair-protocol-dataopslag

If so, will this feedback be provided at the group or at the individual level?

3.

a. Will the data be stored on the faculty's data server?: *Yes*

Will the data that can be traced back to the individual be stored separately on the other faculty server available for this specific purpose?: Y*es*

b. If not, please clarify where will the data be stored instead?:

E. ADDITIONAL INFORMATION

Optional.

F. FORMS TO BE ENCLOSED (CHECKLIST)

- Text (advert) for the recruitment of participants
- Information letter for participant
- Informed consent form for participants
- Written or oral feedback information (debriefing text)
- (Descriptions of) questionnaires
- (Descriptions of) measurement instruments/stimuli/manipulations
- Literature/references

Signature(s):[7] Date and place:

Name, position:

[7] The senior researcher (holding at least a doctoral degree) should sign here.