FOI-R--1086--SE
December 2003
ISSN 1650-1942
Scientific report

Carin Rencrantz

Game based training and education

-Testing the usefulness of game consoles in the Swedish Armed Forces

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Issuing organization	Report number, ISRN	Report type
FOI – Swedish Defence Research Agency Division of Command and Control Systems Department of Man-System-Interaction Box 1165 SE-581 11 Linköping Sweden	FOI-R--1086--SE	Scientific report
	Research area code C4ISR	
	Month year November 2003	**Project no.** E 7060
	Customers code Commissioned Research	
	Sub area code Interdisciplinary projects regarding C4ISR	

Author/s (editor/s)	Project manager
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	Sponsoring agency Swedish Armed Forces
	Scientifically and technically responsible Carin Rencrantz

Report title

Game based training and education
-Testing the usefulness of game consoles in the Swedish Armed Forces

Abstract (not more than 200 words)

Effective and efficient training methods are essential in most organisations and the ability to manage technology is vital. One way of conducting training and education while integrating technology and learning is via simulation. Personal Computer (PC) and game consoles (Xbox, Playstation2 and Game Cube) could be viewed as a form of a low-cost simulation tool. Thus, if it would be possible to use game consoles for training it might create successful training methods. Therefore, this report investigates whether gaming consoles could be used as an effective and efficient tool for training and education. Furthermore, it identifies opportunities created by a console based training environment. The Swedish Armed Forces are as many other organisations, dependent on efficient training methods and they have a constant pressure of cutting costs. Therefore, this research has been conducted within the Swedish Army combat school where 48 cadets participated playing a commercial game on each of the four platforms. Their performances and attitudes were logged and analysed. The results revealed that gaming consoles have a great potential to improve the human capital as well as the structural capital therefore individuals as well as organisations could gain from console based training.

Keywords

Training, learning, low-cost simulation, game consoles, Xbox, Playstation 2, Game Cube.

Further bibliographic information	Language English
ISSN 1650-1942	**Pages** p.63
	Price acc. to pricelist

Utgivare Totalförsvarets Forskningsinstitut - FOI Ledningssystem Människa-System-Interaktion, MSI Box 1165 581 11 Linköping	**Rapportnummer, ISRN** FOI-R--1086--SE	**Klassificering** Vetenskaplig rapport
	Forskningsområde Spaning och ledning	
	Månad, år November 2003	**Projektnummer** E 7060
	Verksamhetsgren	
	Delområde Breda projekt spaning och ledning	
Författare/redaktör Carin Rencrantz	**Projektledare** Håkan Hasewinkel	
	Godkänd av Erland Svensson	
	Uppdragsgivare/kundbeteckning Försvarsmakten	
	Tekniskt och/eller vetenskapligt ansvarig Carin Rencrantz	

Rapportens titel (i översättning)

Spelbaserad träning och utbildning
-Utvärdering av nyttan med spelkonsoler inom svenska försvaret

Sammanfattning (högst 200 ord)

Effektiva tränings- och inlärningsmetoder är fundamentala i de flesta organisationer och förmågan att hantera teknologi är mycket viktig. Ett sätt att förena träning och utbildning samtidigt som teknologi integreras är via simulering. Datorer (PC) och spelkonsoler (Xbox, Playstation 2 och Game Cube) kan betraktas som verktyg för lågkostnadssimulering. Därmed skulle det eventuellt vara möjligt att med hjälp av konsoler skapa bra metoder för träning. Syftet med denna rapport är att undersöka huruvida spelkonsoler skulle kunna användas för att skapa ett effektivt verktyg för träning och inlärning. Vidare kommer möjligheter, som uppstår i samband med en konsolbaserad träningsmiljö, att identifieras. En undersökning inom Armén utfördes där 48 kadetter från markstridsskolan spelade ett kommersiellt spel på samtliga fyra plattformar. Deras prestationer och attityder mättes och analyserades. Resultatet avslöjar att det finns fördelar med att träna med hjälp av spelkonsoler, därmed kan individer såväl som organisation tjäna på spelbaserad träning med konsoler.

Nyckelord

Träning, inlärning, låg-kostnads simulering, spel konsol , Xbox, Playstation 2, Game Cube.

Övriga bibliografiska uppgifter	**Språk** Engelska
ISSN 1650-1942	**Antal sidor:** 63s.
Distribution enligt missiv	**Pris: Enligt prislista**

Abstract

Effective and efficient training methods are essential in most organisations and the ability to manage technology is vital. One way of conducting training and education while integrating technology and learning is via simulation. Personal Computer (PC) and game consoles (Xbox, Playstation2 and Game Cube) could be viewed as a form of a low-cost simulation tool. Thus, if it would be possible to use game consoles for training it might create successful training methods. Therefore, this report investigates whether gaming consoles could be used as an effective and efficient tool for training and education. Furthermore, it identifies any opportunities created by a console based training environment. The Swedish Armed Forces are as many other organizations, dependent on efficient training methods and they have a constant pressure of cutting costs. Therefore this research has been conducted within the Swedish Army combat school where 48 cadets participated playing a commercial game on each of the four platforms. Their performances and attitudes were logged and analysed. The results reviled that gaming consoles has a great potential to improve the human capital as well as the structural capital therefore individuals as well as organisations could gain from game based training.

Keywords: Training, Learning, low-cost simulation, gaming consoles.

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1 Introduction

Business leaders all over the world increasingly support the view that the *knowledge* possessed by human capital is among the most significant resources of an organisation's capabilities and may ultimately be at the root of all competitive advantages (Hitt et al., 2003). Therefore *training* and *education* play a significant role for organisations in order to get a more skilled workforce and thereby a more successful organisation. Most organisations are dependent, or need to ascertain, that they obtain, renew and use the best possible knowledge in all areas of work. A growing number of companies have embraced digital game-based learning in one form or another (Prensky, 2001). It is used in a variety of industries and organisations for a wide purpose ranging from procedures and polices to products and skills (Prensky, 2001).

Defence industries all over the world have always played a significant role in developing new methods and equipment. They spend tremendous economic resources on research and development in many different areas. In terms of knowledge management, training and learning simulations have been used in order to enhance training programs. Many specific and costly projects relating to simulations have been run by the defence industry. Nowadays when the capacity of Personal Computers (PC) increases rapidly and costs of simulation technologies are being cut changes emerge within the simulation industry (Koonce & Bramble, 1998). Nowhere is this more obvious than in a comparison between simulation software developed by the defence industry and game and entertainment technology. The game and entertainment industry is today in many times superior to the simulation industry in terms of, among many things; economies of scale i.e. there is a huge interest in the game and entertainment industry with many different people and companies involved. It is common to use an ordinary PC or game-consoles for purposes such as gaming and other entertainments.

Moreover, today's computers have the same capacity as the mainframes used by the defence industry ten years ago. However, it is usually rather expensive to buy a PC for games and simulations, therefore the gaming-consol industry has grown rapidly the past years. The game consoles of today; Playstation 2 (PS2), Xbox and

Game Cube (GC) seems to be a cost efficient alternative to PC's, which suggest that the consoles are about to take over the game and entertainment market.

There are advantages with an educational and training method related to digital games e.g. it might bring stimulation, involvement and challenge (Prensky, 2001). It might also be an inexpensive alternative since the defence industry could use and modify already existing technology. If educational games could be used on game consoles instead of PC cost could be cut even further. Consoles are a less expensive than PCs, and are easier to use. Furthermore, technical problems could be avoided to a greater extent which saves repair costs and loss of learning time. Moreover, if the users perceive the consoles as fun and motivating they might put more effort on the task i.e. learning on their spare time, which leads to a more skilled workforce and potential maximisation of return on investment. Another benefit of using consoles within the defence might be that instead of paying the cost of the whole training in real life they might be able to practice some elements with the consoles and in that way save both money and equipment. However, there might also be disadvantages, for example it is not obvious that this kind of technology is useful for the defence industry in its present form. Research is lacking, i.e. there is no research done, in the area of game consoles as a tool for training and learning; it is therefore not possible to state whether consoles are useful or not and can be used as an inexpensive alternative to conventional training methods.

1.1 Overall aim and specific objectives

The overall aim of the research is to find out if education in the defence could be more efficient and effective. The objective is to find out if game consoles could serve as a technical teaching aid within the Swedish Armed Forces. Additionally, it will be compared and related to PC. If the consoles are considered superior it is relevant to establish which one of them that is most advantageous (if any) and why. This objective will be reached by the means of the following research question:

- **How does the user experience the PC and consoles as a tool for training and education?**

The question will be related to judgements on the system (with functionality and interactions) and social aspects (with consideration taken to motivation and attitudes). The report will consider the Swedish Army not the Air Force or Navy. The reason for conducting research on the Swedish Armed Forces is that they have a constant press of cutting costs and making the whole organisation more "lean". Furthermore, there are huge investments in the industry that has to be profitable. Additionally, they educate a lot of people each year and if it were to be more efficient, even just slightly better, it would in the end save resources. Investigating the Swedish Armed Forces is a first step in trying to find better methods for training and education; later other industries could be explored.

Initially, relevant literature related to the problem area will be discussed. It will contain aspects related to learning, education and training; these aspects will be discussed with focus on simulation. Games could be viewed as a form of simulations and it will therefore be further evolved. The research question will be investigated via an experiment, 48 participants will try all platforms and then answer questionnaires. The data from the experiment will be presented in the chapter "Results"; it will thereafter be discussed and put into a context highlighting the main points form the literature review. Finally there will be conclusions which summarise the report.

2 Literature Review

An organisation has to maximise the knowledge assets and renew them constantly, there should be an understanding, focus and systematic management of knowledge building, renewal and application, i.e. manage knowledge processes effectively (Wiig, 1997). It is clear for businesses that as technology and the information age advance, producing work in team environments with technical devices becomes increasingly necessary (Barile & Durso, 2002). As information technologies permeate nearly every facet of our society, they link organisations and people of all types more closely together and therefore it is important to investigate the impact of information systems on organisations and individuals (Rozell & Gardner, 2000).

There are many issues to consider when the area of training and learning is approached. The literature review will initially touch upon learning in general and different broad theories of learning. The subject area will then be narrowed down and related to simulation as a training method, one approach of simulation is PC based simulation which has been used as a cost effective and simple form of training and learning. Finally there will be a review of literature related to games and the motivational and attitudinal aspects it might bring. It should then be possible for the reader to put the research question in its context and profit from the research done in the following chapter.

2.1 Learning

During the early decades of last century, psychology, which was still a young discipline begun making a contribution to specific aspects of learning, the primary aim being to support and improve teaching processes (Prahalad & Hamel 1990). Management theories assumed static organisations with a distinct hierarchy. After the war different theories of motivation were developed; relationships between people were viewed as critical to maintaining interest in work which offered no physical or intellectual challenge. In 1943 Maslow defined a hierarchy of needs and in 1959 Herzberg argued for job enrichment which he associated with challenging and meaningful work tasks. At the same time the business

environment was becoming more competitive, more complex and more innovative (Reid & Barrington, 2001). Unfortunately many companies failed to recognise this resulting in poor performance i.e. they failed to change the assumptions on which their businesses were based (Drucker, 1994).

In the increasingly dynamic environment it was often inevitable that training activity should grow and develop within the larger organisations, where employees of most types attended specially planned courses of many kinds (Reid & Barrington, 2001). This implied that training processes were growing and becoming more sophisticated and the number of staff with explicit responsibility for promoting training increased. New product and processes were introduced during the 1970s and 1980s and internal work methods were constantly under review (Reid & Barrington, 2001) 'Worker participation' became a popular concept where the relationship between people, tasks and technology were highlighted. During the 1980s and 1990s PC and Internet made a big impact on society, it has made a big contribution and created lots of new opportunities. At the same time, however, it has provided lots of challenges in people's life and if it is not used in an effective way it could lead to stress, decrease in efficiency and productivity.

This development within learning is the foundation of how it is viewed today and it shows that learning is a wide concept that can be viewed in different ways. Concepts like motivation, challenging tasks and PC will be recurring statements in the report.

Traditional theories are concerned with the establishment of particular behaviour patterns, where target performance is analysed. Moreover, they usually describe only one way to perform with a detailed specification of explicit learning objectives which collectively build to create a total operational performance (Johnston, 1998). More recent theories emphasises cognition and reflect the way in which people learn to recognize and define problems or experiment to find solutions. Resnick (1989; In Johnston, 1998) claims that cognitive theory have three specific aspects of learning where;

- "firstly learning is a process of knowledge construction not knowledge recording or absorption"
- secondly "learning is knowledge-dependent" where one thing leads to another and
- finally, "learning is highly tuned to the situation in which it takes place" i.e. the context is considered to have great importance.

Another challenge to the traditional methods is the 'situated learning' approach which highlights the information in the environment. Proponents of situated learning argue that knowledge to be useful must be situated in a relevant context. It is viewed as a function of the activity, context and culture in which it occurs (Järvelä & Niemivirta, 1999). This is a distinction from traditional classroom learning activities which involve knowledge which is often presented in an abstract form and out of context (Reibel & Wood, 1994). This shows that learning is complex and that many aspects have to be taken into consideration. Learning can take place through many different methods, which are often supported through some type of technology; managers can use techniques based upon texts, cases, management games, field projects and consultancy projects (Jennings, 2002). Seldom is a single method the most efficient but different methods may complement each other to promote the development of a wider range of skills.

Training is a systematic approach to learning that consists of multiple phases, it is said to be a behavioural or cognitive event (Salas, Bowers & Rhodenizer, 1998). The first phase is the specification of task requirements and learning objectives, the second phase is the design of the learning environment (including consideration for measuring performance and for providing practise and feedback) (Salas, et al., 1998). Kirkpatrick's framework for evaluation of training programs (see figure 2.1) has gained wide acceptance in the industrial training community (Simpson & Oser, 2003; Salas, Bowers & Rhodenizer, 1998; Bell & Waag). The framework includes four levels; reaction, learning, behaviour, and results (Kirkpatrick, 1979).

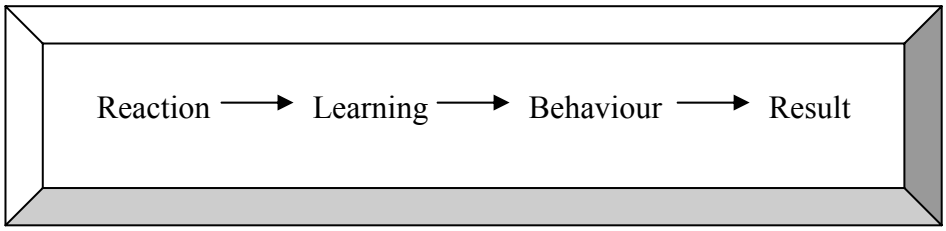

Figure 2.1 *Kirkpatrick's framework for training.*

The first level, reaction, refers to the trainee's thoughts about the training program. The reaction of the trainees are often critical to the continuation of any training program and it is often an indicator of how well training developers identified training needs and translates those needs into specific objectives and lessons (Bell & Waag, 1998). The second level, learning, refers to the degree of learning that occurred in the training setting (Kirkpatrick, 1979). This criterion refers to the measurement of progress achieved on the training objectives that were specified at the outset of the training program. It indicates the degree to which trainee's mastered specific learning objectives during training (Salas et al., 1998; Bell & Waag, 1998). The third level of the training evaluation model emphasises the transfer form the training environment to the actual work environment, thus, it shows if the trainee will perform behaviour learned during training on the job. The final level is the impact on the organisation, organisational objectives that might be affected is for example job proficient, improved morale, reduced costs and lower personnel turnover. This pattern of evaluation can be seen in other models; Reid and Barrington (2001) discuss evaluation of a training program in four stages. Firstly it has to be established why the evaluation is required, secondly it has to be considered who should carry out the evaluation. The third stage is similar to Kirkpatrick's framework of evaluation and Reid and Barrington's (2001) last stage is to establish which kind of measurement that will be used, i.e. final examination, participation in discussion etc. Reid and Barrington's model is used to highlight the fact that many evaluation models are constructed in the same way, it will not however, be further emphasised.

2.2 Selective fidelity simulation

One way of integrating technology and new methods of learning is via simulation. Simulation can be explained as a representation of reality, an imitation of a real process (Stanton, 1996). It is today a widespread method for making preparations, conducting training and exercises and for performing research. Simulators are most frequently used within the flight industry and within medical care where a logical structured approach is necessary for safe and competent practice (Hegarty & Bloch, 2002; Schafstaal, Johnston, & Oser, 2001).

There are many reasons why simulation should be used for training; one major reason is that it is safer than the real equipment. Furthermore, the training can take place in a controlled environment. Simulation can also save money in a variety of ways; purchasing and operating costs are often substantially lower in comparisons with the actual equipment. It also provides the opportunity of separating a single task in a complex environment which reduces the information overload present in the real situation; this makes the simulators more efficient in some aspects than other methods of training. Other benefits with simulations are that they provide an identical training system for all trainees irrespective of for example weather conditions. Additionally, it is also possible to manipulate different parameters such as the level of difficulty. Ethical issues can be considered in a simulated environment, many aspects within the Swedish Army could be practically impossible to undertake in real life, e.g. nuclear war, shooting and neutralisation of enemies, testing durability of materials etc. There are no set of rules of which aspects of a task that should be simulated; it could be a representation of everything or only a fraction of a task. The degree of similarity between the simulator and the real world that is being simulated is called fidelity. Stanton (1996) clarifies that a two-dimensional definition of fidelity refers to the degree to which the simulator looks like (physical fidelity) and acts like (functional fidelity) the real operational equipment. It is argued that high functional fidelity does not have to be supported by high physical fidelity (Stammers, 1985, 1986; Welham, 1986 In Stanton, 1996). This indicates that the whole situation where training takes place does not have to be simulated; some elements from real life might be chosen and practiced in the simulator. The process of choosing training elements is

selective thereby the simulation will be a selective fidelity simulation. Even though some elements are selected there might still be a risk that the simulation is not completely efficiently effective. It could be negative training effects in simulators; for example, if there is a delay in the simulator that does not exist in real life or vice versa it might lead to incorrect behaviour. Therefore it is important to make a review of the task and evaluate the simulation in order to get an appropriate efficient and effective tool for training. It is today impossible to create a completely realistic motoric environment in simulation related to games and consoles e.g. were the participants' move their fingers like on a real gun. However, that is not necessarily the aim when doing a simulation and that is why a simulation could be used as complimentary training.

Simulation quality is often described in terms of validity. There are many definitions of validity; Carson (1986 In Robinson, 2002) describes a model as valid if it is sufficiently accurate for the purpose at hand. The key theme in most definitions is the accuracy of the model and its intended use. Robinson (2002) states that a model can only be valid for the purpose for which it is built. There has been argued that a major drawback with selective fidelity simulations is that they do not simulate the whole environment in a realistic way. However, all elements of the real operational environment do not have to be provided, but those provided need to act in a manner that is functionally equivalent to the way in which they would behave in the real equipment (Stanton, 1996). Thus, complete physical fidelity is rarely required for effective training and transfer (Salas et al., 1998). This could consequently be viewed as a challenge to Resnick's statement that learning is highly tuned to the situation in which it takes place. Resnick's statement could therefore maybe be viewed as a failure in the sense that it is not taking into account that some knowledge could be generalised and applied in other situations.

Training effectiveness evaluations of simulation-based training have been limited (Bell & Waag, 1998). A first step towards an effectiveness evaluation is, according to Bell and Waag (1998), a utility evaluation where the evaluations are based primarily on opinion data. They state that user opinion is a necessary condition for the acceptance of a simulator hence, a necessity when conducting more rigorous

evaluation of simulation-based training (Bell & Waag, 1998). The second stage in Bell and Waag's (1998) model of estimating the training effectiveness of flight simulation is, "performance improvement" which refers to that a person's performance has to improve when conducting training in a simulator. The third stage is "transfer of flight environment" and the fourth stage "transfer to flight environment" is similar to Kirkpatrick's stage "behaviour" and represents whether the knowledge gained during the training is applicable in real life situations. The final stage is "Extrapolation to combat environment" and refers to effectiveness of the simulation. This model has similarities with Kirkpatrick's model of evaluation of training programs; the same pattern of assessment can be revealed. The only differences are that they name their stages slightly different and Bell and Waag (1998) emphases the transfer of training to a greater extent. This shows that it is important to consider these aspects when performing an evaluation of different media associated with learning. Aspects related to each stage in the two models will be considered in the research, the main focus will therefore be on the four different areas in accordance to figure 2.2.

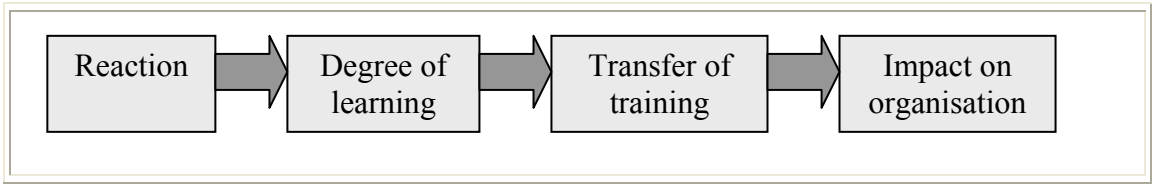

Figure 2.2 *Framework for evaluating training programs*

There are many sources supporting the fact that simulations *provide* learning, an example given from the flight industry is provided by Koonce and Bramble (1998) where they found that 2 hours of simulator training resulted in savings of 1,5 hours of flying time in the actual aircraft, representing a significant cost benefit.

2.2.1 Simulation gaming

One type of selective fidelity simulation is digital games. Games could be used for many purposes; it has been used for training people to master expensive and sensitive equipments, improving teamwork and communication, in addition it could be used, and have been used, as an effective tool for simulation. Gaming is

argued to include factors related to cooperation0, conflict and even collusion (Feinstein, Mann & Corsun, 2002) and it has an important part of our social and mental development (Amory, Naicker, Vincent & Adams, 1999). Simulations appear to be most appropriate when a dynamic environment is needed. Other media such as audio and video may not provide such a rich environment in terms of interaction (Stanton, 1996). Effective methods for learning does often include interaction which is something that a computer or console could provide. Or as Confucius said (Feinstein, Mann & Corsun, 2002):

> " I hear and I forget
> I see and I remember
> I do and I understand"

Amory et al. (1999) argues that educational tools that support visualisation and problem-solving could be developed from computer games. Furthermore, Amory et al. (1999) claim that such tools could provide sufficient stimulation to engage learners in knowledge discovery and at the same time develop new skills. Simpson and Oser (2003) claim that if a simulation should be useful for training, it must be flexible enough to change rapidly in response to the decisions and actions of the training audience. Digital games provide an environment that could be adjusted depending on training objectives, i.e. it is relatively easy and inexpensive to set up different scenarios and/or change game. If the trainee were to play a digital game in order to learn something it should most likely create a positive mood given that computer games mostly are associated with positive feelings. Thereby the first level of Kirkpatrick's model of training evaluation 'reaction' would be successfully fulfilled since the reaction of the trainees often is critical to the continuation of any training program. Research shows that game-based training methods facilitate the training process by increasing users' intrinsic motivation resulting in increased intention to use the technology (Venkatesh & Spier, 2000).

It is important that there is a high quality of the learning material. Sambrook (2001) concludes that the most significant factor influencing learners' judgement of quality of a computer based learning materials was to the extent to which the material was easy to use with clear instructions. Other factors that was considered

to be important was presentation, graphics, engagement (whether the material generates interest or is found to be boring), information and knowledge (the extent to new knowledge was gained).

2.2.1.1 Game Consoles

The most commonly used game consoles as from the beginning of 2003 are Microsoft's Xbox, Sony's Playstation 2 (PS2) and Nintendo's Game Cube (GC) see Appendix A. These are very popular for gaming, among people in different ages. The average age of a game player is 29 years old (Entertainment Software Association, 2003). However, there has been no research on game based simulation related to consoles. There might be advantages with using consoles for game based simulation instead of PC: s. There are several fundamental differences between game consoles and a PC. Consoles have a closed environment with fixed specifications that cannot me manipulated while the PC is open with an ease of access and manipulation. This means that a console provide a more stable and safe solution which does not require technical skills, support and maintenance. It is less expensive to buy a console than a PC; a console is on average 10-12 times cheaper (Entertainment Software Association, 2003). PC have network capabilities while only one console has a complete network capability (i.e. Xbox), PS2 have a slot where an optional broadband modem could be connected, it is not possible today to put a GC in a network. However, GC will get network capabilities in a near future. To summarise, the main reasons why it might be better to use consoles are that it is inexpensive, it is easier to interact, and it does not require any complicated installation or upgrading.

2.3 Aspects affecting performance

Models of individual performance include ability and effort as the main determents of success or failure (Rozel & Gardner, 2000). Level of effort is one of the primary causes for individual performance in general and computer-related performance in particular (Waern, 1989). Level of effort will be affected by motivation and participants' attitudes towards objects, these factors will be considered below.

2.3.1 Motivation

Motivation has been identified as a key determinant of behaviour in general and particularly on an individual's intention to use computer technology and actual computer use (Davis, Bagozzi & Warshaw, 1992). Increased motivation could therefore raise a positive mode, time spent on the task and in the end result in greater learning. It is well known that motivated people become productive and effective (Venkatesh & Speier, 2000; Hwang, 2003). Davis et al (1992) discusses usefulness related to motivation and says that the easier a system is to use, the less effort is required to carry out a given task. Following, if less effort is required to carry out a task the more can be allocated to other job tasks, which should benefit overall job performance (Davis et al., 1992). Another important factor, besides usefulness, related to motivation is whether the activity is perceived to be enjoyable or not. There are both visual and verbal elements in gaming which might be perceived as enjoyable and serve as a motivating factor.

Motivation describes three aspects of behaviour that have an impact on performance (Rollinson, 2002, pp197):

- *Direction of behaviour*, which is affected by what a person desires to do
- *Intensity of behaviour* relates to how hard a person strives to get the objectives fulfilled.
- *Persistence*, the willingness to stay with the behaviour when objectives are fulfilled

Literature related to motivation often discusses *intrinsic* and *extrinsic* motivation. Intrinsic motivation comes from an expectation of receiving an intrinsic reward, i.e. psychological rewards that come from inside a person. Extrinsic motivation relates to extrinsic rewards which are a reward conferred from outside the individual (Rollinson, 2003).

2.3.2 Attitudes

An attitude is a disposition to respond favourably or unfavourably to an object, person, institution or event (Ajzen, 1988). Since attitudes are inaccessible to direct observation it must be inferred from measurable responses. Ajzen (1988) states

that the responses must reflect positive or negative evaluations of the attitude object. When assessing attitudes via attitude and personality scales they should predict how an individual will actually behave in a concrete situation (Ajzen, 1988). This brings that if peoples attitudes related to computer games and consoles are sought for it should be evaluated after some sort of behavioural performance from the people investigated.

The literature review has showed that there are many aspects to consider related to learning and training. Research related to learning, training and simulation have been discussed. Gaming is a relatively new phenomenon and it has mainly been used for leisure, however, it might be possible to use gaming for other purposes i.e. not purely for fun. Unfortunately research is lacking and there is not much information related to console gaming as a tool for training and learning. Therefore research is required were consideration is taken to gaming, training, learning, attitudes and motivation.

3 Methodology

The selection of research methods should be made on the basis of which type of data that is required. The hypothesis, or research question, that is going to be investigated narrows down the amount of appropriate methods however; most hypothesis/areas can be investigated by several different methods (Breakwell, Hammond & Fife-Schaw, 1998). The most commonly used method when doing evaluations related to simulation and training are experiments, which might be due to that experiments have greater face validity than other methods (Simpson & Oser, 2003). Since peoples attitudes are sought after it will be evaluated after a behavioural performance (as described in section 2.3.2), therefore they had to try respectively console and PC before they made the evaluation. The following section will describe how the experiment was conducted in order to get the most useful data.

3.1 Participants

The data for the study was collected from 48 cadets in the Swedish Army Combat School. These individuals were selected from a military academy class of 100 cadets. The class is a part of a one year training program and will lead to a rank of second lieutenant. The participants came from different units and regiments all over Sweden which could be viewed as increasing the external validity and might result in a high generalisability (infantry, rangers, mechanized and marine troops from many parts of Sweden were represented).

3.2 Materials

Materials used in the study were two Xboxes linked to two monitors, PS2 linked to two TV, GC linked to two TV and two PC linked to two monitors. Each consoles had it's respectively hand held devices and the PC had a keyboard and a mouse. The size of the monitors was 15'' and the size of the TV was 28''. The game used was Tom Clancy's Ghost recon (see Appendix B). To compensate for a limited field of view (on the screen) it was desirable that each individual had a screen on their own. Another reason for why there should be a screen per person is that it

would be possible to place the screens so that they could not see each others' terrain.

3.2.1 Scenario

It is important to have a game and scenario that has similarities to real life, i.e. a game and scenario with aspects that could be generalised and applied in real life. The game 'Ghost Recon' (see Ubi soft entertainment, 2003) was selected mainly because it included terrain and tasks relevant for the Swedish Army. Scenario number 9 "blue storm" and number 1 "iron dragon" was chosen for the experiment. Each fire and manoeuvre team had to solve three objectives in the game.

3.2.2 Questionnaires

Questionnaire is a flexible and far-reaching tool when trying to obtain information about: behaviour, awareness and attitudes (Crimp & Wright, 1995). Hence, it is suitable to fulfil the objectives. Questionnaires are usually a good method in order to find out information without the researcher being actively involved, which means that a high reliability could be attained and interviewer bias reduced. Questionnaires could have different levels of structure, i.e. to what extent the subjects are free to interpret the questions and answers (Saunders, Lewis and Thornhill, 2003). The interpretation can be dependent on the subjects' attitude or past experience. A completely structured questionnaire forces the subjects to answer one of several already stated alternatives; this will simplify a quantitative analysis later on in the process (Breakwell et al., 1998). However, when there are only a few alternatives for the subject to choose among there will be a risk of not getting a precise answer. Therefore a combination of opened and closed questions will be used.

Seven questionnaires were handed out. The first questionnaire was distributed two weeks before the actual experiment took place and included questions relating to participants' background. After the fist questionnaire two departments (the class of 100 cadets included 4 departments) were selected (each containing 24 persons).

The reason for choosing the departments was simply that the experiment fitted in their schedule. The second questionnaire, see Appendix C, was handed out on the day of the experiment, after the introduction. The questions related to their background, i.e. computer and gaming experience, if they had used any of the consoler earlier etc. These questions are important since it could affect their performance, e.g. a person that games several hours per day might perform better than a person that has never played at all. The third, forth, fifth and sixth questionnaire, see Appendix D, were handed out after each gaming round, they included questions related specifically to the console or PC. There were three main focus in those questionnaires, firstly interaction (how the participants perceived the controller) Secondly, learning (the participants view of the console as a teaching aid). The last focus of the questionnaire was motivation. The final questionnaire was handed out when all platforms had been used, focus was on comparing the consoles, see Appendix E.

3.3 Observation

Since the experimental leader, an officer/teacher form the Army combat school, and a technical assistant was present during all the experiments observations could be conducted. Observations can be conducted in different ways e.g. a participation observation (when the researcher participates in fully as a member of the research group) or a structured observation (a more systematic way of gathering data with an emphasis on quantifying behaviour). The officer did a systematic observation in his capacity of domain expert and made observation protocols; the researcher did a less structured form of observation. The research protocol will no t be further investigated in the report but will only give a very general opinion about how a domain expert perceived the participants performance. Observations can be extremely time-consuming (Saunders et al., 2003) and they will not be highly emphasised in the present study. An advantage with observations is that they should yield highly reliable results by virtue of their replicability (Saunders et al., 2003). Furthermore, the data can be collected at the time it occur and in its relevant context. It is also possible to see behaviour that the participants are not aware of or could not write down in a questionnaire. Those advantages are some of the reasons for why observations were not excluded.

3.4 Procedure

In order to get conditions in the experiments that could be perceived by the participants as a training event of real life conditions, an outdoor training exercise was conducted some days before the gaming experiment. Officers from the army scheduled and conducted the exercise which all participants took part in. The main goal with the exercise was to practice firing and movement.

Four fire and manoeuvre teams (each of consisting of two participants) took part in the gaming experiment simultaneously. This enabled the researcher to supervise the experiment. They were asked to work in the same teams as in the outdoor training.

The experiment was opened by a short introduction where the main objectives were presented. The participants were allowed to practice in order to get familiar with the game and controller etc. They were then introduced to the scenario of importance and got a short briefing in order to create a more realistic training intervention and to encourage the participants to take the game and task seriously. After the introduction each team made a plan of action and thereafter played the game. Afterwards they got a short break. During the break they were encouraged to answer a questionnaire with questions relating to the console (or PC) previously used. After the break they switched console in accordance with Appendix F and did the same training scenario again. In order to keep the conditions alike they had to do the same training scenario as earlier and for the same amount of time. Afterwards they played the scenario of importance and then evaluated the console during the break. In order to avoid practice effects two different scenarios in 'Ghost Recon' were used. Scenario 9 "black needle" was used for the two first platforms and scenario 1 "blue storm" was used for the last two platforms.

A crib sheet was available during the whole experiment as a guideline if someone forgot which function related to respectively button. Measurements of how each team performed in the game was recorded i.e. number of times they got killed and if they fulfilled the objectives (see Appendix G). If they were killed they got a new

chance. They had all together 4 more times to try to solve the task. The reason for why they were allowed to start again was that their performance in the game was not primarily of interest but rather their opinion about the platforms i.e. if they were not allowed to try again after they had 'died' they would not have been able to try out the platform properly. In order to avoid playing without serious intentions, for example if they choose to run, die and restart rather than advance in a correct tactic way they were only allowed a few restarts. If the gaming session was not taken seriously they got a warning from the supervisor. When the participants had answered the last questionnaire they were handed two cinema-tickets each. The experiment (excluding the outdoor training) lasted approximately four hours.

Three pilot tests was conducted in order to establish the validity, another reason for using pilot tests was to verify that the participants did not have any problems of interpreting the tasks and the information. One of the pilot tests were conducted with instructors/teachers from the army combat school, this was of importance in order to get a more 'qualified' opinion about the experiment.

3.5 Design

The design of the experiment was a within subjects design (repeated measures design) i.e. all participant experience all the conditions of the experiment. The advantage of within subjects design is that confounding can be avoided (confounding arise when participants in various groups differ in ways other than the levels of the independent variable). The different consoles (and the PC) will be used as the independent variable. Additionally, the concepts of performance, their view of learning, motivation and interaction creates the dependent variables (which makes it a 1 x 3 design). However, since each participant experience all conditions (all the consoles) there will be practice effects. Practice effects arise because participants undergo changes as they are repeatedly tested (Shaughnessy & Zechmeister, 2003). It is not possible to eliminate the practice effects it is however, possible to balance (i.e. averaging out) the effect across the conditions which decreases the bias. Therefore the platforms had to occur in all possible orders and that is why 48 people (24 pairs) were required (see Appendix F).

An alternative design of the experiment could have been an incomplete design where each participant is given each treatment only once (Shaughnessy & Zechmeister, 2003). That would reduce the practice effect. However, it would require more participants and their personal characteristics and backgrounds would affect the experiment to a greater extent (Shaughnessy & Zechmeister, 2003). It is difficult to recruit a homogenous group and if the incomplete design where to be used a person with many hours of experience of gaming would probably get different results from a person with less experience; consequently it would affect the experiment negatively.

4 Result

In order to answer the question of how users perceive the PC and consoles as a tool for training/learning, data from the study were analysed. Variance analysis and Tukey's post hoc analyse have been conducted. The result is mainly based on the data from the questionnaires but some aspects from the researchers observations will also be taken into account.

There were 48 participants in the study, two female and 46 male. They ranged in age between 20 and 27 where the average age was 23. The participants estimation of their gaming skills (where 7 is very skilled and 1 is not skilled at all) shows that there is an average of 3,9 see box plot[1] diagram in figure 3.1. The participant spend approximately 18 hours per month on gaming, 9 people said that they never played games see, figure 3.2. Moreover, 44% had never played the game 'Ghost Recon'.

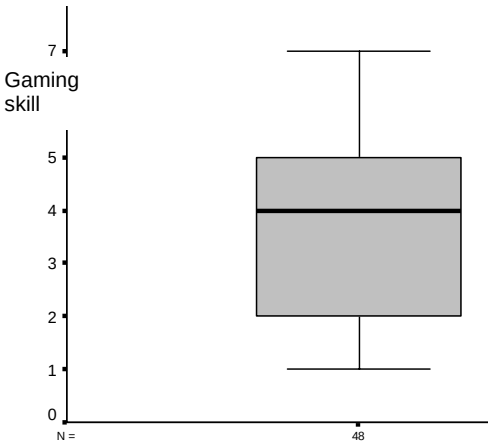

Figure 3.1 *Participants estimation of their gaming skills*

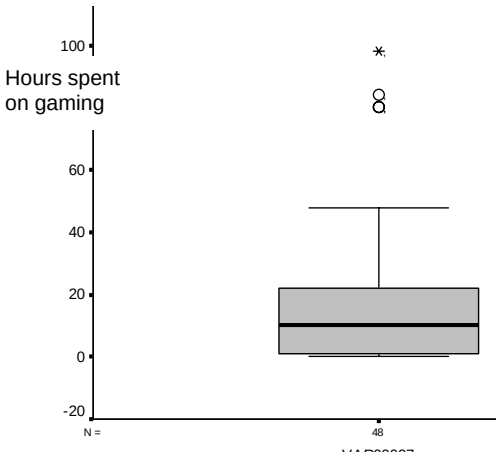

Figure 3.2 *Hours spent on gaming*

[1] This is a summary plot based on the median, quartiles, and extreme values. The box represents the interquartile range which contains the 50% of values. The whiskers are lines that extend from the box to the highest and lowest values. The line across the box indicates the median. 'Outliners' are values between 1,5 and 3 box lengths from the upper or lower edge of the box. 'Extreme' points are values more than 3 box lengths from the upper or lower edge of the box.

There were 33 people that had a PC at home and 11 people had a console (Playstation 2 (PS2) was the most frequently owned console) some people had both a console and a PC see figure 3.3.

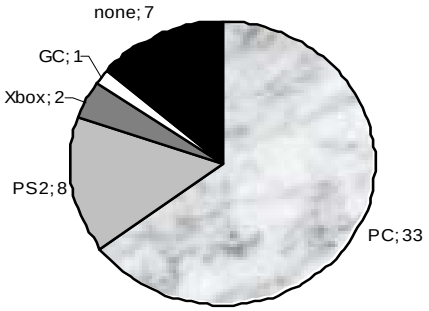

Figure 3.3 *Platforms at home*

The participants' attitude towards the platforms before respectively after they had tried them was measured. The basic idea was to see if their attitude was affected by trying the platforms. Results revealed that there was a slight increase in favour for the consoles, see figure 3.4.

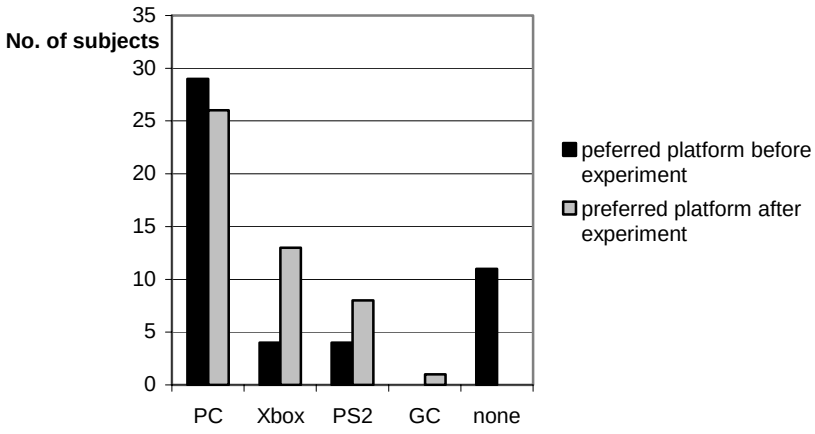

Figure 3.4 *Preferred platform*

The ranking of the consoles *after* they had tried them showed that PC got 26 number one ranking and the consoles got 22 number one rankings [Xbox got 13 number one rankings, PS2 got 8 and GC got only 1 number one ranking (see figure 3.4)]. Analysis shows that there is a significant effect [F(3, 132)=26,65 p>0,05. MSe 28,29]. Turkey's HSD test revealed that PC was significantly better than PS2

and GC. Additionally, PS2 and Xbox were significantly better than GC (p>0,05), ($\bar{X}_{PC}$=1,733; $\bar{X}_{Xbox}$=2,089; $\bar{X}_{PS2}$=2,622; $\bar{X}_{GC}$=3,556).

Graphics were ranked and PC was perceived to have the best graphic (on a scale where 1 was very bad and 7 was very good) with an average of 5,91, Xbox was the second best (5,12), followed by PS2 (4,55) and finally GC (3,62). Correlation analysis shows that there is a small correlation between graphic and overall judgement of the platforms (correlation: 0,182 which is significant at the 0,05 level).

The handheld devices were ranked after respectively console had been used. Analysis shows that there is a significant effect [F(3, 126)=8,32 p>0,05 MSe 11,58]. Turkey HSD test revealed that PC, X and PS2 were significantly better than GC (p>0,05) ($\bar{X}_{PC}$=1,907; $\bar{X}_{Xbox}$=2,465; $\bar{X}_{PS2}$=2,442; $\bar{X}_{GC}$=3,186). Thus no significant difference was found between PC, Xbox and PS2 (see figure 3.5).

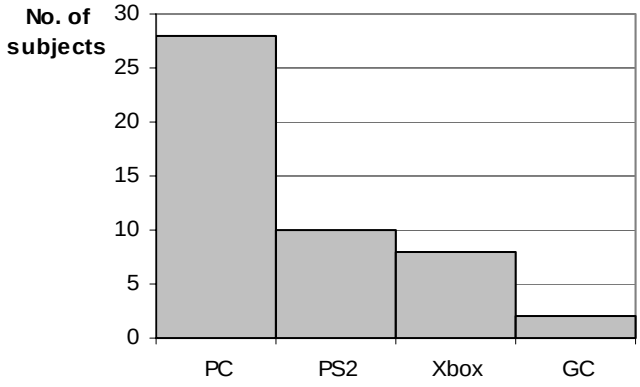

Figure 3.5 *Preferred controller*

There was an overall positive opinion of the training session. The participant ranked different statements where 7 was the highest (best, most interesting etc.) and 1 was the lowest ranking. They thought it was funny (average 5,21), exiting (5,02), involving (5,25), motivating (5,08) and interesting (5,15). Most of the people did not think it was stressful (3,47).

Opinions were divided about the consoles appropriateness as a teaching aid. Mainly, communication, cooperation, tactics and decision-making were viewed as areas that could benefit from a complementary training with gaming consoles (see figure 3.6[2]). Noteworthy is that that only 4% thought that it could not be used for anything. Proportion tests and adjustments according to bon Ferroni's principle reveals that those who answered *yes* is significantly differentiated from *no* for communication and cooperation (communication: $z=7,48$ $z_{table}=2,81$ $p>0,05$; cooperation: $z=8,1$, $z_{table}=2,81$, $p>0,05$).

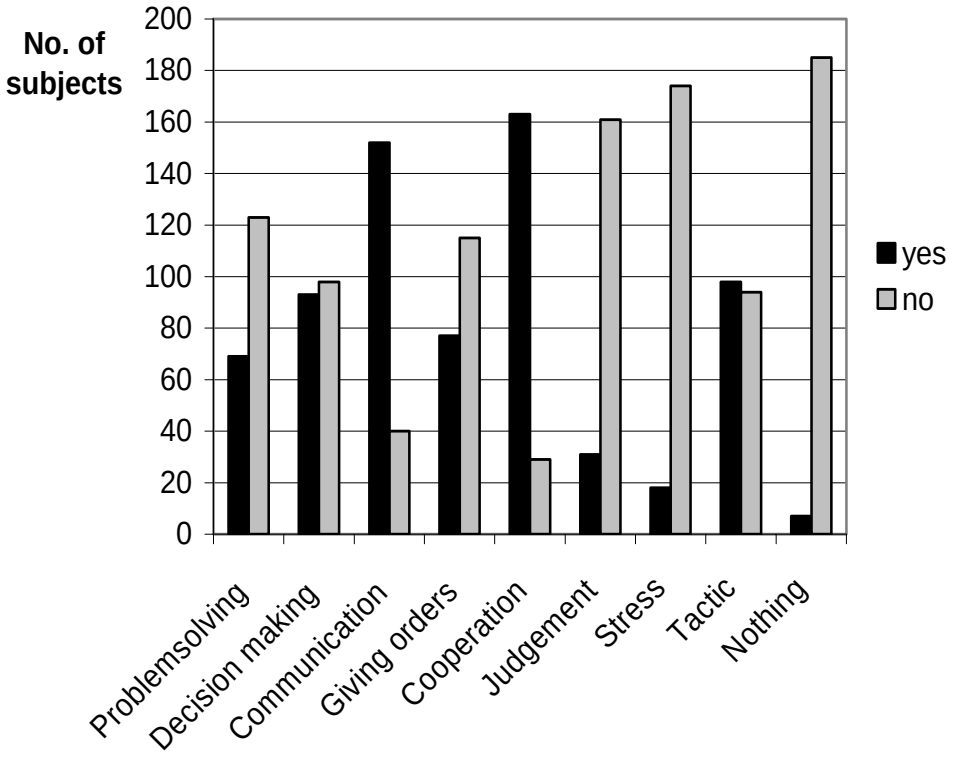

Figure 3.6 *Areas of training*

When judging learning during training, 59% felt that they learned something. They also thought that they would be able to apply it in other situations (see figure 3.7). *Yes* is significantly differentiated from *no* in both columns (learning during training: $z=4,17$, $z_{table}=2,81$; apply in other situations: $z=5,2$, $z_{table}=2,81$).

[2] Figure 3,6 is based on subject's views after each platform had been used i.e. the 48 participants answered the same question after respectively platform had been used.

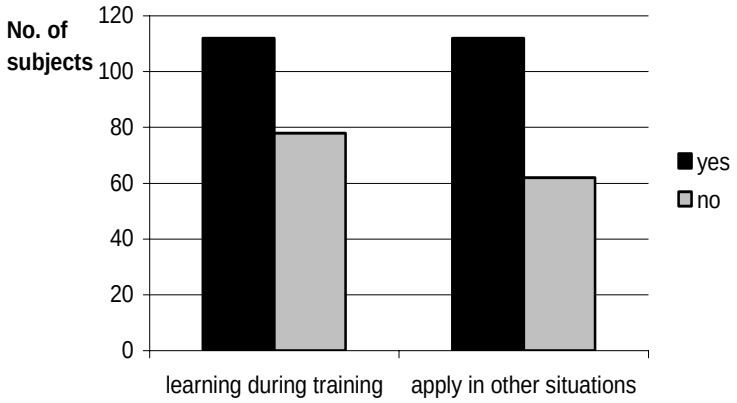

Figure 3.7 *learning during training*

When taking position in the question relating to whether they could consider using gaming consoles as a teaching aid in future situations where they are instructors, 36 subjects answered *yes* (see figure 3.8).

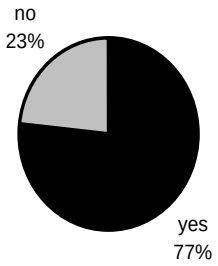

Figure 3.8 *Using gaming for training*

Observations were also conducted. These, together with general comments in the questionnaire revealed that the game was not satisfactory; it was too simple. To practice in fire and manoeuvre teams is not primarily what has to be trained. Many suggested that there should be a game on a 'chief position level' where problem solving and decision making could be practiced to a greater extent. One comment was that it could be a good teaching aid within areas that are expensive to educate. Other subject said that it could save both money and time, and that it would be easy to supervise and control that rules are obeyed. Some comments referred to that real life training should be used, not "playing", it was also said to give a wrong picture of reality. One subject said that money should not be wasted on gaming. Some subjects were worried that it would not be taken seriously. Furthermore, some said that it was not realistic.

5 Discussion of results

This chapter presents the results and puts them into their context using main points from earlier chapters of this report. The discussion relates to the research question "how does the user experience the PC and consoles as a tool for training and education". The question will be answered through three areas namely, motivation, learning and interaction.

5.1 Discussion regarding the platforms

Most people preferred to use the PC for gaming; one possible explanation is that PC has better graphics (much better than PS2 and GC). The reason why PC and Xbox (even though Xbox was only significantly better than GC) had better graphic could be due to the monitor, i.e. these two were connected to a PC monitor while PS2 and GC were connected to a TV. Furthermore, the PC controller (keyboard and mouse) enables a quicker and more precise control of the game. The consoles were criticised on the matter that it was, relatively, difficult to turn around quickly enough. Another possible explanation to the PC's popularity could be that most people are used to handle a computer. This is supported by the fact that 65% had access to a computer at home (see figure 3.3 on page 22). This suggests that if people learned how to use a console efficiently they might in the end prefer a console to a PC. Tendencies supporting this fact is that the consoles got a higher ranking when the participants had tested them (17% preferred a console initially and 46% preferred consoles after the experiment) (see figure 3.4 on page 22). PC had the opposite tendency, it got higher ranking initially (60% preferred PC initially) after everybody had tried the platforms it got a slightly lower ranking (54% preferred PC in the end).

There was a variation in gaming skills and thus, experience and to which extent people played games on their spare time. However, this should probably not influence the study since it was not of importance how people performed, i.e. the focus was on how the participants perceived the different platforms and the significant disadvantages and advantages of the platforms. Since the study was not focusing on a certain level of experience or skills it was important to collect

opinions from both experienced and inexperienced users. There were more men than women in the study (46 men and 2 women) this is however, a fairly representative group since there are more men than women in the Swedish Army.

The participants ages were representative, officers of second lieutenant rank are usually in their 20ies. This could suggest that the results are not generalisable to all age groups within the Army, e.g. older people tend to be less prominent to play games. However, as today's younger officers get older this may change and gaming can, therefore, be expected to be not only more efficient as a training tool but also more accepted as an enabler for effective and efficient training.

When the hand held devices to the consoles were analysed PS2 was considered to have the best one. Some arguments were that its size and placement of buttons and levers were better compared to the others. The hand held device of PS2 was, however, insignificantly better than the Xbox's device. The reason that PS2's controller was considered to be the best (among the consoles) relates to the fact that some participants perceived the Xbox controller to be somewhat too big and 'clumsy'. However, there were still people that preferred the latter controller. Common reactions about the GC controller were that it felt to 'plastic' and, above all, that the 'zoom out' function was relatively hard to use. This sometimes affected the participants negatively when playing which might be an explanatory factor to the low ranking.

To play the game on a monitor received better feedback compared to the use of TV. For example, the graphic was superior in terms of sharpness and level of details. The correlation analysis showed that overall judgements of the platforms were affected by the judgements of graphics. Hence, it is essential that the consoles keep up to a reasonable graphical standard if they should be used for training sessions. Especially considering that 54% preferred to use PC compared to 46% for the consoles. If the graphics of the consoles are improved then it will be a more appealing alternative to PCs. Hence, two alternatives are possible:

- First, the console in itself must improve its graphic capabilities.

- Second, the console must be connectable to a monitor, an option not provided by GC and PS2.

One complain that was brought under attention was that it would have been preferable to play against each other rather than against the AI (Artificial Intelligence). The AI sometimes fails to simulate a realistic combat behaviour, which could encourage bad behaviour, e.g. to advance forward it is often necessary to kill the enemies in a game, which is not the case in real combat; in reality casualties are discouraged. A game can in fact encourage bad operational and tactical decisions if not used in an appropriate way. Thus, it is a disadvantage that, so far, it is impossible to connect PS2 and GC to a network. The only console that provides the opportunity to play against each other in a network is Xbox, hence, with regard to network capabilities Xbox is the only console that live up to the standard of the PC.

Gaming as a tool for training seems to be a motivating factor. It was perceived as, for example, funny and interesting. Hence, accessibility for the soldiers could encourage them to practice in their spare time, which could lower training-related costs. This, however, is not the only synergy effect but the army would also get a more skilled workforce assuming that they play according to the general practise guidelines. Therefore one suggestion would be to equip some public rooms e.g. sleeping quarters, with a console and thereby encourage gaming in people's spare time. It is reasonable to expect that some measures must be taken in order to avoid abuse e.g. only enable certain games to be played.

The console chosen should have network capabilities. This enables group sessions not only to the regiment but basically people from all over the country could participate. By having challenges between different regiments, for example, gaming would be encouraged, made more exiting, and more challenging. Thus, the network capability provides many opportunities that will make the consoles a usable tool for training.

5.2 Subject's reaction

The evaluation of the training process has focused on the first step of Kirkpatrick's as well as Bell and Waag's model: reaction. The participants' opinions have played an essential part in the research. Since the time boundaries did not allow a longitudinal study it will not be possible to say anything about how much the participants learned, i.e. degree of learning and transfer of training. Hence, the impact of learning on the organisation cannot be estimated. However, due to the wide acceptance of simulation as a training tool a positive result could be expected from a longitudinal study.

Three aspects affected by, and affecting, motivation and performance have been discussed in this report; direction of behaviour, intensity of behaviour and persistence. All three affect the first step, *reaction*, of Kirkpatick's and Bell and Waag's models (reaction refers to the trainees thoughts about the training program). The first aspect to influence motivation and performance is *direction of behaviour,* which is affected by personal desires. When analysing the users' background, e.g. how much of their spare time they put on gaming, it is possible to draw the conclusion that the vast majority of them enjoy gaming. This could affect the participants' view of using gaming for work as well, hence, the direction of behaviour is likely to be affected by the desire to game. Most of the participants strove very hard to fulfil the objectives, e.g. they encouraged and helped each other to be able to maximise the performance of the team. This shows a high *intensity of behaviour*. In fact, some people clearly stated that their intention were to require a console and play in their spare time.

When the gaming session was terminated most teams wanted to go on to complete the mission, which could well indicate a high level of *persistence* in accordance with the three aspects of motivation. It is, therefore, reasonable to suggest that a high level of motivation could be gained and affect behaviour in a positive way. Especially considering that people can be expected to work harder to achieve a given goal if they enjoy it. In particular, the following aspects of a gaming training session could raise the motivation: clear goals, quick and informative feedback, e.g. the score shows instant feedback of behaviour. Another aspect that could

increase motivation and make people more inclined to use it is visual effects and graphics (see chapter 5.1).

Gaming as a training method could quite easily be identified with Resnick's (1989; In Johnston, 1989) three aspects of learning, which will be done in this paragraph. The first aspect, *learning is a process of knowledge construction,* is taken into account in a gaming training session since there is an on-going process of interaction, i.e. there is no 'listen and remember'. The second aspect, *learning is knowledge dependent* i.e. one thing leads to another, was highlighted during the observations. Several knock-on effects were revealed during the experiments, e.g. many of those who put an effort into the training did consider it to be rewarding in the end. If the teams failed to advance successfully they eventually changed their strategy of how to proceed. This was a commonly detected phenomenon since most teams lost lives in the beginning only to realise that very good communication was needed to stay alive and fulfil the objectives of the mission. According to the research Resnick's third aspect, *learning is highly tuned to the situation that it takes place in,* is to some extent challenged. As many as 59% of the respondents thought that the knowledge gained from game based training could be applied in other situations. There exists research, mainly conducted on strategy games that support the fact that knowledge gained in a game based environment could be applied in other situations (Melechi, 1997; Dunnigan, 2000). This statement, however, requires more research before it can be finalised. In addition, a game that is more suitable for the training purposes could probably reinforce this.

5.3 Impact on organisations

The last stage of the training model is *impact on organisation,* an area where gaming consoles could have an extensive impact. Gaming consoles and its impact on an organisation could be extensive. If it would, for example, be possible to swoop real life training for gaming it would save money and time. This would, nevertheless, require an improvement of the currently available games, e.g. a more complex game that allows for enemies to be captured instead of killed. This would put more pressure on the user to make the "right" decisions. The game does not

have to be an exact copy of real life with all its inherent complexities; for example, a low fidelity game could be appropriate. Nevertheless, at least initially, game based training is more likely to be used as a complement to real life training rather than a substitute.

Furthermore, it is important to consider what needs to be practised before selecting the game. The variety of games is definitively greater when using only one platform (not as in this study). Research showed that 46% preferred a console rather than a PC despite inadequacies of the game. This indicates that many people are open for gaming as a training tool and could be an encouragement to create more appropriate games.

To use gaming in order to get motivated people with positive attitudes towards learning and education is another advantage which will have a positive impact on an organisation. This will most likely help every organisation to keep up with the latest advancements within the industry and create/keep a competitive advantage. Another benefit for organisations if using consoles rather than PC is that it is easy to handle. There is no complicated installation and it does not require any technical skills, support and maintenance (compared to the PC which has an open environment).

The study is performed within the Swedish Armed Forces, however, aspects that need to be practiced within the Army often need to be practiced elsewhere, e.g. problem solving, decision making, cooperation and managing stress. Therefore results from the study do not necessarily have to be viewed only within the defence context, i.e. t is possible to generalise the results to some extent.

6 Conclusion

This chapter will include a summary of the result and the discussion. There will also be a discussion about limitations with the research relating to references, methodology, validity and reliability. Finally there will be suggestions and recommendations for future work to be made within the research area.

There are many aspects to consider when trying answering the question of *how users experience the PC and consoles as a tool for training and education.* The research question has been approached by the means of *learning, motivation* and *interaction*. People believed that they learned during the training and that the knowledge gained could be applicable in other situations. As many as 77% said that they could consider using game-based training in the future if they are instructors. If a better game was found/developed even more subjects perceived it as an appropriate teaching aid. Above all, two areas were considered to benefit from game based training, namely, communication and cooperation. There were suggestions that the game should enable training of areas that arise on a 'chief position level' where problem solving and decision making are more apparent. Therefore, in order to get an efficient and effective training an appropriate game has to be developed.

Aspects associated to motivation received fairly high ratings and the respondents thought the gaming training was funny, exiting and interesting. In fact, a lot of them play games in their spare time which shows that gaming is a popular activity. This provides a good foundation to use consoles as a tool for training and education since motivation is needed in order to attain efficient training.

When analysing the research question from an 'interaction' point of view the research showed that most people preferred to use the PC for gaming. A variety of reasons are possible for this; speed and accuracy of the controller turned out to be two very important factors that distinguished the PC from the consoles. Another important factor was the graphic, which was considered to be superior for the PC and Xbox compared to the GC and PS2. Nevertheless, it is impossible to neglect that the relative high user experience of PC could contribute to its popularity, e.g.

65% of the respondents had a computer at home. In fact, the popularity of the consoles increased after the experiments so if soldiers were more acknowledged to the consoles and its features it could be expected to become even more popular. Consoles got fairly high rankings even though PC was regarded as superior. The size of the PS2 controller as well as placements of buttons and levers were reasons why PS2 was considered to be the best. However it was only slightly better than Xbox. Xbox is advantageous considering that it has network capabilities and better graphic. It is, however, difficult to state which console that is most appropriate for game based training. The research needs to be expanded in order to give any definite answers e.g. the platforms should be tested with different games. What is clear though is that resources could be saved if consoles rather than PC were used. Consoles are easer to handle, there is no complicated installation and it does not require any technical skills, support and maintenance.

To use gaming in order to get motivated people with positive attitudes towards learning and education is an advantage which will have a positive impact on an organisation. This will most likely help every organisation to keep up with the latest advancements within the industry and create/keep a competitive advantage.

Considering the general positive reactions from the participants; it seems that game based training have great potential. Hence this form of training has potential to improve the human capital as well as the structural capital, i.e. individuals as well as organisations could gain from game based training.

6.1 Critique

This subchapter is divided into four areas: references, methodology, validity and reliability.

There are a tremendous amount of *references* on the area of learning and training. It is a too big area to penetrate and therefore it is always a risk of missing important references and information. Therefore there has been a focus on material related to both training and simulation. Some references related to gaming and low fidelity simulation have been used, which could be viewed as the most relevant

literature with consideration to the research question. Preferably, it should have been more references related to gaming as a teaching aid. However, there is not much scientific research conducted on gaming and training and that is the reason for why it is not included.

Obviously, there are varieties of different ways of conducting the research and answering the research question. One way to save money and time would probably have been not to conduct the experiment but to rely purely on questionnaires or interviews. However, due to different basic conditions, e.g. some people had only played a certain platform and others had not played at all, it would have been hard to conduct research and get accurate and relevant data if they were not allowed to try all platforms. Experiment was probably the most efficient way of getting peoples opinion about all different platforms in relation to the others (compared on the same conditions). It allowed people to make their judgements based on own experience which is something that probably reduced bias. It was a rather big experiment with lots of aspects to take into consideration, i.e. all the questionnaires, selection of appropriate scenarios, balancing the order of the platforms, evaluating which information that should (and should not) be given to the participants. In spite of that the whole experiment proceeded well and all collected data could be used.

During the pilot studies observations revealed that the practice effect tended to be fairly big. To some extent it was avoided through letting the participants use the platforms in ‘all possible orders’. In the first pilot study only one scenario was used on all platforms; however, the practice effect was overwhelming. It was determined that the practice effects would have had a greater impact on the participants’ judgement than the independent variable (i.e. platform) and therefore it was decided that two scenarios should be used. However, it was not possible also to balance the scenarios. Therefore it was decided that scenario 09 should be used for the first two platforms and scenario 01 for the last two platforms. Thus, all participants did not play the same scenario on all platforms which might have affected their evaluation. This is a source of error that could not be avoided within the limits of the research.

Alternative ways of evaluating the platforms could have been via interviews and/or extensive observations. Due to a limited time period, questionnaires were considered to be the best alternative. It gave a lot of data that could be worked upon and revealed some interesting results. If there had been more time it would have been interesting to conduct interviews in order to validate the experiment, and to see whether more or different information could be reviled. Patel and Davidson (1994) suggest that in order to validate something a different technique could be used e.g. if attitude scales is being used in a questionnaire maybe interviews could replace it in order to see whether a positive attitude in the questionnaire is equivalent to a positive attitude in the interview.

The validity of the experiment was partly established during the pilot test, the 'pilot' participants did the whole experiment; additionally, there were informal interviews in order to establish if something was missed out, if they felt that they understood the questions and if the questions were relevant. There is always a risk of overlooking some factors which could affect the validity negatively, there is no absolute guarantee that it did not happen in this experiment. There were several questions in the questionnaire that measured the same thing, e.g. their view of learning; these questions usually gave the same result, this could be a systematic error but most likely it shows that the same things were measured at several occasions and what was sought for was answered.

The most common way to establish reliability, i.e. the consistency or stability of the experiment, is via replication (Breakwell et al., 1998). Since it was not possible to replicate the whole experiment several pilot studies was initially conducted. Several adjustments were done after the first pilot. The second pilot did not require many adjustments and the third pilot gave about the same data and information as the second one. Therefore the reliability of the experiment was considered to be satisfactory.

The study was only concerned with the participants' views and judgement about the platforms; there were no reliable objective measurement of the different consoles and the PC. Even though the study was designed to only evaluate the platforms it is hard to avoid the fact that the participants' views could be

influenced of the fact that only one game was available. For example the game had a limitation on the GC console, the zoom was constructed differently on GC compared to the other platforms which might have affected the participants' view of GC slightly.

The research was evaluative and there were unfortunately not time to put together an advanced training program where certain aspects could be trained. It might have revealed different results if there were more emphasis on training with a detailed and informative feedback from a domain expert. Due to the limited period of time for the research project the data from the observation protocols was not included in the analysis. This could have been a way of increasing reliability and validity and would probably have benefited the whole study.

A negative factor is that it was not possible to evaluate the degree of learning and transfer of training. Thereby there is no objective statement about how effective and efficient gaming consoles are.

6.2 Future research

This study allows for several different directions in terms of future research. For example, the second and third step of Kirkpatrick's model, (degree of learning and transfer of training), ought to be investigated. In order to do so a longitudinal study should be undertaken where the participants' knowledge is measured before as well as after the gaming training. To measure the effect; time sensitive measures should be chosen so that it can be established whether gaming has had an effect. It would also be of value to compare a gaming session with a real life training session where the latter acts as a control group to determine *how* efficient and effective game-based training is.

A future possibility might be to develop 'adds-on' not only for PCs but also for consoles, e.g. incorporate the gun used by the army into the game, that will enable the user to game with a 'real' gun instead of a hand held device. This could benefit some aspects of the training that is being conducted today and get a more 'realistic' feeling. A future development might be to take advantage of the virtual

reality that is rapidly making its advancement. However, that is still quite distant from the training of today and it is a long way to go before it could be an efficient and effective alternative.

The platforms should preferably be tested with another game in order to se if the game has had a positive or negative effect on any platform. This matter has been touch upon earlier in the research process. One possible solution to the problems is to develop a game for the specific tasks in the Army considering the Swedish infrastructure and environment. It could also be an option to modify existing games.

The research has showed that there are potential with gaming consoles as a tool for training and education, it will probably be a well used tool for training in the future. However, gaming consoles could probably never entirely replace ordinary training; it seems to be most effective and efficient as a complement.

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Appendix A - Consoles

Playstation 2, Gamecube and Xbox were used in the experiment. It is fairly hard to compare the consoles hardware because the data presented by Sony, Nintendo and Microsoft is not always comparable. The information about the technical aspects of the consoles is taken from /www.howstuffworks.com/ 2003-08-24.

Playstation 2
Produced by Sony

- Processor: 128-bit "Emotion Engine"
  - 300 MHz
  - Floating point unit (FPU) co-processor
  - Maximum bus transfer rate of 3.2 GB per second
  - Includes current PlayStation CPU core
- Graphics: "Graphics Synthesizer"
  - 150 MHz
  - Embedded cache
  - 4 MB VRAM
  - 75 million polygons per second
- Audio: SPU2 (+CPU), 48 channels, 44.1- or 48-kHz sampling rate, 2 MB memory
- RAM: 32 MB RDRAM
- Game medium: Proprietary 4.7-GB DVD and original PlayStation CDs
- Drive bay (for hard disk or network inteface)
- Controller: Two controller ports, "Dual Shock 2" analog controller
- Other features:
  - Two memory card slots, Optical digital output, Two USB ports, FireWire port and Support for audio CDs and DVD-Video

Gamecube
Produced by Nintendo

- Processor: "Gekko" IBM Power PC microprocessor
  - 485 MHz
  - Cache:
    - level 1: 32 KB Instruction and 32 KB Data
    - level 2: 256 KB
  - 32-bit address, 64-bit data bus
  - Maximum bus transfer rate of 2.6 GB per second
  - 0.18 micron copper interconnects
- Graphics: "Flipper" ATI graphics chip
  - 162 MHz
  - 1 MB embedded texture cache
  - 3 MB Mosys 1T-SRAM (This static RAM uses a single transistor per cell, like DRAM.)
  - Approximately 12 million polygons per second
- Audio: Special 16-bit digital signal processor, 64 channels, 48-kHz sampling rate
- RAM: 40 MB (24 MB 1T-SRAM, 16 MB of 100-MHz DRAM)
- Game medium: Proprietary 1.5-GB optical disc
- Controller: Four game controller ports, Wavebird wireless game controller
- Other features:
  - Handle for carrying, Two slots for 4-MB Digicard Flash memory cards or a 64-MB SD-Digicard adapter, High-speed parallel port, Two high-speed serial ports and Analog and digital audio-video outputs.

Xbox
Produced by Microsoft

- Processor: Modified Intel Pentium III
  - 733 MHz
  - Maximum bus transfer rate of 6.4 GB per second
- Graphics: Custom nVidia 3-D graphics chip
  - 250 MHz
  - Approximately 125 million polygons per second
- Audio: Custom 3-D audio processor
- RAM: 64 MB (Xbox has a unified memory architecture -- the memory can be allocated to graphics, audio, textures or any other function as needed.)
- Game medium: Proprietary 4.7-GB DVD
- Modem/network: Media communications processor (MCP), 10/100-Mbps Ethernet, broadband enabled, 56K modem (optional)
- Controller: Four game controller ports
- Other features:
  - 8-GB built-in hard drive, 5X DVD drive with movie playback, 8-MB removable memory card, Expansion port.

Appendix B - The game “Ghost recon”

Ghost recon is a first person shooter game within the action category, is based on a story by Tom Clancy. The official ghost recon game site describes the game (ubi soft entertainment, 2003):

“ War has broken out on the borders of Russia and the fate of the world hangs in the balance. That’s when the call goes out for the Ghosts – an elite handful of specially trained U.S. Army Green Berets, armed with the latest technology and trained to use the deadliest weapons. Their mission: Spearhead the way for a NATO peacekeeping force, and keep the lid on the conflict before it mushrooms… literally.”

The games takes place in Eastern Europe year 2008 (ubi soft entertainment, 2003).

Appendix C - Questionnaire

Name _____

Name of your partner in the exercise: _____

Military occupational speciality: _____

1. How would you describe your gaming experience? (Circle one alternative)

Novice 1 2 3 4 5 6 7 Expert

2. How would you describe our experience of first person shooter games? (e.g. Quake)

Not experienced 1 2 3 4 5 6 7 Very experienced

3. Do you know your 'fire and manoeuvre team' partner?

☐ No, not at all

☐ Yes, since Joint Military Academy

☐ Yes, since basic training

☐ Yes, before basic training

4. Which platform have you mainly used for first-person shooter game? (Please tick one alternative)

☐ PC

☐ Xbox

☐ Playstation 2

☐ Game Cube

☐ None

5. Have you ever played Ghost Recon? (tick one box)

Yes ☐ No ☐ Don't know ☐

6. Which of those listed bellow do you prefer for gaming?

☐ PC

☐ Xbox

☐ Playstation 2

☐ Game Cube

Reason _____

7. a) Which platform do you have at home? (Please tick one or several)

☐ PC

☐ Xbox

☐ Playstation 2

☐ Game Cube

☐ None

7 b) If you have any of those listed above at home, for what purpose do you use it?

☐ Gaming

☐ Gaming in networks (i.e. with/against other people)

☐ Watching movies

☐ Listening to music

Other: _____

8. Do you think it is appropriate to allocate time for gaming and consoles (i.e. Xbox, Playstation2 and/or Game Cube)?

Yes ☐ No ☐

Please comment your answer:

_____

_____

_____

9. How often do you play computer or consol games? (Approximate and choose one row)

_____ hours/day
_____ hours/week
_____ hours/month

☐ never

10. What do you use a computer for?(tick one or more)

☐ Gaming

☐ Sending mail

☐ Word processing

☐ Programming

Other: _____

Appendix D - Questionnaire

Name _____

Name of your partner in the exercise: _____

1. How do you perceive the controller? (Circle one alternative)

Very hard to use	1	2	3	4	5	6	7	Very easy to use

2. Take position in following issues (Circle one alternative)

Comfortable to hold

Very uncomfortable	1	2	3	4	5	6	7	Very comfortable

Placement of buttons

Very bad	1	2	3	4	5	6	7	Very good

Size of buttons

Very bad	1	2	3	4	5	6	7	Very good

Lever

Very bad	1	2	3	4	5	6	7	Very good

Size of controller

Very bad	1	2	3	4	5	6	7	Very good

Vibration effect

Very bad	1	2	3	4	5	6	7	Very good

Colours of buttons

Very bad	1	2	3	4	5	6	7	Very good

Symbols

Very bad	1	2	3	4	5	6	7	Very good

Comments about the controller:

_____

_____

_____

3. *How hard/easy was it to understand what had to be done in the game? (Circle one alternative)*

Very bad 1 2 3 4 5 6 7 Very good

4. *How hard/easy was it to move around in the game?*

Very bad 1 2 3 4 5 6 7 Very good

5. *a) Do you feel that you learned anything during the training?*

Yes ☐ No ☐

5 b) Do you think that what you learned could be applied in other training sessions?

Yes ☐ No ☐

Comments:

_____

_____

_____

6. *How did the work of setting up a tactical plan proceed?*

Very bad 1 2 3 4 5 6 7 Very good

7. *Did you create the tactical plan as you would have done in real life training?*

☐ Yes

☐ No, because of:

_____

_____

_____

8. *Did you follow the tactical plan?*

☐ Yes

☐ No, because of:

_____

_____

_____

9. How was the communication between you and your partner?

Very bad 1 2 3 4 5 6 7 Very good

Comments:

_____

_____

_____

10. Do you thing that your communication during the training was similar to what you would have done in real life training?

Yes ☐ No ☐

Comments:

_____

_____

_____

11. Do you think that the training was instructive?

Yes ☐ No ☐

Comments:

_____

_____

_____

12. Which element(s) do you think you practiced during the gaming session (Please tick one or several)

☐ Problem solving

☐ Decision making

☐ Communication

☐ Giving orders

☐ Cooperation

☐ Judgement

☐ Managing stress

☐ Combat technique

☐ Nothing

Other _____

13. What do you think about the gaming on the platform previously used?(i.e. Xbox, Playstation2 Game Cube or PC) (Please circle one alternative on each row)

Bad overall impression	1	2	3	4	5	6	7	Good overall impression
Very hard	1	2	3	4	5	6	7	Very easy
Very boring	1	2	3	4	5	6	7	Very funny
Very bad	1	2	3	4	5	6	7	Very good
Not exciting	1	2	3	4	5	6	7	Very exiting
Not engaging	1	2	3	4	5	6	7	Very engaging
Not stressful	1	2	3	4	5	6	7	Very stressful
Not motivating	1	2	3	4	5	6	7	Very motivating
Not interesting	1	2	3	4	5	6	7	Very interesting

Appendix E - Questionnaire

Name _____

Name of your partner in the exercise: _____

1. Do you have any comments about how the training sessions differentiated? (PC, Xbox, Playstation2 and Game Cube)

_____

_____

_____

2. *How did you perceive the game? (Please tick one box)*

☐ I have difficulties to image a real life situation

☐ I have some difficulties to image a real life situation

☐ I can image a real life situation

☐ I can easily image a real life situation

3. *Were you affected by the audio sound effects?*

☐ It strengthened my overall impression

☐ It worsen my overall impression…

☐ It does not affect my overall impression

☐ I did not notice any sound effects

4. How did you perceive the interface/layout of the PC?

What was good?

What was bad?

Good overall impression 1 2 3 4 5 6 7 Bad overall impression

5. How did you perceive the interface/layout of the Xbox?

What was good?

What was bad?

Good overall impression 1 2 3 4 5 6 7 Bad overall impression

6. How did you perceive the interface/layout of the Playstation2?

What was good?

What was bad?

Good overall impression	1	2	3	4	5	6	7	Bad overall impression

7. How did you perceive the interface/layout of the Game Cube?

What was good?

What was bad?

Good overall impression	1	2	3	4	5	6	7	Bad overall impression

8. Wh*ich controller do you prefer for gaming? (Please rank your answers where 1 is the best and 4 the worst)*

__ The one to Xbox

__ The one to Game Cube

__ The one to Playstation 2

__ Keyboard and mouse to the PC

Reason:_____

9. Wh*ich platform do you prefer for gaming? (Please rank your answers where 1 is the best and 4 is the worst)*

__ Xbox

__ Game Cube

__ Playstation 2

__ PC

Reason:_____

10. On which platform did you perform your best? (Please rank your answers where 1 is the best and 4 is the worst)

__ Xbox

__ Game Cube

__ Playstation 2

__ PC

Reason:_____

11. Do you think it is appropriate to allocate time for gaming and consoles (i.e. Xbox, Playstation2 and/or Game Cube)?

Yes ☐ No ☐

Please comment your answer:

_____

_____

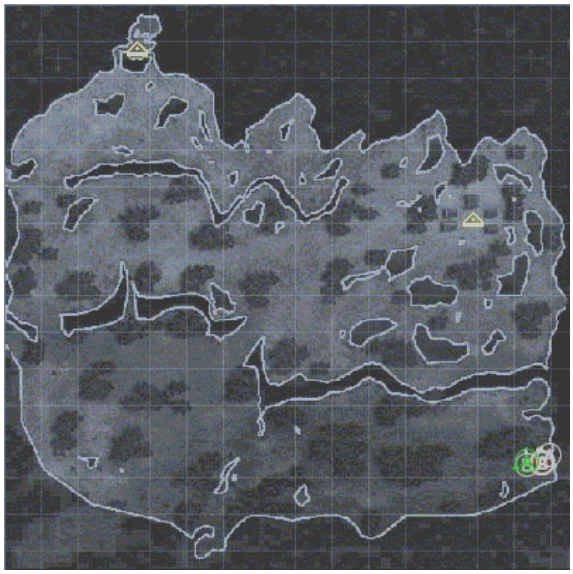
_____

Thank you for your participation

Appendix F – Schedule of participant rotation

	Platformar					
	1:st	2:nd	3:rd	4:th		Name
couple 1	PC	PS 2	Xbox	Game Cube	person 1 person 2	
2	PS 2	Xbox	Game Cube	PC	person 1 person 2	
3	Xbox	Game Cube	PC	PS 2	person 1 person 2	
4	Game Cube	PC	PS 2	Xbox	person 1 person 2	
5	PC	PS 2	Game Cube	Xbox	person 1 person 2	
6	PS 2	PC	Xbox	Game Cube	person1 person 2	
7	Xbox	Game Cube	PS 2	PC	person 1 person 2	
8	Game Cube	Xbox	PC	PS 2	person 1 person 2	
9	PC	Xbox	PS 2	Game Cube	Person 1 person 2	
10	PS 2	Game Cube	PC	Xbox	person 1 person 2	
11	Xbox	PC	Game Cube	PS 2	person 1 person 2	
12	Game Cube	PS 2	Xbox	PC	person 1 person 2	
13	PC	Xbox	Game Cube	PS 2	person 1 person 2	
14	PS 2	Game Cube	Xbox	PC	person1 person 2	
15	Xbox	PC	PS 2	Game Cube	person 1 person 2	
16	Game Cube	PS 2	PC	Xbox	person 1 person 2	
17	PC	Game Cube	PS 2	Xbox	person 1 person 2	
18	PS 2	Xbox	PC	Game Cube	person 1 person 2	
19	Xbox	PS 2	Game Cube	PC	person 1 person 2	
20	Game Cube	PC	Xbox	PS 2	person1 person 2	
21	PC	Game Cube	Xbox	PS 2	person 1 person 2	
22	PS 2	PC	Game Cube	Xbox	person 1 person 2	
23	Xbox	PS 2	PC	Game Cube	person1 person 2	
24	Game Cube	Xbox	PS 2	PC	person1 person 2	

Appendix G - Maps for restarts



Platform:

Name:

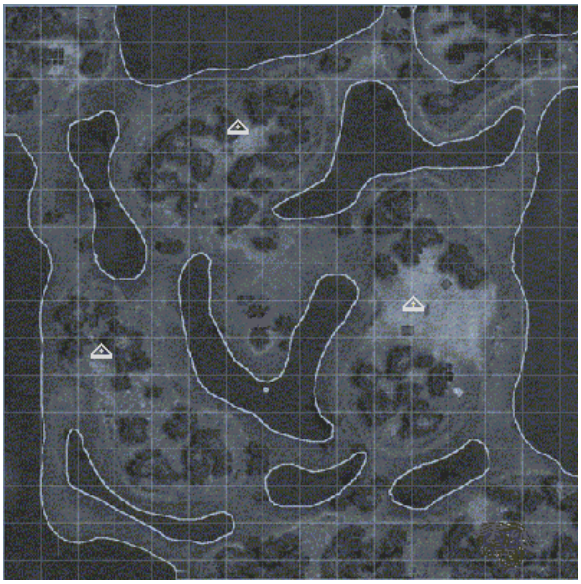
Start	
1	
2	
3	
4	
5	

Fulfilled objectives:

☐ First

☐ Second

☐ Third



Platform:

Name:

Start	
1	
2	
3	
4	
5	

Fulfilled objectives:

☐ First

☐ Second

☐ Third