Debriefing Topics and Their Effects on Learning with Computer Games

Lucian R.F.Z.J Walther

University Twente, Enschede
Faculty of Behavioral Sciences,
Educational Science and Technology

05.08.2013

Supervisors: Dr. H.H. Leemkuil & Dr. H. van der Meij

Abstract

The present study examines the question in how far short self-debriefings are effective to support individual learning with computer games. Two debriefing topics were compared with each other and with a *Control* condition. Furthermore, the effect of debriefing on motivation has been examined. A between-subject design in which the debriefing was manipulated across three conditions was applied. The 49 participants (mean age 22) played the computer game Lemonade Tycoon 2 two sessions of forty minutes. Between the two sessions, participants in the two experimental conditions received short self-debriefings in form of guiding questions, one condition about the *Discussion of problems* and the other about the *Intended learning outcomes.* Participants in the control condition only read a text about lemonade. Domain knowledge and game performance were recorded and examined. The findings showed an effect of both debriefing topics on heuristic knowledge and an effect of the *Intended learning outcomes* debriefing on the total knowledge test score as well. The game scores increased significantly across all three conditions. No effect of debriefing on condition was found. Significant correlations were found between the two game scores as well as with the test scores. The conclusion is that short self-debriefings were to some extent effective to support individual learning with computer games. However, more structure than proposed by Fritzsche (2004) should be provided because most individuals have difficulties structuring answers on debriefing questions by themselves.

Keywords: debriefing; self-debriefing; game-based learning

Table of content

1. Introduction

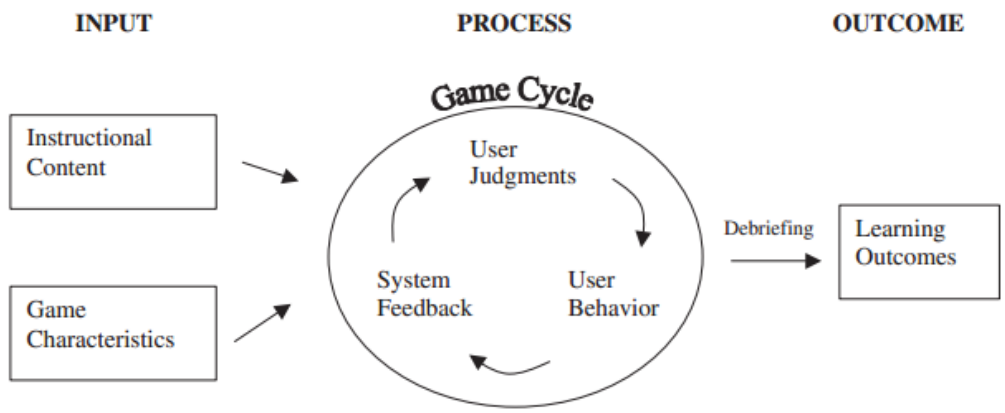
Nowadays, personal computers are present everywhere in life, supporting young and old at work and entertaining them during leisure time. Most people even carry a small computer in form of a cellphone in their pockets, making computer games available to a wider range of people, everywhere, all the time. In the last decades, computer games have been used for educational purposes in a variety of settings, for instance in schools, at home, in the military or in medical environments. The relation between games and instruction is very interesting because it seems such an appealing idea to teach and learn through games in a playful manner. It has been found that game players often show persistence, attention to detail and problem solving skills, behaviors that should be present in learning situations (Gee, 2003). However, instruction and games have from the traditional point of view, more contraries than similarities. As Garris, Ahlers & Driskell (2002) state, game play is commonly characterized as voluntary, nonproductive, and separated from the real world, while instruction is usually non-voluntary, aiming at specific learning outcomes, and related to the real life. From this view it seems challenging to design educational (computer) games. On the other hand the progress in games is most times similar to learning because when one is engaged with a game, one's mind is experiencing pleasure when slowly understanding the new system. Leemkuil (2006) defines games as "competitive, situated, interactive (learning-) environments based upon a set of rules and/or an underlying model, in which, under certain constraints and uncertain circumstances a challenging goal has to be reached." (p.5).

Educational computer games

The value of playing games has been examined in many studies. Kirriemuir (2002) for instance argues that playing games can support valuable skill development in the domains of strategic thinking, planning, communication, application of numbers, negotiating skills, group decision-making and data-handling. According to Kunz (2003), reasons for the use of simulation games are that they foster interest and enthusiasm in the learner and provide a better overview of relationships and models. They can also demonstrate concepts and theories better and train decision making and effective reactions to changes in the environment. Garris et al. (2002) found that when playing games, students are strongly involved and motivated and focus on long-term goals within these environments. Furthermore, students can be motivated through games to start learning and practicing something they are not really interested in, but games can also keep the students motivated over time, if they are properly designed. This can be achieved through an appealing context and interface, but also because of a feeling of control the user experiences (Leemkuil, 2006). A literature review revealed that educational games are consistently perceived as more interesting than traditional instruction (Randel, Morris, Wetzel, and Whitehill, 1992).

Kirriemuir & McFarlane (2004) state that many simulation games have in common that they directly provide the player with feedback about the consequences of his actions and that they can easily be adjusted to ones needs by changing a few factors in the game. Furthermore, a simulation is usually the less expensive option, compared to real-world training and provides a safe virtual environment for exploring relations of causes and effects and training of dangerous actions. In "Game-Based Learning: What it is, Why it Works, and Where it's Going" Trybus explains that GBL combines advantages of traditional learning (as lectures or online tutorials) for instance cost efficiency, low physical risk, and standardized assessments, with advantages of hands-on training, as they are highly engaging, learning pace can be tailored to individuals, immediate feedback is provided, experience can be easily transferred to the real world, and of course that the learner is actively engaged and can explore the consequences of different actions. Gee (2003), describes 36 principles of well-designed games. Four of the most prominent of them are the Subset Principle, the Active, Critical Learning Principle, Practice Principle, and the Probing Principle. The Subset Principle states that learning takes place in a (simplified) subset of the real domain so that players can easily map their in-game behavior to real-life performance. According to the Active, Critical Learning Principle, the learning environment has to encourage active and critical, not passive, learning. The Practice Principle states that the learner gets lots of practice in a context where the practice is not boring. Finally, according to the Probing Principle, learning is a cycle of probing the world, reflecting on one's action and forming a hypothesis; re-probing the world to test the hypothesis and accepting or rethinking this hypothesis. Similarly, Garris et al. (2002) developed an Input-Process-Outcome Model (Figure 1), which describes game based learning going through a game cycle of user judgments, behavior, and feedback.

Figure 1
Input-Process-Outcome Model (Garris et al, 2002)



The model describes how, in well-designed educational games, the instructional content combined with game characteristics as challenge, fantasy, complexity, and control increases motivation to start and continue engaging in an activity. This leads to an iterative game cycle, as the game play passes through repeated judgment-behavior-feedback loops. According to Garris, the user first makes subjective judgments about the game concerning interest, enjoyment, task involvement, and confidence. Task involvement can be defined as how concentrated on and absorbed in an activity an individual is, which depends on control factors, sensory factors, distraction factors, and realism factors. Confidence is usually experienced because in games no real-world consequences of failure have to be faced. Progressive levels of difficulty are also an important aspect of games that establishes confidence. Right from the start all these affective judgments about the game influence the direction, intensity, and quality of future behavior in the game. The user's behavior in the game evokes feedback. To support this is known to be critical for performance and motivation but the effects of feedback on performance are highly variable and depend on the circumstances (Wexley & Latham, 1991; Kluger & De Nisi, 1996). In order to motivate the user to continue playing, feedback in games typically indicates that current performance is just below desired standards. When one's skills are matching with the task's difficulties one experiences a sense of enjoyment, also referred to as flow (Csikszentmihalyi, 1990; Garris et al. ,2002). In order to cope with this feedback-standard discrepancy, the individual can either abandon play or increase the effort to meet the standard. In order to provide the participant with the opportunity to reflect on the game experience and establish a link between what is represented in the experience and the real world, the model includes a debriefing following the activity. This helps the student to draw connections between game events and real-world events and leads to the desired learning outcomes. Many authors, for instance Crookall (2010) and Leemkuil (2008), describe the missing of this type of activities as a shortcoming of most existing computer games that have the goal to stimulate some form of learning.

Typical problems that occur when learning with computer games

Leemkuil (2008) argued that with commercial off-the-shelf games there is a serious risk that users do not engage in explicit articulation and explanation of the content that is learned, and by this reducing the learning outcomes significantly. This statement is in line with Berry & Broadbent's (1988) idea to distinguish an implicit unselective game play mode and an explicit selective one. Students use the unselective mode usually when key variables and their interrelationships cannot be easily recognized, for example in highly dynamic learning environments with a low degree of transparency. This mode leads to the learning of facts, procedures, and sequences of actions that are mostly context specific and implicit, making it difficult to verbalize and transfer them to other

situations. The selective mode, on the other hand, requires more cognitive effort because the learner has to compare different problems, retrieve relevant knowledge from memory, and formulate new hypotheses, but the learner is more explicit aware of what he is learning (Leemkuil, 2008). Van der Meij, Albers, & Leemkuil (2011) recommend stimulating or scaffolding self-regulative actions in simulation games by external elements. This could facilitate the use of the explicit selective mode. People learn through active engagement and when this experience is coupled with instructional support, for instance scaffolding or debriefing, it can provide an effective learning environment (Garris et al., 2002). This idea is based on Kolb's theory of experiential learning (1984). Kolb describes learning through experiences that passes through a cycle which contains four related stages: the concrete experience, the reflective observation, the abstract conceptualization, and the active experimentation (Kolb, 1984). Studies in many fields, for example clinical simulation in nursing, came to the similar results, namely that, concerning learning with simulation games, especially the reflection stage needs support (e.g. Shinnick, Woo, Horwich, & Steadman, 2011). Crookall (2010) argues: "One thing that is not being done as much as it should is proper debriefing—that is, the occasion and activity for the reflection on and the sharing of the game experience to turn it into learning." (p.907). A debriefing activity is a special kind of feedback and reflection process which does not have one "right" answer and can take many forms. It can be done orally or in a written form, in groups or independently and it can be guided by a facilitator or by a script but it can also happen unguided. Garris et al. (2002) explains that in order to achieve satisfying learning outcomes, learning-by-doing should be combined with the opportunity to reflect and elaborate relevant information and to link the new knowledge to the real world. As mentioned before, the Input-Process-Outcome Model includes a debriefing in which participants can evaluate how successful their actions were and how these can be improved to bridge the gap between actual performance and desired performance, but also to relate game events to real life events. A recent meta-analysis on debriefing revealed an average improvement of performance of approximately 25%, with an average debriefing time of 18 minutes (Tannenbaum & Cerasoli, 2013). Furthermore, this study suggested that debriefing works equally well for teams and individuals. Findings of other studies also indicate strong motivational potential of reflective questions like self-debriefing. For instance, Hattie & Timperley (2007) state that questions like this can sensitize learners to the competence or strategy information in a task or situation, leading to more confidence and greater effort. This can help reducing the discrepancy between what is understood and what is aimed to be understood and hereby increase effort, motivation, or engagement to reduce this discrepancy.

How to do self-debriefing?

While in many debriefing settings a facilitator is present to stimulate the reflection and discussion of the experience and its implications, another possible form of debriefing is self-debriefing, which can be done individually or in groups. The rise of online education but also financial issues, as the fact that expert debriefers have to be paid, make self-led debriefing appealing for educators and the industry. In Tanenbaum & Cerasoli's meta-study (2012) this kind of debriefing was not examined, as they only included studies that used multiple sources of information for the debriefing. However, they could draw no definite conclusions concerning the effects of facilitators on debriefing.

Van der Meij, Leemkuil, & Li (2013) examined whether collaborative self-debriefing would scaffold digital game-based learning better than individual self-debriefing. In their study, participants in the two conditions played the single player mode of a business strategy game. In the following debriefing session, participants in the individual condition debriefed their experiences alone with the help of supporting debriefing questions and participants in the collaborative condition discussed in pairs, supported by the same debriefing questions. It was expected that with the opportunity of collaboration, learners would have a greater chance to understand concepts and principles and reconstruct more complete experiences in game playing. The results of the study suggested the contrary, as it was found that individual self-debriefing scaffolded digital game-based learning significantly better than collaborative self-debriefing. In the post test, heuristic knowledge score was significantly higher in the individual self-debriefing condition than in the collaborative self-debriefing condition and all other scores were higher as well. These findings confirm the assumption that it is effective to support self-debriefing with debriefing questions and that these supporting questions help participants to become aware of their implicit knowledge even better when they can concentrate on themselves instead of discussing them with a partner. Similar results were found in Tannenbaum & Cerasoli's meta-analysis, in which it is advised that when aiming at the improvement of individual effectiveness, improving the individual's performance, instead of groups performance, should be the focus of the debriefing (Tannenbaum & Cerasoli, 2013). For effective debriefing Van der Meij et al. (2013)advise to choose debriefing questions according to Kolb's four phases of experiential learning as well as using the 'Six Es of Debriefing' as proposed by Petranek (1994), which are events, emotions, empathy, explanations, and every day, and employment. Of course, the effectiveness of debriefing supported learning with digital games depends on the nature of the games. According to Van der Meij et al. (2013) debriefing should be done cooperatively for games with more complicated goals, for instance creating a shared vision, or joint problem solving.

The literature mentioned above indicates that one promising way to scaffold digital game-based learning is individual self-debriefing guided by debriefing questions. However, apart from the recommendations to use Kolb's phases and Petranek's "six debriefing Es", little is known about what kind of topics should be treated to stimulate reflection and learning and which aspects of debriefing are more yielding than others. In order to make debriefing efficient and suitable for situations with limited time, it seems reasonable to reduce it to those aspects that foster learning the most and by this minimize the risk of fatigue, confusion, or cognitive overload. To avoid the interruption of the flow of the game can be another reason to keep debriefings as short as possible, in case the debriefings are held between several sessions of the activity. The fact that in Tannenbaum's & Cerasoli's (2013) meta-analysis no observable relationship between effect size and time spent debriefing was found, indicates that a short debriefing can be effective as well. This leads to the question: When attempting to reduce debriefing to its essence with the precept to hold it as effective as possible, on which of Kolb's stages should be put emphasis? In order to examine the differences in effects between debriefing topics corresponding to the stages of Kolb (1984), these should to be approached independently to identify which of the stages can be most effectively supported.

Fritzsche, Leonard, Boscia, & Anderson (2004) presented five topics that can be useful in debriefing, each emphasizing different aspects of learning. The topics are: Personal Reactions, Discussion of Events, Discussion of Problems, Intended Learning Outcomes, and Links to the Real World. When these topics are matched to Kolb's four stages of experiential learning, Personal Reactions and Discussion of Events correspond to the concrete experience, Discussion of Problems to the reflective observation stage, Intended Learning Outcomes to the abstract conceptualization stage, and Links to the Real World in the active experimentation stage. An comparison of Kolb's phases, Petranek's six debriefing E's, and Fritzsche's simulation debriefing topics including example debriefing questions Is presented in Table 1. As many educational games only induce low degrees of distress, debriefing regarding personal reactions like emotions might be of less importance for the learning progress than debriefing concerning reflective observation and abstract conceptualization. The active experimentation is also not covered in the debriefing but in the subsequent game session. This leaves the "Discussion of Problems", proposed by Fritzsche, and the "Intended Learning Outcomes", proposed by Boscia (in Fritzsche, 2004), as the most promising topics to examine further.

Table 1
Comparison of Kolb's phases of experiential learning, Petranek's six debriefing E's, and Fritzsche's simulation debriefing topics with example debriefing questions

Kolb's phases	Petranek's debriefing E's	Fritzsche's debriefing Topics	Example debriefing question
Concrete experience	Events	Discussion of Events	"What were the main events?"
	Emotions	Personal Reactions	"What emotions did you experience as you participated?"
Reflective observation	Empathy	Discussion of Problems	"What problems did you encounter in making decisions or as result of your previous decisions?"
Abstract conceptualization	Explanations	Intended Learning Outcomes	"What things that you already knew took on new learning?"
Active experimentation	Every day	Links to the Real World	"What are some decisions you made that have not been tried in the real world? Why do you think that is so?"
	Evaluation		"What would you do differently?"

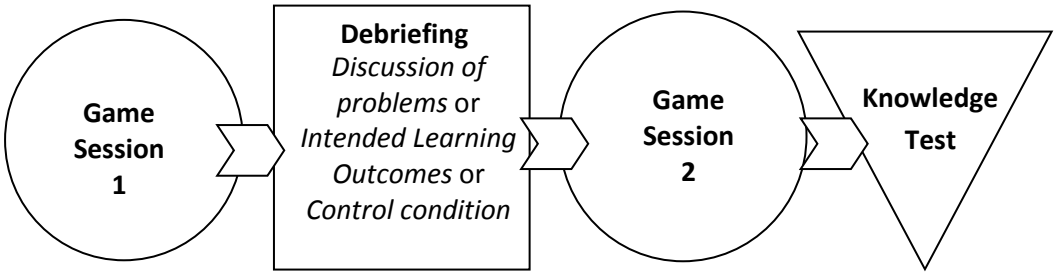
While the topic of Discussion of Problems focuses on the creation of awareness through reflective observation, the topic of Intended Learning Outcomes is concerned with drawing conclusions through abstract conceptualization. To let participants discuss or reflect on the problems they encountered during the experience is closely connected to the idea that much can be and is learned through mistakes. By focusing the debriefing on this topic, the user can concentrate completely on examining why certain things went wrong and how these outcomes could be changed. All the things that did not go wrong were somehow managed by the user, meaning that he has the knowledge and/or skills to cope with that kind of issues, consciously or unconsciously. Additionally, the problem centered debriefing should also discuss the connection between in game problems and real life problems. The discussion or reflection on the intended learning outcomes, on the other hand, focuses on making participants aware of what and how they have learned. This also includes becoming aware of ideas and connections that already existed in the user's mind but were not well established and the reflection on things or concepts in the game that changed the meaning the user gave to already existing ideas. The question arises whether a debriefing that is reduced to only one topic, for example Discussion of Problems or Intended Learning Outcomes has a significant

effect on learning compared to a no-debriefing condition and to which degree these two different topics lead to different learning outcomes.

Research Question

The aim of this study is to investigate in how far short self-debriefings concerned with the discussion of problems or the drawing of conclusions differ in their effectiveness to promote independent learning with computer games. Furthermore, it is explored whether these short self-debriefings yield an advantage in general, compared to when no debriefing is held. Domain knowledge and game performance of students who play a business simulation computer game are examined. A between-subject design is used, in which the debriefing was manipulated across three conditions. Students in the two experimental conditions (*discussion of problems* and *Intended learning outcomes)* receive a short self-debriefing in form of guiding questions between two successive game sessions. While the *Discussion of problems* condition is provided with the "Discussion of Problems" questions by Fritzsche, the *Intended learning outcomes* condition receive questions according to the topic "Intended Learning Outcomes", as proposed by Boscia (in Fritzsche, 2004). Students in the *control* condition receive no debriefing. Figure 2 shows the sequence of the experimental setup schematically.

Figure 2
Schematic Research Model



Question 1: Is there an effect of condition on game score and knowledge test score?

It is predicted that, despite the debriefing time being short, students in the *Discussion of problems* condition and students in the *Intended learning outcomes* condition score higher in the second game session as well as on the knowledge test than students in the *control* condition. Furthermore it is expected that both experimental conditions perform equally in game scores and knowledge test scores because each debriefing covers another important stage of Kolb's theory of experiential learning. This prediction is based on the outcomes of Tannenbaum & Cerasoli's meta-analysis (2013), and especially on the facts that they found that debriefing improved performance for about 25%, while the time used for debriefing had no influence. However, the fact that no self-debriefing studies were included in the meta-analysis makes it questionable to base the predictions on this study.

Question 2: Is there an effect of condition on motivation?

It is predicted that students in the experimental conditions will show an increase in motivation, while the students in the *control* condition will not. These expectations are based on the findings of Hattie & Timperley (2007) that questions stimulating reflection can increase effort, motivation, or engagement because they have the power to reduce discrepancies between what is understood and what is aimed to be understood.

2. Method

Participants

The sample consisted of 49 university students (27men, 22women) with a mean age of 22 years (*SD* = 2,2). They came from the Netherlands or Germany speaking English as second or third language and studying psychology or communication science. The participants were randomly assigned to one of three conditions: *Discussion of problems* condition (*n* = 17), the *Intended learning outcomes* condition (*n* = 16) or the *control* condition (*n* = 16). They received 2 subject points (of which they need 15 in their first two study years) for their participation.

Materials

Game. The game that was used for the experiment was Lemonade Tycoon 2, edition New York (http://www.shockwave.com/gamelanding/lemonade2.jsp). It is a single player business strategy game with the aim to set up and run a successful lemonade business. The game starts with a simple lemonade stand in the Bronx. To achieve the goal and maximize profits, the player has to manage variables such as recipe, price, stock, marketing, location, and rent, in order to deal with external factors as weather, customers' satisfaction, and popularity of lemonade. The player can adjust the variables before starting a business day and receives feedback during and after the day to help him modifying the strategy for the following day. During the day only the variables recipe and price can be manipulated. The game can be played in two different modes, career mode and challenge mode. While career mode is an open-end game, challenge mode only runs for 30 business days in which participants have to make as much money as possible. For this study, participants played the career mode because it allowed controlling the time in minutes, instead of the number of game days. This gave participants more freedom in their way of playing and by this increased the external validity. The game performance was used to assess the learning outcomes of the three conditions. The goal of the game is to make as much profit as possible. The profit of each game day is displayed, together with the amount of other assets as stock and equipment, in a report after each day. For each game session of 40 minutes a game score was calculated by subtracting the money available at the beginning of the game ($500) from the current bank account and dividing by the number of game days, which results in the average profit over all the days. These game scores were used as measure for implicit knowledge of the game.

Game Experience Questionnaire (GEQ). The fact that people who play or played games, more or less similar to the one used in this experiment, in their free time, have some knowledge of how these games work, made it important to assess their experience with computer games in general and with this type of game in particular. A five-item questionnaire about game experience using closed questions was administered. The questions addressed general computer game experience, how many hours were spent on playing computer games in the last week, the time strategy games have been played, the time business simulation games have been played and the time Lemonade Tycoon (1, deluxe or 2) has been played. For the questions about gaming in the last week and the experience with Lemonade Tycoon, five answer categories were provided, ranging from 0 hours to more than 10 hours. For the other three questions 3 answer categories ranging from no experience to very much experience were provided. Furthermore, this questionnaire also asked the participants to indicate their age and sex.

*Game Motivation Questionnaire (FAM).*Before the first and after the second game session a questionnaire consisting of 18itemswas administered in order to measure four constructs: interest, probability of success, anxiety and challenge. The FAM (Fragebogen zur Erfassung aktueller Motivation) has been developed by Vollmeyer, Rheinberg and Burns (2001) to measure current motivation in learning and performance situations and is based on the assumption that a cognitive–motivational model for learning works best to explain learning outcomes. The construct of interest addresses the participant's positive affect (e.g., "I would work on such a task in my leisure time."). The questions about probability of success assess the participant's belief that he can succeed (e.g., "I think I can cope with the difficulty of this task."). The construct of anxiety represents the fear of failure (e.g. "I feel under pressure to perform well in the task."). Questions about challenge assessing how far participants perceive the task as a challenging situation in which they want to succeed (e.g., "I am strongly determined to try hard on this task."). A short description of the game and its goal was given before the participants filled in this questionnaire. The constructs of interest and anxiety were assessed with five questions each, while those of challenge and probability of success were assessed with 4 questions. The answer format was a 7-point Likert scale with "True" on the left end and "Not True" on the right, meaning that lower scores indicated agreement with the statement, while higher scores indicated disagreement.

Debriefing. After the first game session of 40 minutes, both experimental conditions received written debriefing questions and empty space to answer them in written form. The *Discussion of problems* condition, received questions addressing their problems, as proposed by Fritzsche (2004). The questions let them inquire the problems encountered during the game, the respective causes, their connections to real life, and possible solutions. The *Intended learning*

outcomes condition, on the other hand, was provided with debriefing questions concerning their learning outcomes as proposed by Boscia (in Fritzsche, 2004). The purpose of the questions was to stimulate students to think about what they had learned from the activity, from which aspect of the game they learned most, what of this was already known, how this took new meaning through the experience and why they think they learned what they learned. A maximum time of 15 minutes was given for the debriefing. In order to compensate for the time of the debriefing, students in the *control* condition had to read a text about Lemonade.

*Knowledge test.*A15-item questionnaire, based upon the ones used in Van der Meij et al.'s (2013)and Lok's (2011) studies, with a combination of open- and closed-ended questions was used to assess the student's beliefs about the underlying variables and mechanisms of the game after the second game session. The questions addressed important concepts and principles of the game as well as heuristics of how to deal with specific situations. Concepts and principles are not explicitly mentioned in the game but they have great influence on the course of the game. Heuristics on the other hand are experience-based techniques to deal with situations, when fast decisions are required. Five of the questions were about major concepts of Lemonade Tycoon 2, of which four were open-ended and one was in true/false format. Examples for concepts are popularity and satisfaction and an example for this type of questions is: "Indicate three reasons for customers to be unsatisfied". The next five questions enquired game principles, of which four were open ended questions and one in multiple-choice format. Principles are connections of different concepts in the game, as user's actions, special events and outcomes hereof are interrelated. An example of a question about a principle is: "When the weather is over 30°C (85°F), you decide to put 5 ice cubes in the lemonade. How many lemons and sugar should be added to meet customers' satisfaction? " In this case not only the ratio has to be correct, but also the weather and types of customers have to be taken into account. The last five questions measured heuristic knowledge. If the participants understood the structure of the game and how the principles are connected with each other, they should be able to deal effectively with new situations. These were open-ended questions, describing in-game situations and asking participants to explain how they would react to them and why. The participants were prompted to indicate reasons for their decisions as well as which outcome they expected. In order to check whether the participant's answers were correct they were checked against the answer model, also based on the studies by Van der Meij et al. (2013) and Lok (2011).

Procedure

The experiment took place in rooms of the Twente University, which are dedicated for conducting experiments. Participants were randomly assigned to three conditions by a list on which the three conditions alternated. After signing the informed consent, the participants filled in the

game experience questionnaire which took about 5 minutes. Afterwards they were given a short description of the game, Lemonade Tycoon 2, and they were introduced to their goal – to set up and run a successful lemonade business and make as much money as possible in 40 minutes. Then they were given up to 10 minutes to fill in the game motivation questionnaire. Hereafter, the first game session started with a short tutorial which introduced the interface and the most important aspects of the game. After 40 minutes the experimenter entered the room and wrote down the current bank account and the number of game days. He provided the participants with the respective experimental manipulation in form of printed debriefing questions for the experimental conditions or a text about lemonade for the control condition. This text did not contain any information that was helpful for the game. The experimenter indicated that they had a maximum of 15 minutes to work on the material. Following, the next game session started and the participants were informed that they had the same time and goal as in the first session. During both game sessions they played individually and help was only given on computer technical issues; however the experimenter made sure that they kept focused on their task by observing them via video camera. Directly after this second game session, the participants completed the game motivation questionnaire again and finally they were given a maximum of 25 minutes for the knowledge test.

Scoring and Data Analysis

First, the direction of the items of the FAM was arranged and the mean for each of the four constructs was calculated. Change scores were calculated for the FAM by subtracting the first from the second FAM score. Data from the GEQ, FAM and the participant's age was checked for equality of distributions across the conditions. In case of unequal distributions, these variables were used as covariates for further analysis. The answers on open questions of the knowledge test were rated by two raters; the Cohen's kappa inter-rater reliability was satisfactory with 0.72. IBM SPSS Statistics 20 (Predictive Analysis Software) was used to analyze the data. A repeated measures ANOVA with the first and second game score was used to analyze the participants' improvement from one session to the other and to test for differences between the conditions. To test the research hypotheses, analysis of variance (ANOVA) and post-hoc analysis was applied, with Bonferroni correction when necessary. The three concepts in the knowledge test were examined separately. The alpha level was $p < .05$.

3. Results

In order to check for normal distribution of the dependent variables between the three conditions a Kruskal Wallis test was applied. It revealed that the three conditions differed significantly regarding age (p = .014) as well as strategy game experience (GEQ) (p= .024). An overview over the means and standard deviations of these variables is given in Table 2. The two

variables which had been identified as not equally distributed across the conditions were analyzed with five separate univariate ANCOVAs, each with the scores of one part of the knowledge test (concepts, principles, and heuristic knowledge) or one of the game scores as dependent variable. The analysis showed a positive effect of strategy game experience on the principles part ($F(2,4) = 7.22$, $p = .002$) and on the heuristic part ($F(2,46) = 4.72$, $p = .014$)of the knowledge test. Age was a significant predictor for game score 1 ($F(9,39) = 2.55$, $p = .021$), as well as game score 2 ($F(4,43) = 3.46$, $p = .003$).

Table 2

Means and Standard Deviations of Unequally distributed variables, Game scores, Knowledge test scores and FAM change scores

	Condition		
	Discussion of problems (*n* = 17) *Mean* (SD)	*Intended learning outcomes* (*n* = 16) *Mean* (SD)	*Control* (*n* = 16) *Mean* (SD)
Age	22.59 (2.29)	21.13 (1.82)	23.25 (2.02)
Strategy Game Experience	1.94 (0.66)	1.44 (0.51)	2.00 (0.63)
No reward needed	3.12 (0.86)	3.19 (1.28)	2.37 (1.03)
Game Scores[a]			
Game Score 1	-32.01 (24.48)	-20.62 (31,16)	-33.95 (29,23)
Game Score 2	-8.10 (16.19)	-1.76 (21,20)	-5.09 (21,52)
Improvement	23.91 (16.21)	18.87 (26.57)	28.86 (25.54)
Knowledge Test (max.28)	13.06 (3.91)	11.56 (4.07)	11.22 (3.31)
Concepts (max. 6)	2.29 (0.99)	2.31(1.06)	2.06 (0.95)
Principles (max.5,5)	2.82 (1.35)	2.22 (1.28)	2.78 (1.05)
Heuristics (max.16,5)	7.94 (2.45)	7.03 (2.59)	6.38 (2.25)
FAM Change Scores[b]			
Interest	.26 (0. 75)	.20 (1.13)	-.30 (0.86)
Challenge	-.03 (0.54)	.27 (0.82)	.02 (0.88)
Success probability	.28 (1.18)	.45 (1.00)	.31 (0.98)
Anxiety	.07 (0.73)	-.04 (0.94)	.51 (0.73)

[a]Game scores show participants' average daily profit.

[b]Higher change scores indicate that participants changed their attitude by agreeing more; negative change scores indicate a decrease in agreement.

How does repeated playing improve performance?

From the first to the second game session, the most progress in game scores was made by

the *control* condition (M = 28.86) compared to a mean of 23.91 by the *Discussion of problems* condition and 18.87 by the *Intended learning outcomes* condition. The means and standard deviations of the game scores are presented in Table 2. A one-way repeated measures ANOVA was conducted to compare the first and second game score and check whether the differences across the three conditions were significant. A significant improvement in game scores was found from the first to the second session, with Wilks' Lambda=0.00, $F(1,46) = 52.23$, $p < .001$ and a mean increase of 23.88. The analysis revealed no significant differences or interaction effects between the conditions regarding the improvement of game scores.

Is there a connection between game scores and knowledge test scores?

As the two game scores were used as measure of implicit knowledge and the scores on the knowledge test as measure of explicit knowledge of the game, the two game scores and the scores on the three parts of the knowledge test were analyzed for correlations. Table 3 gives an overview over the correlations. For game score 1, correlations were found with game score 2, with concept knowledge, with principle knowledge, and with heuristic knowledge. Concerning game score 2, correlations were found with concept knowledge, as well as with principle knowledge. The correlation with heuristic knowledge was not significant. Concept knowledge correlated with principle knowledge and with heuristic knowledge and for principle knowledge correlation was found with heuristic knowledge.

Table 3
Correlations between Game Scores and Knowledge Test Scores

	GameScore1	GameScore2	KT_ Concepts	KT_ Principles	KT_ Heuristics	KT_Total
GameScore1	1	,593**	,382**	,463**	,346*	,477**
GameScore2	,593**	1	,374**	,337*	,257	,376**
KT_ Concepts	,382**	,374**	1	,286*	,460**	,654**
KT_ Principles	,463**	,337*	,286*	1	,452**	,697**
KT_ Heuristics	,346*	,257	,460**	,452**	1	,921**
KT_Total	,477**	,376**	,654**	,697**	,921**	1

Correlations between Game Scores and Knowledge Test Scores for Discussion of problems *condition*

	GameScore1	GameScore2	KT_ Concepts	KT_ Principles	KT_ Heuristics	KT_Total
GameScore1	1	,755**	,529*	,787**	,610**	,788**
GameScore2	,755**	1	,450	,815**	,570*	,752**
KT_ Concepts	,529*	,450	1	,277	,356	,572*
KT_ Principles	,787**	,815**	,277	1	,602*	,793**
KT_ Heuristics	,610**	,570*	,356	,602*	1	,926**
KT_Total	,788**	,752**	,572*	,793**	,926**	1

Correlations between Game Scores and Knowledge Test Scores for Intended Learning Outcomes *condition*

	GameScore1	GameScore2	KT_ Concepts	KT_ Principles	KT_ Heuristics	KT_Total
GameScore1	1	,540*	,447	,524*	,381	,524**
GameScore2	,540*	1	,461	,500*	,165	,383
KT_ Concepts	,447	,461	1	,523*	,407	,685**
KT_ Principles	,524*	,500*	,523*	1	,511*	,777**
KT_ Heuristics	,381	,165	,407	,511*	1	,905**
KT_Total	,524**	,383	,685**	,777**	,905**	1

Correlations between Game Scores and Knowledge Test Scores for Control *condition*

	GameScore1	GameScore2	KT_ Concepts	KT_ Principles	KT_ Heuristics	KT_Total
GameScore1	1	,528*	,156	,283	,114	,212
GameScore2	,528*	1	,239	-,194	,197	,142
KT_ Concepts	,156	,239	1	,065	,637**	,740**
KT_ Principles	,283	-,194	,065	1	,220	,485
KT_ Heuristics	,114	,197	,637**	,220	1	,933**
KT_Total	,212	,142	,740**	,485	,933**	1

How does debriefing affect learning?

Four separate univariate ANCOVAs with the scores of the knowledge test (total score, concepts, principles, and heuristic knowledge) as dependent variable, condition as independent variable, and game score 1, age, and strategy game experience revealed a significant effect of condition on total test score ($F(2,44) = 2.55$, $p = .04$ (one sided)) as well as heuristic knowledge, $F(2,44) = 3.39$, $p = .02$ (one sided), but not on knowledge of concepts or principles. Post-hoc analysis with Bonferroni correction showed that the difference between the *Discussion of problems* condition (M = 7.91, SD = .53) and the *Control* condition (M = 5.86, SD = .57) was significant for the heuristics score ($p = .04$ (one sided)). It also revealed that the difference between the *Intended learning outcomes* condition and the C*ontrol* condition in total score was significant with p = .08 (*Intended learning outcomes*: M = 12.97, SD = .90; C*ontrol*: M = 10.36 SD = .89) and in heuristic knowledge with p = .05 (one sided) (*Intended learning outcomes*: M = 7.84, SD = .61; C*ontrol*: M = 5.87, SD = .58). No differences between the two experimental conditions were found. Figure 3 shows the scores of the three conditions on the heuristics part of the knowledge test knowledge test and Figure 4 their total knowledge test scores.

For the covariate strategy game experience, significant effects were found on conceptual knowledge with $F(1,43) = 7.43$, $p = .009$, on principle knowledge with $F(1,43) = 9.56$, $p = .003$, and on

heuristic knowledge with $F(1,43) = 7.47$, $p = .009$. Regarding game scores, strategy game experience had a significant effect only on the second game score with $F(1,43) = 5{,}2$, $p = .028$. Analysis of covariance with game score 2 as dependent variable, condition as independent variable, and game score 1, age, and strategy game experience as covariates revealed only the first game score as predictor for the second game score, with $F(1,43) = 18.65$, $p < .001$, while the effect for condition was not significant.

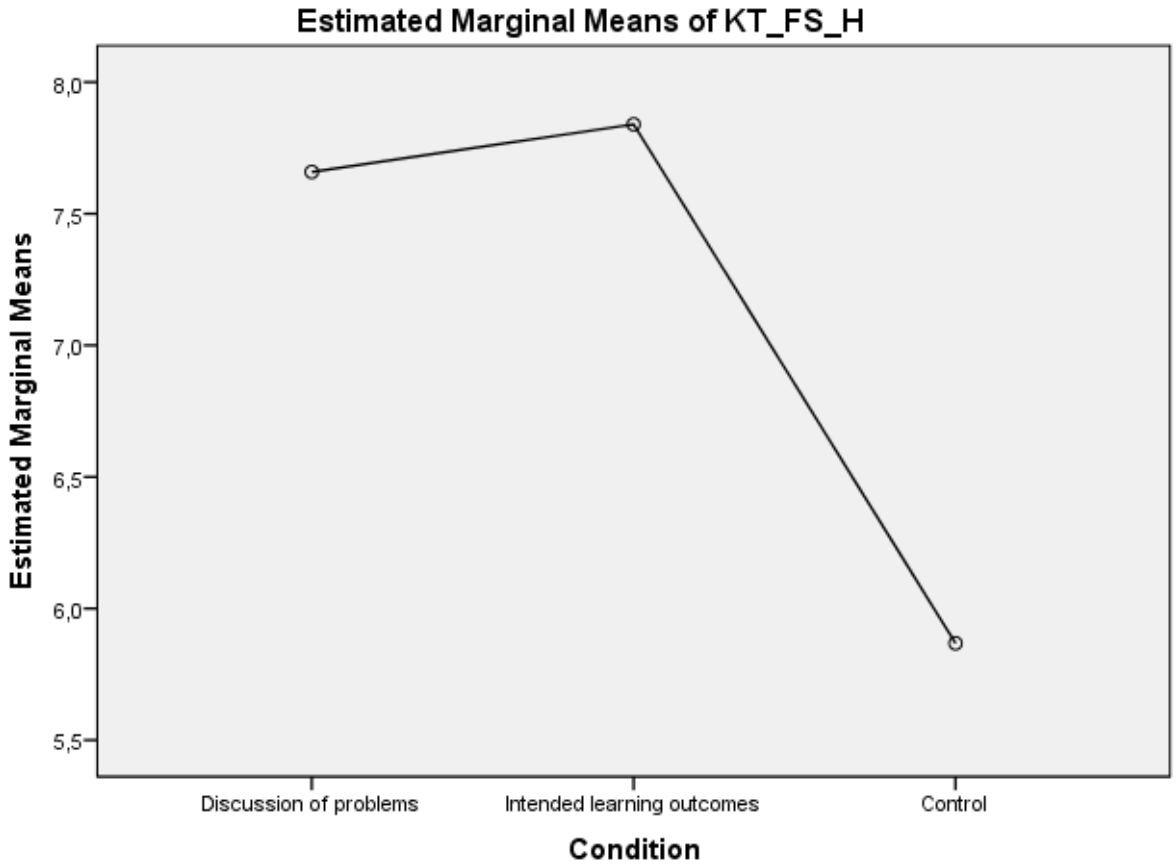


Figure 3: Scores of the three conditions on the heuristics part of the knowledge test

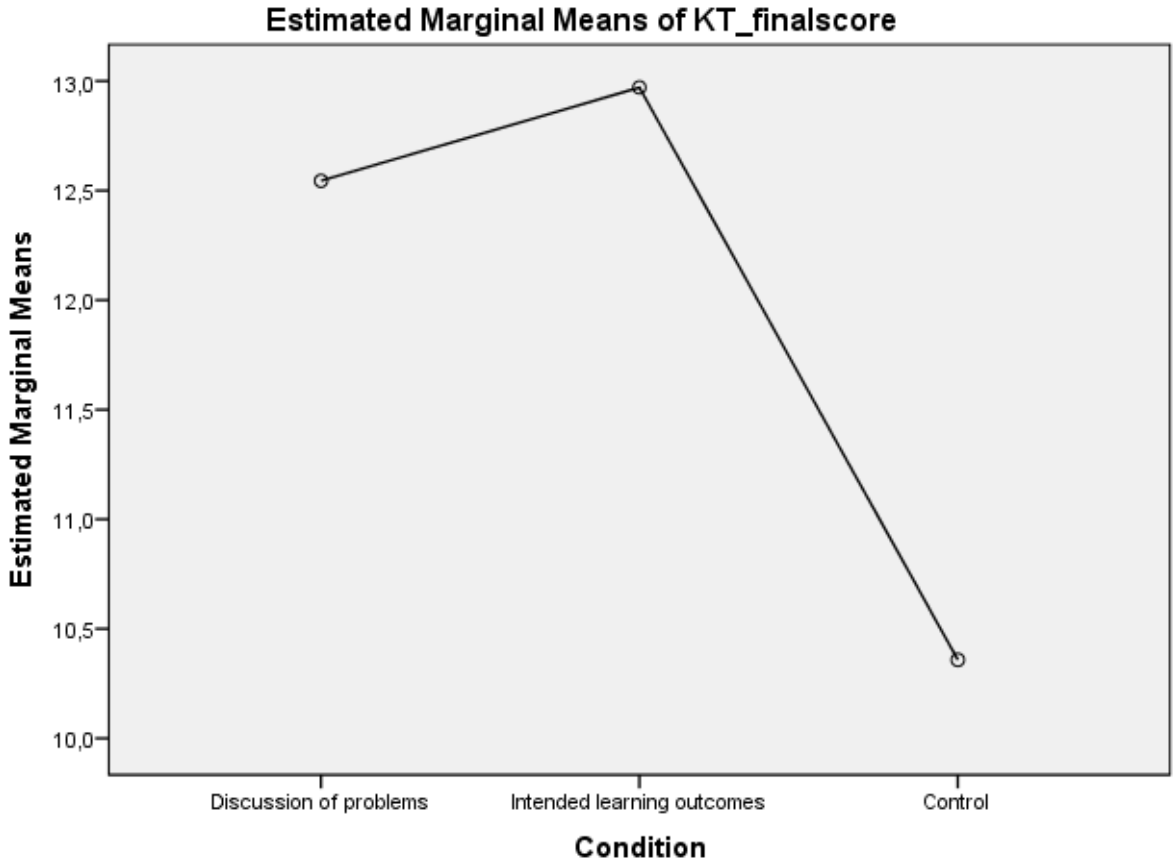


Figure 4: Total scores of the three conditions on the knowledge test

Does debriefing have an influence on motivation?

The four change scores of the FAM (Interest, Probability of success, Anxiety, and Challenge) were examined with MANOVA to check for differences between the conditions regarding the game scores and knowledge test scores. These analyses were executed with as well as without the two variables which had been identified as not equally distributed across the conditions as covariates. No effects between the conditions were found. However it has to be stated that both experimental conditions showed an increase in interest from the first to the second session while the control condition's score decreased. An overview over the means and standard deviations of the FAM change scores in given in Table 2.

4. Discussion

The purpose of this study was to examine and compare different short self-debriefing topics regarding their effectiveness to support independent learning with computer games. Game performance and domain knowledge of participants who played the business simulation "Lemonade Tycoon 2" were examined in order to compare the two debriefing topics, *Discussion of problems* and

Intended learning outcomes, with each other as well as with a control condition.

Regarding the first research question, the prediction was that students in the *Discussion of problems* condition and students in the *Intended learning outcomes* condition would score higher in the second game session and on the knowledge test than students in the *control* condition. It was also expected that both experimental conditions would perform equally. This prediction was partially confirmed, as both experimental conditions achieved significantly higher heuristic knowledge scores than the *Control* condition and for the *Intended learning outcomes* condition the total knowledge test scores were higher as well. However, no differences regarding concept knowledge, principle knowledge or game scores were found. The prediction that no differences in game scores or knowledge test scores between the two experimental conditions would be found was confirmed. Both debriefing topics seem to show similar effect on the knowledge test as they both cover important stages of Kolb's learning cycle but they had no influence on the game scores.

Concerning the second research question it was predicted that students in both experimental conditions would show an increase in motivation from the first to the second session, in contrary to students in the *control* condition. This prediction was not confirmed as no significant differences between the conditions in motivation were found. However, a difference in direction of the Interest change scores was remarkable: the control condition showed a decrease but both experimental conditions' scores increased, suggesting that the debriefings had some potential to stimulate interest and by this increase motivation.

The fact that no significant differences were found between the two debriefing conditions but effects of condition were found on total test scores and heuristic knowledge but not on other parts of the knowledge test or game scores indicates that both short self-debriefings supported the learning to some extent. This is in line with the findings of Tannenbaum's & Cerasoli's (2013) meta-study, that short debriefings are effective as well. The results suggest that the debriefing questions prepared participants adequately for the questions of the heuristics part of the knowledge test. Through the debriefing they reflected on important concepts of the game and their interactions. They achieved higher scores because terms, concepts and connections tested in the heuristics part were already activated during the debriefing and by this became more explicit, leading to reduced effort when recalling them during the knowledge test. But why did the debriefing not affect the second game scores or the concept and principle knowledge? One possible answer to this question is that the time of the gaming sessions was not sufficient for the participants to apply their strategies successfully, or that the game was too difficult or complex to do so in forty minutes. Another explanation would be that there was a problem with the content or structure of the debriefing.

The answers on the debriefing questions were not scored as they only served as trigger to

stimulate reflection on a certain topic. Nevertheless, regarding the length of the answers it has to be noted that they differed widely. While many individuals understood how to answer the debriefing questions in a reasonable way, quite a few did not, or they lacked motivation to answer these open questions. A few gave structure to their answers by themselves, for example by organizing them with numbers, which resulted in some of the most sophisticated answers. This suggests that more structure for the answers in self-debriefing would be helpful for individuals who have difficulties in answering broader questions or do not structure their answers by themselves. While the questions proposed by Fritzsche (2004) provide some structure to the reflection process the results of this study suggest that more structure is recommended. For example, the first question in the *Discussion of problems* debriefing could be "Name four problems you encountered in making decisions or as a result of your previous decisions" instead of "What problems did you encounter in making decisions or as a result of your previous decisions?". The successive questions could refer to these four instances and by this prevent lack of ideas or loosing focus during the answer process. This can also improve the questions explicitness and have influence on participants' motivation, as it restricts their task and can increase perceived self-efficiency. While in this study the effect of condition on motivation was not significant, with an improved structure this could be the case, as the data indicates that both debriefing condition's interest scores increased while the *Control* condition's decreased. This suggestion is based on Tannenbaum & Cerasoli's (2013) statement that the reflection on specific past events, instead of general performance, yields a different focus and can lead to deeper examination of specific actions and situations. All this leads to the conclusion that self-debriefing is suitable for supporting individual learning with computer games. However, in order to improve this form of support it is reasonable to use a little more structure than proposed by Fritzsche (2004) is provided.

Significant correlations between the second game scores, as a measure of in-game performance, and all the scores on the knowledge test, except of the scores on the heuristics part, suggests that the knowledge test was a valid measure for game performance; however the validity of the heuristic part remains questionable. It might have enquired knowledge that is not exclusively obtainable through playing this particular game and is, at least to some extent, answerable by logical reasoning. This is due to the fact that Lemonade Tycoon 2 simulates aspects of real life business in a relative realistic way, which is one reason why it seems suitable for learning. Due to time issues, the sample size (49 participants) of this study was smaller than desired. In future studies a larger sample should be used in order to receive more meaningful results through greater statistical power. Furthermore, future research should also focus on other target groups, for example children who are great learners and well known for their enthusiasm for any type of games.

Acknowledgements

I would like to thank my supervisors Dr. H.H. Leemkuil and Dr. H. van der Meij for their support and constructive feedback.

References

Berry, D. & Broadbent, D. (1988). Interactive tasks and the implicit-explicit distinction. *British Journal of Psychology*, 79, 251–272.

Crookall, D. (2010). Serious Games, Debriefing, and Simulation/Gaming as a Discipline. *Simulation & Gaming,* 41(6), 898–920.

Csikszentmihalyi, M. (1990).*Flow: The psychology of optimal performance.* New York: Cambridge University Press.

Fritzsche, D. J., Leonard, N. H., Boscia, M. W. & Anderson, P. H. (2004). Simulation Debriefing Procedures. *Developments in Business Simulation and Experiential Learning*, 31.

Garris R., Ahlers, R. & Driskell, J.E. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming*, 33(4), 441-467.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy.* New York: Pal grave/ St. Martin's.

Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of educational research,* 77*(1), 81-112.* http://dx.doi.org/doi: 10.3102/003465430298487.

Kensinger, E. A. (2007). Negative emotion enhances memory accuracy: Behavioral and neuroimaging evidence. *Current Directions in Psychological Science*, 16, 213–218.

Kirriemuir, J. (2002). A Survey of the Use of Computer and Video Games in Classrooms. *Internal report for Becta* (British Educational Communications and Technology Agency).

Kirriemuir, J. & McFarlane, A. (2004). Literature review in games and learning. *Nesta futurelab series. Report 8*. Retrieved November 21, 2012. http://dx.doi.org/doi:10.1177/1046878102238607.

Kluger, A. N., & De Nisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin,* 119, 254-284.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. New York: Prentice Hall.

Kunz, D.A. (2003). Using Business Simulation: Ten Questions, Proceedings from the MMA Fall Educators' Conference.

Leemkuil, H. H. (2006). *Is it all in the game?: Learner support in an educational knowledge management simulation game.*

Leemkuil, H. H. (2008). Educational computer games: scaffolding is the active substance. In L. Caluwé, G. J. de Hofstede & V. Peters (Eds), *Why do games work? In search of the active substance,* 165–170. Deventer: Kluwer.

Lok, S. (2011). Het herhaalt en collaboratief spelen van een educatieve game (Bachelor thesis). University of Twente, Enschede, Netherlands.

Petranek, C. F. (1994). A Maturation in Experiential Learning: Principles of Simulation and Gaming. *Simulation Gaming, 25*(4), 513-523.

Randel, J., Morris, B., Wetzel, C., & Whitehill, B. (1992). The effectiveness of games for educational purposes: A review of recent research. *Simulation & Gaming,*23, 261-276.

Shinnick, M. A., Woo, M., Horwich, T. B., & Steadman, R. (2011, May). Debriefing: The most important component in simulation? *Clinical Simulation in Nursing*, 7(3), e105-e111. http://dx.doi.org/doi:10.1016/j.ecns.2010.11.005.

Tannenbaum, S. I. & Cerasoli, C. P. (2013). Do Team and Individual Debriefs Enhance Performance? A Meta-Analysis. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 55(1), 231-245.* http://dx.doi.org/*doi:10.1177/0018720812448394.*

Trybus, J., New Media Institute, http://www.newmedia.org/game-based-learning--what-it-is-why-it-works-and-where-its-going.html, retrieved July 2013.

van der Meij, H., Albers, E., and Leemkuil, H. (2011). Learning from games: Does collaboration help? *British Journal of Educational Technology,* 42(4), 655–664. doi:10.1111/j.1467-8535.2010.01067.x

van der Meij, H., Leemkuil, H. & Li, J-L (2013). Does individual or collaborative self-debriefing better enhance learning from games? *Computers in Human Behavior*, 29, 2471-2479.

Vollmeyer, R., & Rheinberg, F. (2000). Does motivation affect performance via persistence? *Learning and Instruction*, 10(4), 293-309. http://dx.doi.org/doi: 10.1016/S0959-4752(99)00031-6.

Wexley, K. N., & Latham, G. P. (1991). *Developing and training human resources in organizations* (2nd ed.). New York: HarperCollins.

Appendix 1 – Game Experience Questionnaire

Participant Nr: _____ Age: _____ Sex: M / F

With these questions we want to estimate your experience with computer games.

1. How much experience do you have with computer games in general?
   ◯ (Almost) None
   ◯ Some
   ◯ (Very) Much

2. Please estimate how many hours did you spend playing computer games in the last week?
   ◯ 0
   ◯ 1-3
   ◯ 4-6
   ◯ 7-9
   ◯ 10 or more

3. How much experience do you have with playing digital strategy games in general?
   ◯ (Almost) None
   ◯ Some
   ◯ (Very) Much

4. How much experience do you have with playing business-simulation games?
   ◯ (Almost) None
   ◯ Some
   ◯ (Very) Much

5. Please estimate how many hours experience you have with playing Lemonade Tycoon (version 1 or 2 or “Sim Lemonade Millionaire”).
   ◯ 0
   ◯ 1-3
   ◯ 4-6
   ◯ 7-9
   ◯ 10 or more

Appendix 2 – Motivation Questionnaire (FAM)

Participant Nr: _____

On this sheet you can rate your current attitude towards the described task. Please chose and mark the number that corresponds to your current attitude best.

	True						**Not true**
1. I like this kind of puzzles.	1	2	3	4	5	6	7
2. I think I can cope with the difficulty of this task.	1	2	3	4	5	6	7
3. Probably I will not succeed in the task.	1	2	3	4	5	6	7
4. In the task, I like the role of the scientist, discovering new connections.	1	2	3	4	5	6	7
5. I feel under pressure to perform well in the task.	1	2	3	4	5	6	7
6. The task is a real challenge for me.	1	2	3	4	5	6	7
7. After reading the task description I think the task is very interesting.	1	2	3	4	5	6	7
8. I am keen to know how good I will perform in this task.	1	2	3	4	5	6	7
9. I am a bit scared that I could embarrass myself here.	1	2	3	4	5	6	7
10. I am strongly determined to try hard on this task.	1	2	3	4	5	6	7
11. For task like this I don’t need a reward, because they are fun.	1	2	3	4	5	6	7
12. I would feel awkward, if I would fail at this task.	1	2	3	4	5	6	7
13. I think everybody can succeed in this task.	1	2	3	4	5	6	7
14. I think I will not succeed in this task.	1	2	3	4	5	6	7
15. If I succeed in this task, I will be somewhat proud of my capability.	1	2	3	4	5	6	7
16. When thinking of the task I feel a bit worried.	1	2	3	4	5	6	7
17. I would work on such a task in my leisure time.	1	2	3	4	5	6	7
18. The concrete performance requirements here disturbs me.	1	2	3	4	5	6	7

Appendix 3 – Debriefing Questions: Discussion of Problems

Participant No: _____

Discussion of Problems

a. What problems did you encounter in making decisions or as a result of your previous decisions?
Please explain your answer

_____

_____

_____

_____

_____

_____

_____

_____

b. What caused those problems?
Please explain your answer

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

c. Do these events, decisions and problems occur in real life?
Please explain your answer

_____

_____

_____

_____

_____

_____

_____

d. Are the causes of these problems similar in real life?
Please explain your answer

_____

_____

_____

_____

_____

_____

_____

e. What could you do to avoid these types of problems in real life?
Please explain your answer

_____

_____

_____

_____

_____

_____

Appendix 4 – Debriefing Questions: Intended Learning Outcomes

Participant No: _____

Discussion of Learning Outcomes

a. What did you learn that was new to you during this simulation?
Please explain your answer

_____

_____

_____

_____

_____

_____

b. What things that you already knew took on new meaning?
Please explain your answer

_____

_____

_____

_____

_____

_____

From what aspect of the simulation did you learn the most? What did you learn?
Please explain your answer

_____

_____

_____

_____

_____

_____

c. What kind of connections among things you already knew did the simulation create?
Please explain your answer

_____

_____

_____

_____

_____

_____

e. What is it about the simulation that caused this to take place?
Please explain your answer

_____

_____

_____

_____

_____

_____

Appendix 5 – Debriefing Questions: Intended Learning Outcomes
Participant No: _____

Discussion of Learning Outcomes

a. What did you learn that was new to you during this simulation?
Please explain your answer

_____

_____

_____

_____

_____

_____

_____

_____

_____

b. What things that you already knew took on new meaning?
Please explain your answer

_____

_____

_____

_____

_____

_____

_____

_____

_____

c. From what aspect of the simulation did you learn the most? What did you learn?

Please explain your answer

_____

_____

_____

_____

_____

_____

_____

d. What kind of connections among things you already knew did the simulation create?
Please explain your answer

_____

_____

_____

_____

_____

_____

_____

e. What is it about the simulation that caused this to take place?
Please explain your answer

_____

_____

_____

_____

_____

_____

_____

Appendix 6 – Knowledge Test

Participant Nr: _____
Please answer the questions about the game.

1. Name three reasons for customers to be unsatisfied.
1. _____
2. _____
3. _____

2. What is meant with 'Lost sales'?
_____
_____

3. Except the supplies for making lemonade, please name three possible expenses for running the business.
1. _____
2. _____
3. _____

4. Which concept(s) are you dealing with when you purchase an umbrella as upgrade?
_____
_____

5. True or false?: Popularity represents the percentage of people who come to your stand. If this statement is false, the correct answer is:
_____
_____

6. Which things have to be considered when buying stock?
_____
_____
_____
_____

7. When the weather is over 30°C (85°F), you decide to put 5 ice cubes in the lemonade. How many lemons and sugar should be added to meet customers' satisfaction?
Lemons: _____Sugar: _____

8. When you move your stand, …
a) … both, satisfaction and popularity change with the location.
b) … both, satisfaction and popularity depend on your stand.
c) … popularity changes with the location and satisfaction depends on your stand.
d) … satisfaction changes with the location and popularity depends on your stand.

9. Which of these two actions is better to attract more customers? Please explain why your choice is better than the other one.
a) Invest more money in advertising, because:
_____

_____

b) Purchase an upgrade that increases popularity, because:

_____

_____

10. When there are too many customers and they are complaining about the waiting, which of the two actions do you think is better? Please explain why your choice is better than the other one.

a) Lower the cost on advertising, because:

_____

_____

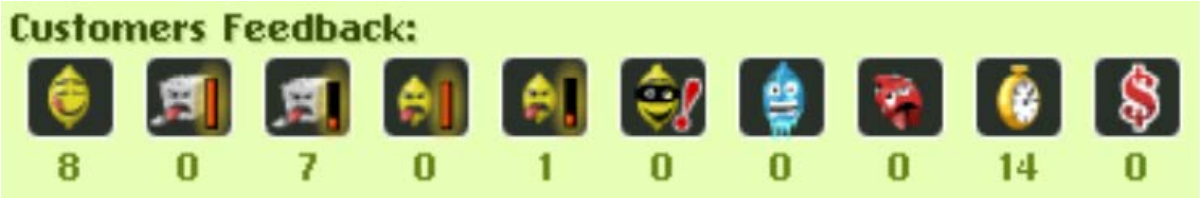
b) Move the stand to a place with fewer customers, because:

_____

_____

The next five questions describe possible situations in the game. Please describe in a <u>detailed way which actions</u> you would execute to prepare for the next day. Provide <u>reasons for each action</u> to explain why you do so and <u>which effect you expect</u>.

11. After a business day you receive the feedback below. You sold 40 of 60 cups. Describe your preparations and expectations for the next day.



Action(s)	Reason/ Predicted effect(s)

12. You start with your stand in the Bronx. The lemonade price is set to $ 1,50. Your recipe is 8 lemons, 3 sugar and 2 ice cubes. The weatherforecast is sunny andaround 25°C (75°F). Your customers complain about the waiting time. You had 30 cups and went out of stock before evening.

Action(s)	Reason/ Predicted effect(s)

13. You moved to the central station. After one day at the new location the popularity is 80%. The weather forecast is rainy and around 23°C (71°F). The recipe is set to 9 lemons, 3 sugar and 3 ice cubes. You already purchased the upgrades radio and customer reward card. Yesterday you sold 60 60 cups.

Action(s)	Reason/ Predicted effect(s)

14. Your popularity with a stand in the park is 30%. The news report states "Children think Lemonade is not 'cool'." The weather forecast indicates rainy weather with around 15°C (60°F). Your recipe is 8 lemons, 3 sugar and 3 ice cubes and the price is set to $ 2,25.Many customers say it's too expensive.

Action(s)	Reason/ Predicted effect(s)

15. You just moved to the park. After one day at the new location your popularity is 10%. Yesterday you sold 43 of 60 cups. The weather forecast says tomorrow it will be sunny with around 15°C (60°F). Your recipe is set to 6 lemons, 3 sugar and 3 ice cubes. You already bought the calculator upgrade.

Action(s)	Reason/ Predicted effect(s)

Appendix 7 – Knowledge Test Answer Model
(Answers are provided in grey)

1. Name three reasons for customers to be unsatisfied.

A)Bad recipe (ingredients/weather) -0,5 points

B) Long waiting time – 0,5 points

C) High price – 0,5 points

Maximum 1,5 points

2. What ismeant with 'Lost sales'?

People who come to the stand and leave without buying anything – 1 point

3. Except the supplies for making lemonade, please name three possible expenses for running the business.

A) Advertising – 0,5 points

B) Upgrades – 0,5 points

C) Rent – 0,5 points

Maximum 1,5 points

4. Which concept(s) are you dealing with when you purchase an umbrella as upgrade?

Satisfaction (people complain less about waiting) – 1 point

5. True or false?:Popularity represents the percentage of people who come to your stand. If this statement is false, the correct answer is:

True – 1 point

6. Which things have to be considered when buying stock?

A) Buy enough supplies for the next day (depending on recipe) -0,5 points

B) Estimate number of customers (to make sure not to get out of stock) -0,5 points

C) Buying more of the supplies is cheaper -0,5 points

D) Buy not too much stock: Ice melts every day, Lemons and sugar also get bad after a few days -0,5 points

E) What is left over from the last day -0,5 points

Maximum 1,5 points

7. When the weather is over 30°C (85°F), you decide to put 5 ice cubes in the lemonade. How many lemons and sugar should be added to meet customers' satisfaction?

Lemons: _____Sugar: _____

8/7 Lemons and4/3Sugar -1 point

8. When you move your stand, …

e) … both, satisfaction and popularity change with the location.

f) … both, satisfaction and popularity depend on your stand.

g) … popularity changes with the location and satisfaction depends on your stand.

h) … satisfaction changes with the location and popularity depends on your stand.

c) – 1 point

9. Which of these two actions is better to attract more customers? Please explain why your choice is better than the other one.

c) Invest more money in advertising, because:

_____

d) Purchase an upgrade that increases popularity, because:

_____

b) It is a onetime investment that constantly increases popularity – 1 point

10. When there are too many customers and are complaining about the waiting, which of the two actions do you think is better? Please explain why your choice is better than the other one.

c) Lower the cost on advertising, because:

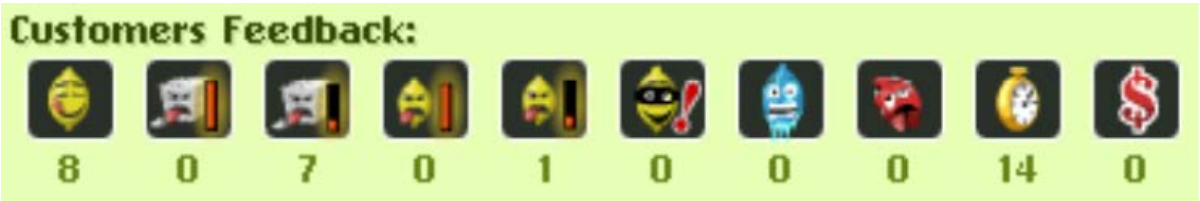
_____

Move the stand to a place with fewer customers, because:

_____

a) So you have less expenses, and keep popularity(which would change with the location) – 1 point

11. After a business day you receive the feedback below. You sold 40 of 60 cups. Describe your preparations and expectations for the next day.



Adjust recipe (0,5 points), more sugar (0,5 points), because people think lemonade is not sweet enough(0,5 points), Buy an upgrade (0,5 points) to shorten waiting time (0,5 points), Increase advertising (0,5 points) to increase popularity (0,5 points), Increase price (0,5 points), because nobody complained about the price (0,5 points)

Maximum 3 points

12. You start with your stand in the Bronx. The lemonade price is set to $ 1,50. Your recipe is 8 lemons, 3 sugar and 2 ice cubes. The weatherforecast is sunny andaround 25°C (75°F). Your customers complain about the waiting time. You had 30 cups and went out of stock before evening.

Adjust recipe(0,5 points), more ice (minimum 3 cubes) ***(0,5 points)because the weather gets warm(0,5 points)*****Buy more cups** ***(0,5 points) because you were out of stock and could have sold more(0,5 points)*****Increase price** ***(0,5 points)because you were out of stock and could have sold more – higher price more win per cup (0,5 points), When the weather is warm people want to pay more for lemonade (0,5 points)***

Buy an upgrade ***(0,5 points) to reduce waiting time (0,5 points)***

Maximum 4 points

You moved to the central station. After one day at the new location the popularity is 80%. The weather forecast is rainy and around 23°C (71°F). The recipe is set to 9 lemons, 3 sugar and 3 ice cubes. You already purchased the upgrades radio and customer reward card. Yesterday you sold 60 of 60 cups.

Adjust recipe with less lemon (1 or 2 less) (0,5 points)because the ratio doesn't fit, it's to sour (0,5 points), Increase price (0,5 points) because you sold all cups and could have asked more per cup (1 point) Don't change anything (1 point) because you sold everything(1 point) Buy more cups (0,5 points) because you sold everything(0,5 points)

Maximum 3 points

13. Your popularity with a stand in the park is 30%. The news report states "Children think Lemonade is not 'cool'." The weather forecast indicates rainy weather with around 15°C (60°F). Your recipe is 8 lemons, 3 sugar and 3 ice cubes and the price is set to $ 2,25.Many customers say it's too expensive.

Buy not too much stock (0,5 points), because children dont like lemonade → less customers (0,5 points, Adjust recipe with less ice (1 or 2 cubes) (0,5 points), because it is cold and rainy(0,5 points)Buy a calculator or cash register (0,5 points) to reduce waiting time (0,5 points)

Buy an umbrella (0,5 points)against rain(0,5 points)

Reduce price (0,5 points)because of bad weather less customers will come(0,5 points)

Make more advertising (0,5 points) because this improves image "cool" (0,5 points)

Maximum 4 points

14. You just moved to the park. After one day at the new location your popularity is 10%. Yesterday you sold 43 of 60 cups. The weather forecast says tomorrow it will be sunny with around 15°C (60°F). Your recipe is set to 6 lemons, 3 sugar and 3 ice cubes. You already bought the calculator upgrade.

Adjust recipe with less ice (1 or 2 cubes) (0,5 points), because weather is getting cold (0,5 points)More advertising (0,5 points) to become more popular (0,5 points)

Buy an upgrade (0,5 points), to increase popularity (0,5 points)

Reduce price (0,5 points) to sell more cups (0,5 points)

Maximum 3 points