Master Thesis Psychology

Jacek Sliwinski

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Dr. Ard Heuvelman Dr. Somaya ben Allouch

Department of Media, Communication & Organization

UNIVERSITY OF TWENTE.

Prof. Dr.-Ing. Carsten Busch

Research Center for Digital Games



Abstract

The current study investigates the utility of a computer game based multimedia training for fostering cognitive flexibility. Prior studies have shown a transfer of skills from the virtual environment of a computer game into the real world. This study aims to tie in on examining the effectivity of game based learning. Nine managers and a mixed sample of twenty students and young employees participated in an experiment comprising of either one hour of playing a computer game or watching it. The dependent variables were, besides cognitive flexibility, presence, enjoyment, and retention. The training did not prove to be effective in increasing the participants' cognitive flexibility, though its impact was identified of being highly influenced by prior game experience, which may facilitate the experience of presence and enhance the information processing of game content. In summary, a computer game based multimedia training as used in this study does have the potential of being beneficial in the context of developing the ability of cognitive flexibility; however, it is not suitable for everyone so that training material and participants have to be matched with great care. Additionally, phases of reflection might be considered to be included in training, to facilitate and control the learning process.

Introduction

Companies naturally strive for success. This success is achieved by an increased effort of competitiveness. However, staying competitive against other companies requires a constant need for advancement, often accompanied by innovation. This implicates a continuous process of change, meaning new ways of thinking and behaviour. Being stuck in certain patterns of thinking is likely to hinder an adequate adaptation to a rapidly evolving market. To facilitate an appropriate adaptation of employees, especially those in leading positions, and foster new and creative ways of thinking, a multimedia training is being developed for this study.

By familiarizing with an environment and being confronted with situations and problems, we develop strategies of appropriate acting. Once a strategy is evaluated as effective and established, we most often use it as a guideline for comprehension and behaviour. These strategies are also called cognitive scripts (Schank & Abelson, 1977) and are equal to mental representations of what is supposed to happen in a particular circumstance (Ashcraft, 2006). An example for a work-related cognitive script could be the generalized knowledge of deciding how to communicate with fellow employees and organize the division of work on a new project.

Although the use of a cognitive script might be in the majority of cases effective, holding rigidly on to it may suppress or inhibit novel ways of thinking and acting that might lead to new and maybe better approaches. The ability of adapting to accustomed circumstances differently and shift between strategies is called cognitive flexibility (Spiro, Feltovich, Jacobson, Coulson, 1992) and was so far almost exclusively studied in the context of fundamental cognition (e.g. Chevalier & Blaye, 2008; Beversdorf, 1999; Scott, 1962).

By studying cognitive flexibility from a social perspective, work-related indicators of success can be investigated, which are in this case "a person's awareness of communication alternatives, willingness to adapt to the situation, and self-efficacy in being flexible" (Martin & Anderson, 1998, p.1).

The current study uses a multimedia training, which is based on a computer game. Computer games have been chosen as medium, because they feature the element of interactivity. This gives the user a more active role, and results in higher engagement as contrasted with traditional video training (Chapman, Selvarajah, & Webster, 1999). Furthermore, the degree of interactivity is positively related to the concept of presence (Welch, Blackmon, Liu, Mellers, & Stark, 1996), which is found to facilitate learning (Garrison & Cleveland-Innes, 2005).

Both, engagement and presence, are closely related. Presence refers in this study to the subjective experience or sensation of being in the virtual environment (VE), respectively the game world. It must not be confused with the term immersion, or involvement, though both are necessary for experiencing presence (Witmer & Singer, 1998). Immersion is a psychological state and refers to the sense of being enveloped by the game. It is influenced by the physical aspects of the game device, like the monitor size and input controls, the experienced presence in the VE, the narrative of the game, and especially the game play dynamics itself. Involvement is a synonym for engagement and relates to the experienced significance of the player to the VE and depends on how great and meaningful the interaction is. It is the amount of energy and attention the player invests in the game. To experience presence, a user must feel adequate amounts of immersion, engagement, and a comparability of the VE with the real world, while keeping distractions and negative physiological effects at a minimum (Dillon, Keogh, Freeman, & Davidoff, 2000; Witmer & Singer, 1998).

Using two levels of treatment (active and passive) as independent variable, this study aims to reveal the influence of a computer game based multimedia training on cognitive flexibility and its application for real world work situations. Hence, the research question is as follows

RQ: How effective is a computer game based multimedia training in increasing employees' and managers' cognitive flexibility and upon what underlying mechanisms is it based?

An important point of the current study is the appropriate choice of the stimulus material, respectively the computer game. Different types of games address different skills. For example, a study by Green, Pouget, & Bavelier (2010) revealed that playing first-person shooter (FPS) action games is associated with a better fast decision-making. Participants who underwent treatment, which was gaming a total of 50 hours with FPSs, were significantly more efficient at visual preceptual decion-making processes than the control group, which played a simulation-style game. The explanation for that finding is that the ongoing and quick processing of and reacting to sensory information improves the general probabilistic inference. The enhanced decion-making skill was not limited to the VE of the game or the modality it was learned, as results from a novel auditory task confirmed the superiority of FPS gamers against the control group.

This study investigates the transfer of skills from a computer game to the reality as well, however the nature of decision-making corresponding to cognitive flexibility is substantially different. The emphasis lies not on fast decision-making but rather on the stressing of decision options and its choice, hence the quality of the decision itself. Therefore, first-person (and third-person) shooter games are believed to be not suited for this purpose. Other action games, like jump'n'run or beat'em up games, are not suitable either because they also mainly

rely on dexterity and hand-eye coordination. The same holds for sports games. And adventure games do not comprise much (alternative) decisions or choices at all because of their linear gameplay. Role playing games (RPG's) are theoretically promising candidates, because they often confront the player with different decision options in dialogs with virtual characters. However, their decisions are generally in a simplistic manner, meaning good or bad moral choices. No RPG could be found which has more differentiated and factual decision options. In addition to that, RPG's have a relatively long setting in period (in comparison to other game types).

As stimulus material for this study, a strategy game was chosen. As time(-pressure) has no relevance for cognitive flexibility, a turn-based game was chosen over a real-time one. Turn-based strategy games are believed to train skills, which are more likely to be relevant in the real world work environment, meaning higher cognitive functions on the level of planning and reasoning rather than perception and execution.

The dependent variables of this study are Enjoyment, Presence, Retention, and Cognitive flexibility. Participants who enjoy the gaming session are expected to be more "present" in the game environment than participants who do not enjoy the game. Associating positive feelings with the act of gaming (either actively or passively) may facilitate the willingness to deepen into the VE and thereby mediating the sense of presence. A strong positive correlation between these two variables was also observed in a study by Weibel, Wissmath, Habegger, Steiner, & Groner (2008). Vice versa, the experience of presence is believed to enhance the quality of the VE use, making it more fun (Nichols, Haldane, & Wilson, 2000). Therefore, the first hypothesis is

H1: There is a positive relationship between enjoyment and presence.

However, participants in the treatment group (a), who play actually the game, are likely to experience a higher presence than participants from group (b), who just watch somebody else playing. The active role of the player is believed to be a significant factor for involving the player in the VE (Chapman, Selvarajah, & Webster, 1999), and in strengthening their sense of presence.

H2: The treatment group with an active gaming role (b) is expected to score higher on presence than the passive group (a).

Presence has so far not been studied in relation to cognitive flexibility. It has mostly been used to study its effects on task performance in VE's, though results are contradicting (Lok, Naik, Whitton, & Brooks, 2003; Sallnäs, Rassmus-Gröhn, & Sjöström, 2000). This implies a very domain-specific character of presence and makes it difficult to predict its impact. Furthermore, its influence on general cognitive performance measures is still a topic of debate (Slater, 1999).

To investigate the impact of interactive computer games in multimedia training concerning cognitive flexibility, the active group (a) is compared with the passive group (b), which is equivalent to video training. The element of interactivity is believed to contribute positively to the training outcomes. Furthermore, an increased presence is found to facilitate learning in VE's (Garrison & Cleveland-Innes, 2005). A significantly higher score for group (a) in comparison to group (b) is believed to prove the effectivity of the training and a transfer of skills from the computer game to the real world.

H3: The treatment group with an active gaming role (a) is expected to score higher than the passive group (b) on cognitive flexibility.

Retention or in other words the ability to recall the content of the game is associated with the absorption of the stimulus material, respectively the educational material. In this sense, It is hypothesized that

H4: An increased retention of the game content is expected to improve the cognitive flexibility.

An exploratory study by Sutcliffe, Gault, & Shin (2005) revealed no relationship between presence and retention in the context of VE's. However, the approach of the current study is theory-driven rather than exploratory. Because this study expects positive correlations with cognitive flexibility from both variables, a positive relation between presence and retention is therefore expected as well.

Method

Design

This study was organized in a 1 (Game) X 2 (Treatment) between-subjects factorial design. The nature of the treatment was used as independent variable. Two different levels were chosen, namely (a) active and (b) passive.

Participants were randomly assigned to one of the treatment groups. The active group (a) comprises a session of one hour actual gaming. 60 minutes were chosen, because it matches a compromise of being long enough to dwell in the game, and not too long to get tired of it, including an initial familiarisation with its VE & the game dynamics. The passive group (b) consists of one hour watching how somebody else plays and is considered as an equivalent for video training, hence a control group. The experimental sessions integrated the treatment for both groups at once, thus two participants sitting side-by-side, with the subject assigned to the active group actually playing the game, and the subject assigned to the passive group watching.

Participants

The study was conducted in the course of a workshop for managers and within the research project "Innovationsdramaturgie nach dem Heldenprinzip", organized by the Berlin University of the Arts and the Gameslab Berlin, research center for digital games, and funded by the "Bundesministerium für Bildung und Forschung" and the European Union.

Nine managers were recruited to take part in this study (4 female, 5 male, mean age 44). Additionally, 20 participants, mainly students and young employees, recruited from local higher education facilities, were used as subjects for this study (6 female, 14 male, mean age 27).

Stimulus material

The computer game King's Bounty[®] (1C Company) was chosen as stimulus material for this study. It is a turn-based strategy game, which plays in a medieval fantasy setting. In comparison with other contemporary games of that type it has a few advantages, which are of relevance for studying it in the context of multimedia training. First of all, it has a short setting in period because of its well designed tutorial. In approximately 30 minutes the player is tought the basics of gampelay, which are movement, combat, skills, and inventory. Furthermore, the game is accompanied by a comprehensible story, which is believed to enhance the effects of presence and engagement (Bielenberg & Carpenter-Smith, 1997; Ju & Wagner, 1997; Schneider, Lang, Shin, & Bradley, 2004).

The key element of King's Bounty is the turn-based combat system. On a hexagonal square grid, the player's and enemy's units are placed (see Figure 1). Each unit has a limited amount of action points, which determine its radius of movement. Each type of unit has a different value of attack and defence, as well as a distinct combat style and special abilities. The player is proactively engaged to weigh various tactics (possibilities of movement and combat) and to decide how to operate with each unit. The consideration of various options, the mental reasoning and decision-making, constitute the basic characteristics of cognitive flexiblity.

Metaphorically, the combat field might be seen as an organisation, while the player's units represent the employees, and the enemies units the problems to be solved. By working together and using the individual powers of each unit in a clever way, obstacles can be overcome and the battle won, meaning a success for the company.

11 | Computer game based multimedia training and Cognitive flexibility



Figure 1. The combat field of King's Bounty.

Apparatus

Several computers were used to run the game, all of them running a Microsoft Windows operating system. The hardware of all computers was good enough to run Kings Bounty at maximum quality and performance, meaning the details of objects and shadows, the visibility distance, and additional filtering methods. Keyboard and mouse were used as input devices, however, the game uses mainly mouse controls for that purpose. As display device, a monitor was attached to the computer. Because the experimental sessions were conducted on various computers, the screen size alternated between 19 and 23 inch.

Procedure

- (1) *Informed consent, questionnaires, pre-test.* After initially greeting the participants and asking to sign an informed consent form, each completed a short questionnaire asking for information about age, gender, occupation, work experience, and game experience. After that, the cognitive flexibility was tested (pre-test).
- (2) *Treatment*. Participants from the experimental group a (active) underwent a gaming session of 60 minutes. The members of group b (passive) were placed in the roles of spectators.
- (3) Questionnaires, post-test. After the gaming session, participants were asked to complete a questionnaire (see Appendix). The questions were designed to assess the experienced enjoyment and presence and to test the retention concerning the game. Also, the cognitive flexibility test was administered once again (post-test).

Dependent variables

Enjoyment. Participants were asked on a seven-point scale how much they enjoyed the gaming session. The scale ranged from -3 (not at all) to +3 (very much), while 0 represented a neutral appraisal.

Presence. To assess the concept of presence, the presence questionnaire by Witmer & Singer (1998) as used in Singer, Allen, McDonald, & Gildea (1997) was utilized. The internal consistency (Cronbach's Alpha) of the scale is $\alpha = .88$. It is based on the semantic differantial principle (Dyer, Matthews, Stulac, Wright, & Yudowitch, 1976) and consists of 32 questions (though only 24 had been utilized), which are scored on a seven-point scale. The questions measure three factors, namely Control/Involvement, Realism or Natural (& Resolution), and Interface Quality.

Retention. To test memory retention, a questionnaire was developed, specially tailored to the stimulus material. Four factors were measured, which are VE, movement/controls, combat system, and narrative/story. Each factor was measured by four closed questions.

Cognitive flexibility. To assess the effectivity of the training, respectively the cognitive flexibility, the Cognitive Flexibility Scale (CFS) by Martin & Rubin (1995) was used. The scale's internal reliability is $\alpha = .76$, with a Pearson test-retest correlation of .83. It consists of 12 statements, which are scored on a six-point scale in Likert format. The statements measure three factors, which are the awareness of communication alternatives, willingness to adapt to the situation, and self-efficacy in being flexible. Differences within subjects of CFS scores before and after the treatment were assumed to represent a direct effect of the treatment.

Statistical Analysis

All statistical calculations were made using SPSS Statistics 16.0 (SPSS Inc., 2007). Regression analysis was used in order to determine relations between variables.

Results

Experience

Both samples, the group of managers and the remaining heterogeneous group (further referred to as "mixed sample"), differed from each other with regard to work experience. The managers stated a prior work experience in their current position of averagely 134 months, thus circa 11 years. The participants from the mixed sample indicated a prior experience of averagely 37 months, thus circa 3 years.

No difference was found in the frequency of computer use. All participants reported to use the computer every day, with one participant from the mixed sample using the computer several times a week.

Game experience was investigated with two questions, for the frequency of playing digital games, and the invested time in digital games per week, during the last 6 months. While the participants from the mixed sample play averagely 7 hours per week, the managers stated a total time of 0 hours, thus not at all. The frequency distribution of playing digital games is shown in Table 1.

Table 1

Frequency distribution of playing digital games, as measured by the question "How often do you play digital games?"

Frequency	Every day	Several times a week	Once a week	Once a month	less
Manager sample	0	0	0	3	6
Mixed sample	5	4	4	2	5

A significant correlation was found between Game experience and Gender (r = -.40, p < .05), suggesting that male participants, especially from the mixed sample, play much more digital games.

Enjoyment and Presence

The treatment, thus playing the game one hour, was experienced by the participants from the mixed sample in general as neutral; the managers experienced it, according to self report, as a little unenjoyable. The mixed sample in general, as well as participants from the active groups from both samples, experienced the treatment as more enjoyable than the passive group (see Figure 2). The scores on Presence are likewise. However, both circumstances are statistically not significant.



Figure 2. Experienced enjoyment of the treatment, divided by the sample and treatment group. Measured by the question "How much did you enjoy playing /watching the game?". Scoring: 4: neutral, 1: not at all, 7: very much.

The experienced Enjoyment was found to be moderated by the gender of the participants. Both, male participants from the mixed sample and female participants from the managers' sample tended, to appraise the gaming experience as neutral. By contrast, female participants from the mixed sample as well as male participants from the managers' sample indicated a less enjoyable appraisal of their experience (see Figure 3).



Figure 3. Experienced enjoyment of the treatment, divided by the sample and treatment group.

A positive and significant correlation was found between the variables Enjoyment and Presence (r = .55, p < .01). All individual factors of Presence are correlating with Enjoyment significantly at a level of $\alpha = 0.05$, though the Presence factor Control is found to correlate the most, with a level of significance at $\alpha = 0.01$ (see Table 2).

Table 2

Correlations between Enjoyment and Presence, including the sub factors of Presence

Variable		Presence	Control	Realism	Interface Quality
Enjoyment	Pearson Correlation	.55**	.57**	.41*	.24*

Note. * p < .05. ** p < .01.

An interaction effect was found between Sample and Gender, for Presence (F (1, 29) = 4.4, p < .05), indicating that male participants from the mixed sample score higher on Presence than the other respondents.

Concerning the Presence factor Interface Quality, a significant difference dependent on the nature of the sample was identified (r = -.53, p < .01). Participants from the managers' sample rated the Interface Quality lower in comparison to the mixed sample.

Cognitive flexibility

In order to measure a training effect after the treatment, a repeated-measures ANOVA was carried out for the variable Cognitive flexibility. No significant increase was observed, indicating that no learning took place. In general, a small decrease was identified.

No differences between the treatment groups were found. Gender revealed to have an influence on the development of the cognitive flexibility scores (F (1, 25) = 4.55, p < .05). In both samples, cognitive flexibility scores decreased much more for the female than the male participants (see Figure 4). Only the male participants from the mixed sample improved in cognitive flexibility, though not significantly (see Figure 5).



Figure 4. Cognitive flexibility scores before and after the treatment, divided by the participants' gender.



Figure 5. Cognitive flexibility scores before and after the treatment, divided by the participants' sample belonging and gender.

Retention

Retention was found to have no influence on cognitive flexibility. However, retention scores were much higher for the male participants from the mixed sample (see Figure 6).

Significant correlations were found between retention and presence (r = -.58, p < .01), as well as enjoyment (r = -.48, p < .01).



Figure 6. Retention scores, divided by the participants' sample belonging and gender.

Discussion

The research question of the current study is "*How effective is a computer game based multimedia training in increasing employees' and managers' cognitive flexibility and upon what underlying mechanisms is it based?*". To solve this question, the results will be discussed in the following. At first, the findings will be explained in relation to the proposed hypotheses, which will be followed by a general discussion afterwards. Thereafter, the limitations of this study will be addressed. And finally, a conclusion will be presented to summarize the discussion.

Hypotheses

H1: There is a positive relationship between enjoyment and presence.

Enjoyment is found to be correlated positively and significantly with presence. Therefore, the hypothesis has been accepted.

This relationship is especially strong for the Presence factor Control, suggesting that interactivity, as experienced in the active treatment group, works positively on the enjoyment of the treatment, making it more fun. Results show indeed that the active treatment group experienced somewhat greater levels of enjoyment after the treatment.

H2: The treatment group with an active gaming role (a) is expected to score higher on presence than the passive group (b).

No significant difference between the treatment groups was found for presence. Based on this finding, the hypothesis has to be rejected.

Presence scores for the factor Control in particular were expected to differ between the treatment groups, because only participants in the active group had direct control over the actions in the game. Surprisingly, this was often not the case. This observation could be explained by the workings of the human mirror neuron system (Gallese, 2006; Newman-

Norlund, van Schie, van Zuijlen & Bekkering, 2007). Participants from the passive group shared a common representation (the game world) with the person sitting next to them. According to the simulation theory (Gallese & Goldman, 1999) the passive participants have the capability to predict actions of the active person controlling the game and the ability to simulate their own actions or intentions because it relies on the same brain regions. Cells in the mirror system fire not only if an action is performed, but also if the same action is being observed. The observing participant's point of view might have merged with the one from the active gamer, causing an identical experience of presence.

Participants from the managers' sample rated the Presence factor Interface quality lower in comparison to the mixed sample. This was probably an effect of the virtually nonexistent game experience. Without a familiarity with virtual environments and their common representation of control elements, called the interface, the attentional focus might have shifted on learning the interface and how to use it to manipulate elements of the game, like how to equip a new item in the inventory to increase a certain ability of the avatar. Participants who are already familiar with such interfaces might have immersed easier in the game world and experienced a higher level of presence, because they did not have to spend so much cognitive effort in the learning process of the controls first.

H3: The treatment group with an active gaming role (a) is expected to score higher than the passive group (b) on cognitive flexibility.

No significant difference between the treatment groups was found. Therefore, the hypothesis cannot be accepted. The increased effectivity and superiority of an interactive game based training in comparison to video training could not be proven.

Though, game experience might play a substantial role in the context of learning by using a digital game as medium. Especially male participants from the mixed sample showed the

greatest improvements in cognitive flexibility, in comparison to the total. And it is also this very group, which had the most game experience before treatment. This might have helped to concentrate on the game content itself, thus focus the attention on the educational material, rather than having to learn the game mechanics first, which are a necessary requirement to understand the higher order tactical component of the game.

Additionally, there also might be a gender effect. From observation, female participants expressed more often feelings of helplessness and despair than male participants. But this was justified only in the minority of cases, while from the perspective of in-game progress they performed well. The dissonant and negative self-assessment might have impeded an improvement in cognitive flexibility, which would result from the sense of achievement of a virtual battle and its strategic warfare which caused it.

H4: An increased retention of the game content is expected to improve the cognitive flexibility.

Retention was found to have no influence on cognitive flexibility, which is why the hypothesis has to be rejected.

Again, game experience might play a mediating role. The highest retention scores were obtained by male participants from the mixed sample, respectively those with the most game experience. Being familiar with virtual game environments might facilitate the learning of game content, because there is already an association network established, with prior memory from similar games. New experiences might be therefore easier integrated in the already established network of information.

General discussion

The effectivity of the training could not be proven. No training effect of the treatment could be identified. However, prior game experience might be a necessary requirement for such a training to be effective, as results from participants with game experience are substantially better than the rest. For the remaining participants, cognitive flexibility scores even decreased after the treatment. This might come from frustration of having to learn the game mechanics and interface plus control functionalities first. In this sense, participants were forced to learn basics of game play instead of being able to focus their attention on the tactical component of the combat system in the game.

The turn-based combat requires the player to weigh the possibilities of movement and combat of each unit. To win the battle, one must consider the capabilities and eventualities of different moves and plan a tactic thereupon. Keeping in mind the various options possible and involving the player in mental reasoning and decision-making processes represents the basic characteristics of cognitive flexiblity and is therefore believed to train this ability. However, one can only manage to fully engage in this task if the controls and rules of the game are mastered. These have to be learned first, and if not, the results of game play in terms of success are likely to be inadequate and therefore frustrating.

For example, if a player is not very familiar with the rule set of turn-based combat and does not know exactly how to activate a special attack of a given unit, it will be unlikely to anticipate the enemy's next action and trigger a proper reaction. Analogical, if a manager, leading a team of employees, each with different skill sets, is not conscious of their potentialities and the rules of the game of his work domain, it will prove difficult to develop a successful business strategy.

This study's results do not support a transfer of skills from a computer game to reality, like the study by Green, Pouget, & Bavelier (2010). There, participants played a first-person shooter, wheras in this study participants played a round-based strategy game. The skills trained in the study by Green, Pouget, & Bavelier (2010) are being processed unconsciously, which is different from the skills being trained in the current study, which require conscious processing by analyzing the situation and acting in a considered way, based on deliberate decision-making, rather than just reacting. Yet, not all participants immersed in this conscious proces, and instead just played without much deeper thought. This might have come either because they did not know how to, thus due to a lack of basic knowledge of the game mechanics and control options, or because they just did not want to, thus due to a lack of motivation.

Fun can be a key driving motivator to engage in the VE and to maximize effective learning and training (Kirkley & Kirkley, 2003). The participants of this study reported, on average, a neutral enjoyment level after the treatment. To prevent frustration and make the game experience more enjoyable, it is essential to not overload the player and keep a good balance between ability and challenge (Czikszentmihalyi, 1975). In designing a computer game based multimedia training, a pilot study could be carried out to check if this requirement is met.

By analyzing the participants self-reports after the experiment and interviewing them additionally, many made the impression of requiring a period of reflection for the treatment effects to unfold. Just by adressing the objectives of the training and bringing the trained skills into consciousness, which were by many not recognized in the game, a self-reflecting process started, which might have worked as a catalyst for the improvement of cognitive flexiblity.

To deal with the experience, more specifically the treatment, id est processing the recent acquired information and coping with the feelings that were generated, a phase of consolidation, refered as conscious reflective activity (Dewey, 1933), might prove beneficial. It is an active proces of re-revaluation and aimed to crystallize and reinforce the learning, as well as the processing of interpretations and developing of concepts and generalizations for the future (Boud, Keogh, & Walker, 1985).

The British Further Education Curriculum and Development Unit (FEU) proposes in their guide Experience, Reflection, Learning (1981) a model, which integrates the role of reflection in the learning process (see Figure 7).



Figure 7. The FEU Model. From Boud, D., Keogh, R., & Walker, D. (1985). *Reflection: turning experience into learning.* Routledge, NJ: Routledge Chapman & Hall.

The FEU model is divided in three phases, namely the experience of the learner, the specific learning, and the reflective activity. In order to extract the specific learning from the overall experience, thus learn from the experience, respectively the training, it needs to be followed by an organised reflection (see Figure 8). Here, the amount of time designated for reflection should equal the amount of time actually playing the game (Heinich, Molenda, Russell, & Smaldino, 1996; Squire, 2003; Thiagarajan, 1998).



Figure 8. A model of reflection in the learning process. From Boud, D., Keogh, R., & Walker, D. (1985). *Reflection: turning experience into learning*. Routledge, NJ: Routledge Chapman & Hall.

In addition to that, a phase of preparation before the training could be included. In the preparatory stage, participants could be stimulated for what to look for, which questions to ask (for themselves), and what skills are going to be practised. Here, the reflective activity would be the contemplation of what is going to occur, what the demands of the task are, and what skills and ressources are therefore required.

The combination of different types of learning, or rather different learning environments and instructional methods, is called blended learning (Graham, 2005). In this case, a learning approach is proposed, mixing game based learning with traditional methods of instruction. The implementation of a blended three-stage concept for computer game based multimedia training, comprising preparation, treatment, and reflection, is believed to increase the effectivity for training outcomes, which require conscious processing, as cognitive flexibility.

Limitations

The greatest limitation of the current study is the number of participants, which was 29 in total. This should have been higher in order to make more reliable predictions about the relationships between the studied variables and formulating general statements. Especially prior game experience should be controlled more carefully. That is to say, the selection of participants should be balanced in terms of participants with and without game experience. To investigate the suggested importance of game experience in computer game based multimedia training, a follow-up study could compare managers with and without game experience. Furthermore, additional measures of performance could be included to acquire a more sophisticated picture of learning from multimedia training. To test the proposed three-stage concept for multimedia training, a research design could be utilized, which includes the stages of preparation and reflection. Future research is advised to take the aforementioned recommendations into account.

Conclusion

A computer game based multimedia training as used in this study has the potential of being effective, though the trainees' background has to be taken into account in the design process. Prior game experience has been shown to play an important role. That is, trainees have to have a basic understatement and handling ability of the computer game, which is to be chosen to transport the educational material. Additionally, the interest and motivation has to be considered, because willing gamers are more easily transferred in a state of enjoyment and presence, and thus have greater chances to profit from the training. And finally, phases of reflection might be considered to be included in training, to facilitate and control the learning process.

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Appendix

Questionna	aires			
Personal da	ata and experience			
Age				
Gender:	O O male female			
Profession				
How much	experience do you have ir	the abovemention	oned profession, ir	n months?
How many (any digital	hours per week do you av games, e.g. Computer gar	eragely play vide mes, Playstation,	o games, based on XBOX, Nintendo,	the last 6 months? Smartphone)
How often	do you play video games?			
0	0	Ο	0	0
every day	several times a week	once a week	once a month	less
How often	do you use computers?			
0	0	О	О	0
every day	several times a week	once a week	once a month	less

Cognitive flexibility

<i>Instructions</i> : The following statements deal with your beliefs and feelings about your own behavior. Read each statement and respond by circling the number that best represents your agreement with each statement.					
Strong Agree	ly Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
6	5	4	3	2	1
1.	I can communicate an	idea in many	different ways.		
2.	I avoid new and unus	ual situations.	(R)		
3.	I feel like I never get	to make decis	ions. (R)		
4.	I can find workable s	olutions to see	emingly unsolvable	e problems.	
5.	I seldom have choices	when decidir	ng how to behave	. (R)	
6.	I am willing to work	at creative solu	utions to problem	IS.	
7.	In any given situation	, I am able to	act appropriately		
8.	My behavior is a resu	lt of consciou	s decisions that I	make.	
9.	9. I have many possible ways of behaving in any given situation.				
10.	10. I have difficulty using my knowledge on a given topic in real life situations. (R)				
11.	I am willing to listen	and consider	alternatives for ha	ndling a probler	n.
12.	I have the self-confid	ence necessary	to try different v	vays of behaving	

Cognitive Flexibility Scale: Items and Response Format

Note.-Items marked (R) are reverse scored.

Enjoyment

How much did you enjoy playing/watching the game?

not at all			neutral		•	very much
-3	-2	-1	0	+1	+2	+3
0	Ο	0	0	0	Ο	0

Presence

PRESENCE QUESTIONNAIRE (Witmer & Singer, Versus 3.0, Nov. 1994)

Characterize your experience in the environment, by marking an "X" in the appropriate box of the 7-point scale, in accordance with the question content and descriptive labels. Please consider the entire scale when making your responses, as the intermediate levels may apply. Answer the questions independently in the order that they appear. Do not skip questions or return to a previous question to change your answer.

WITH REGARD TO THE EXPERIENCED ENVIRONMENT

1. How much were you able to control events?

NOT AT ALL SOMEWHAT COMPLETELY

2. How responsive was the environment to actions that you initiated (or performed)?

NOT	MODERATELY	COMPL	ETELY
RESPONSIVE	RESPONSIVE	RESPC	ONSIVE

3. How natural did your interactions with the environment seem?

		I I
EXTREMELY	BORDERLINE	COMPLETELY
ARTIFICIAL		NATURAL

4. How much did the visual aspects of the environment involve you?

NOT AT ALL	SOMEWHAT	COMPLETELY

5. How much did the auditory aspects of the environment involve you?

	1		
NOT AT ALL		SOMEWHAT	COMPLETELY

6. How natural was the mechanism which controlled movement through the environment?

EXTREMELY		BORDERLINE		COMPLETELY
ARTIFICIAL				NATURAL
7. How compelling	was your ser	ase of objects moving thro	ough space?	
	1		1	
NOT AT ALL		MODERATELY		VERY
		COMPELLING		COMPELLING
8. How much did ye world experiences?	our experienc	tes in the virtual environm	ient seem consis	stent with your real
I I	1	1	1	1 1
NOT		MODERATELY		VERY
CONSISTENT		CONSISTENT		CONSISTENT
NOT AT ALL	y were you al	SOMEWHAT	earch the enviror	COMPLETELY
NOT AT ALL		SOMEWHAI		COMPLETELY
11. How well could	l you identify	sounds?		
1	ł	1	Ĺ	1 1
NOT AT ALL		SOMEWHAT		COMPLETELY
12. How well could	l you localize	sounds?		
NOT AT ALL		SOMEWHAT		COMPLETELY

13. How well could you actively survey or search the virtual environment using touch?

NOT AT ALL	SOMEWHAT	COMPLETELY
14. How compelling was	your sense of moving around inside the vir	tual environment?
ll		
NOT	MODERATELY	VERY
COMPELLING	COMPELLING	COMPELLING
15. How closely were yo	u able to examine objects?	
	<u> </u>	
NOT AT ALL	PRETTY CLOSELY	VERY CLOSELY
16. How well could you	examine objects from multiple viewpoints?	
ll	JJ	I
NOT AT ALL	SOMEWHAT	EXTENSIVELY
17. How well could you	move or manipulate objects in the virtual en	wironment?
NOT AT ALL	SOMEWHAT	EXTENSIVELY
18. How involved were y	you in the virtual environment experience?	
		I
NOT AT ALL	MILDLY	COMPLETELY
INVOLVED	INVOLVED	ENGROSSED
19. How much delay did	you experience between your actions and ex	xpected outcomes?
L		
NO DELAYS	MODERATE DELAYS	LONG DELAYS
20. How quickly did you	adjust to the virtual environment experienc	e?
II		
NOT AT ALL	SLOWLY	LESS THAN
		ONE MINUTE

21. How proficient in moving and interacting with the virtual environment did you feel at the end of the experience?

1		
NOT	REASONABLY	VERY
PROFICIENT	PROFICIENT	PROFICIENT

22. How much did the visual display quality interfere or distract you from performing assigned tasks or required activities?

NOT AT ALL	INTERFERED	PREVENTED TASK
	SOMEWHAT	PERFORMANCE

23. How much did the control devices interfere with the performance of assigned tasks or with other activities?

NOT AT ALL	INTERFERED	INTERFERED
	SOMEWHAT	GREATLY

24. How well could you concentrate on the assigned tasks or required activities rather than on the mechanisms used to perform those tasks or activities?

NOT AT ALL	SOMEWHAT	COMPLETELY

25. How completely were your senses engaged in this experience?

NOT AT ALL	MILDLY	COMPLETELY
ENGAGED	ENGAGED	ENGAGED

26. To what extent did events occurring outside the virtual environment distract from your experience in the virtual environment?

NOT AT ALL	MODERATELY	VERY MUCH

27. Overall, how much did you focus on using the display and control devices instead of the virtual experience and experimental tasks?

I I		
NOT AT ALL	SOMEWHAT	VERY MUCH

28. Were you involved in the experimental task to the extent that you lost track of time?

1		
NOT AT ALL	 SOMEWHAT	COMPLETELY

29. How easy was it to identify objects through physical interaction; like touching an object, walking over a surface, or bumping into a wall or object?

IMPOSSIBLE	MODERATELY	VERY EASY
	DIFFICULT	

30. Were there moments during the virtual environment experience when you felt completely focused on the task or environment?

	1			
NONE		OCCASIO	DNALLY	FREQUENTLY

31. How easily did you adjust to the control devices used to interact with the virtual environment?

DIFFICULT	MODERATE		EASILY

32. Was the information provided through different senses in the virtual environment (e.g., vision, hearing, touch) consistent?

I I		
NOT	SOMEWHAT	VERY
CONSISTENT	CONSISTENT	CONSISTENT

Retention

(VE)

1a...What do you see on the lower status bar in exploring mode?2a...How can you differentiate between enemies and friends in exploring mode?3a...What can you do inside buildings (e.g. the castle)?4a...Where can you look up what to do next?

(movement/controls)

1b...How do you move?

2b...How does the movement differ between exploring and combat mode?

3b...How can you change the camera angle?

4b...How can you dig up a treasure?

(combat system)

1c...Which options of action do you have in combat mode?

2c...How to use magic spells?

3c...How can you see additional information and stats about an enemy unit?

4c...What do you earn in the end of a battle?

(narrative/story)

1d...What did you have to do to pass the training at the Knight's School?

2d...What was the name of your mentor at the Knight's School?

3d...What position were you assigned after the training?

4d...What did you have to do in the first quest from the king?

Open questions / Open interview