Usability of Virtual Worlds

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Abstract. In recent years virtual worlds left their origins driven by new technologies. As a consequence 3D-based environments moved into business related domains and are used e.g. to support virtual meetings or product presentations. However, enterprises have to consider that a large share of companies' employees still fits to the definition of so-called digital immigrants. While younger employees are familiar with the usage of 3D-based environments, navigating in virtual rooms might be challenging for digital immigrants. This could limit the usage of virtual worlds for business related contexts. We therefore conducted usability tests with digital immigrants in virtual worlds and analyzed their experiences. Our results show that in fact digital immigrants face problems when using virtual worlds. Based upon our study we discuss how to improve the usability of virtual worlds for this group of users.

Keywords: Virtual worlds, usability, digital immigrants.

1 Introduction

In the last decade, virtual worlds (VW) faced a tremendous media hype, primarily focused on Second Life, which has been followed by a strong decline of interest. Widely unrecognized, platforms like HabboHotel now have more than 200 million users and outpace pioneers such as Second Life or Twinity. Moreover, open source solutions were developed, which begin to solve major problems of virtual worlds such as high access barriers and outdated graphic engines.

Generally, virtual worlds are characterized by social interconnectedness and generation of content by users [1, 2]. Virtual worlds differ from other social media platforms by embedding those properties in a virtual 3D-context and by extending them through a wide range of interaction possibilities (bridging of geographical and physical barriers) [3–8]. Although literature does not provide a single definition for VWs, contemporary VWs are generally characterized as graphical, persistent and immersive environments which facilitate interaction among users who are represented as avatars [9-12].

People that are located at different geographical places can use virtual worlds as a platform to collaborate with each other in a common environment, e.g. for purposes of business [13] or learning [14, 15]. The users act through avatars in three-dimensional spaces [11]. Compared to other social media applications, VWs impose higher requirements to the technical skills of users due to the navigation in

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three-dimensional spaces. Social media applications and therefore also virtual worlds increasingly emerge in everyday work to a certain degree and are thus not solely used by technophile persons (digital natives) but also increasingly by digital immigrants or visitors being dependent on an efficient usage during their work. The usage, or respectively the usability of VWs as well as of other software systems, constitutes an important criterion for the acceptance by users and eventually the successful usage [16].

In this article we address the question to what extent user guidance in VWs is suited for the target group of digital immigrants. Therefore, we evaluated an exemplarily virtual world and conducted usability tests. We considered the level of knowledge of the participants and identified problems participants faced when navigating in this virtual world [17–19].

The remainder of the paper is structured as follows. First, we provide a literature review concerning digital immigrants. Afterwards in chapter 3 we describe the research design. In chapter 4 the results of the usability test are discussed. The article ends with a conclusion and discussion of following research.

2 Technology Skills of Digital Immigrants

Prensky used the terms “digital native” and “digital immigrant” in an article about the differences between various age groups and their interactions with technology [20]. He proposes that younger people tend to be digital natives due to their exposure to information and communication technology from an early age on. As a result these young individuals require multiple streams of information, prefer inductive reasoning and want frequent and quick interactions with content. In contrast, older people, even those remaining current with technological advances, are labeled as digital immigrants. Methodologically, digital immigrants prefer consecutive, step-by-step instructions rather than parallel information channels with random access. This general division through age is challenged by other scholars, arguing that it is simplistic and problematic. Despite growing up in a society with digital technology being highly integrated into everyday life, a significant proportion of young people is not adept with technology [21, 22].

White provides an alternate differentiation, redefining digital natives and digital immigrants as “residents” and “visitors” [23]. This categorization is based on motivation rather than age. Residents shift a proportion of their social life into the digital environment by maintaining profiles on social networking platforms. Visitors, on the other hand, view technology as a tool to attain their goal, such as information research, rather than as a communication platform to express themselves. They are however not averse to using e-mail or instant messaging. White emphasizes that the distinction between residents and visitors is gradual rather than binary [23]. Individuals may be able to place themselves at a particular point along this continuum rather than in one of two boxes.

According to Oblinger and Oblinger, one of the defining characteristics that separates digital natives from digital immigrants is that the natives are more comfortable

in image-rich environments and have advanced visual-spatial skills through the influence of computer games [24].

Previous studies conducted to examine the usability and likeability of educational virtual reality games concluded that issues, such as false handling of user interfaces or navigational problems, mainly affect novice users. However, these issues did not discourage them from playing the game. Moreover, the likeability of a virtual reality game was found to be proportional to the level of sophistication of that game [25].

Usability tests in virtual worlds using the constructivist theory identified several usability issues. The three main problems concerned lag time, which prohibited complex tasks, inconvenient avatar maneuverability, which affected new users in particular, and unhelpful sounds, which represented a distraction to the user. Additionally confusing messages as well as irreversible actions constituted problems [26].

3 Usability Test

Methodologically, the measurement of usability and user skills in our study is based on empirical research. In 2011 we investigated the behavior of 5 digital immigrants using the virtual world Second Life (as a representative for virtual worlds). A survey has been conducted before and after the usability test to gain demographic information, to measure the technology skills of the participants concerning social media and 3D-environments, and to observe usage behavior of the participants based on specific tasks that had to be fulfilled. The results were documented via an audio recording as well as a screen capture of each participant. The user-tests were conducted with the same PCs and the viewer. The test for each participant was performed separately in a quiet room. In a first step a method to evaluate the usability in dependency of the skills of digital immigrants was chosen. In a second step, based on the DIN EN ISO 9241 specification, concrete task for the usability test were created.

3.1 Methods

In literature several methods for empirical usability research are discussed. One of the most common methods is known as *thinking-aloud*. The basic principle is that participants solve tasks on the system to be examined, while continuously speaking out their thoughts. The verbalization of thoughts gives insight into the perspective of the user and developers have the possibility to identify misinterpretations [27, 28].

Another method is *constructive interaction*, sometimes also referred to as *co-discovery learning*. It has similarities to the *thinking-aloud* approach, however, participants elaborate on the tasks as a team while exchanging their thoughts. In contrast to the *thinking-aloud* method, people find this approach more natural since they have a counterpart to speak to. As a downside, different problem solving strategies may conflict with each other. Moreover, this method requires at least twice the amount of participants, thereby raising the costs of the entire procedure [29].

Traditionally, the test conductor remains neutral and does not interfere during testing. The *coaching method*, though, encourages participants to ask questions to the conductor, who in return responds with appropriate instructions. By hearing typical user questions, problems are identified and help documentation can be designed accordingly [30].

Websites and interfaces are often only briefly noticed. Therefore the view has to be quickly drawn to the relevant aspects. *Eye-tracking* is a method of analyzing the attention span that a user gives to these aspects. Based on measurements of the viewing directions and movements, user interfaces can be evaluated according to the distribution of attention. However, due to the technical complexity it is rather seldom implemented, but nevertheless a very insightful method [31].

This usability test was conducted based on the methods *thinking-aloud* in conjunction with the *coaching method*. This combination was chosen in order to gain insight into the actions of the users while at the same time discovering information needs. Afterwards a discussion was held between the test conductor and the participants, in which the participants evaluated their experiences retrospectively.

3.2 Conception of Tasks

The usability test was designed according to criteria based on the DIN EN ISO 9241 (ISO 9241). The ISO 9241 generally deals with aspects of human-computer-interaction. Its origins, though, are rooted in applications for office work and have evolved historically. The norm comprises seven principles that act as guidelines for the design of dialogues between humans and information systems:

- Suitability for the task: the dialogue is suitable for a task when it supports the user in the effective and efficient completion of the task.
- Suitability for learning: the dialogue is suitable for learning when it supports and guides the user in learning to use the system.
- Suitability for individualization: the dialogue is capable of individualization when the interface software can be modified to suit the task needs, individual preferences, and skills of the user.
- Conformity with user expectations: the dialogue conforms with user expectations when it is consistent and corresponds to the user characteristics, such as task knowledge, education, experience, and to commonly accepted conventions.
- Self-descriptiveness: the dialogue is self-descriptive when each dialogue step is immediately comprehensible through feedback from the system or is explained to the user on request.
- Controllability: the dialogue is controllable when the user is able to initiate and control the direction and pace of the interaction until the point at which the goal has been met.
- Error tolerance: the dialogue is error tolerant if despite evident errors in input, the intended result may be achieved with either no or minimal action by the user. (DIN EN ISO 9241, 1992 - 2006)

The transferability of all criteria to virtual worlds had to be carefully examined, since certain characteristics of a virtual world, such as the freedom of scope for players, differentiated them strongly from conventional applications that were developed for a specific task. Standardized questions concerning individualization were not suitable for this usability test and were therefore excluded.

Generally, there are many aspects to consider in the development of tasks. The tasks should have a high relation to the real deployment. It is recommendable to include all relevant areas into the task creation. The first task should be kept simple, whereas the rest should not be too trivial and manageable in a reasonable time [30]. Tasks are frequently chosen according to the following criteria:

- First impression (look and feel of the program)
- First tasks (to determine whether a user considers the program generally as easy or difficult to use)
- Most executed activities
- Critical tasks (even if executed infrequently)
- Specific problem areas (usually identified by customer or through heuristic evaluation)
- New functions that were added to a program or changed from previous versions (including changes based on previous usability tests) [32]

Under consideration of these criteria 10 tasks were developed, which covered basic movements, orientation in the virtual environment, communication, interaction with objects within the VW, and adjustment of the avatar's appearance. The tasks started with relatively simple instructions so that users would get acquainted with the navigation of the avatar and get a feeling of movement within the VW. The subsequent tasks instructed them to locate other avatars in their vicinity and communicate to them via chat. Further tasks involved teleportation to different locations, interaction with objects, such as using elevators, and adjusting the appearance of the avatar either through changes in clothing or the body.

4 Results

4.1 Knowledge of Participants

The test persons had no prior experiences with virtual worlds. Moreover, participants were selected that showed typical characteristics of a digital immigrant. The first questionnaire acquired demographic information and determined the computer skills. The average age was 35 (min: 23 max: 48). All of the participants were employees working in office jobs. It was also noted in the questionnaire that on average the participants spent 2 hours a day on the computer in their leisure time. Main activities included communication and news as well as general information research. Online shopping and photo and video editing were also relevant use cases. Games, on the other hand, were hardly played.

4.2 Evaluation of the System

The questionnaire we conducted afterwards, contained questions that were linked to the criteria of the ISO 9241. We analyzed raw data by measuring the mean value and the standard deviation of each question of a criterion. The scale ranged from 1 to 7. A higher score indicated a better performance of the software in that category. The results are summarized in the graph below (see Table 1.)

Table 1. Evaluation of the virtual world according to ISO 9241

ISO-Criterion	Mean	Standard deviation
Suitability for the task	4,50	1,18
Self descriptiveness	3,27	1,62
Conformity with user expectations	4,00	1,37
Suitability for learning	4,40	1,60
Controllability	4,60	1,21
Fault tolerance	3,95	1,41
Total	4,12	1,40

Generally, the virtual world was assessed as being neutral to positive. The category self descriptiveness, however, is characterized by a low mean. The conformity with user expectations as well as the fault tolerance was also rated as relatively low. These categories are further analyzed in the next section.

4.3 Usability Issues

Our analysis shows that participants misinterpreted or ignored certain functions in the menu repeatedly due to their insufficient labeling. E.g. the term “IM (Instant Messaging)” was not understood by most of the participants or a “click to chat”-box remained unused despite its prominence in the menu. Participants tried to chat via the “speak” function instead, which turned out ineffective since this function concealed the voice-speak feature. The meaning of a profile and its comment function was misinterpreted as chat.

In the navigational menu, which was controlled via mouse, it was only apparent that an arrow had to be clicked but not that while holding down the mouse button several arrows could be simultaneously activated which would have enabled a smoother movement.

A more critical issue was revealed when it came to changing the avatar’s appearance. The menu for changing the appearance was found quickly and seemed easy to use at first. Within the main menu there were several submenus, which had a similar look but different functions which were not intuitive. Clicking with the left mouse button often led to no effect. In order to open the respective options menu several clicks were needed. Furthermore, objects in the list for clothing were shown which could not be deployed. Through respective icons, such as the “+”-symbol, however, participants mistakenly assumed they were immediately deployable.

Limited server capacities resulted in delayed loadings. Some clothes did not load until a long time into the test which irritated users. Also some objects were not rendered any longer when the distance was too far. This became a problem when an avatar was flying in a certain height and all of its reference points vanished.

Furthermore, no mechanisms were provided to intercept mode errors. If a user has activated a specific function, such as the chat, and tries to navigate the avatar through his keyboard, the action will remain ineffective since the keyboard only works within the chat. The same issue appears once the map is opened. All keyboard commands are directed to the menu of the map. The user only realizes this when his actions have false results. The results of the usability test with respect to prior knowledge are depicted summarizing in the following:

- Problems to find menu bars despite daily usage of software and the Internet.
- Motivation for usage was high and potentials for distributed teams were recognized, mechanisms of the classical web could be transferred to virtual worlds.
- The movement and navigation was perceived as being easy and intuitive (some of the participants already had experiences with video games).
- High correlation between the regular usage of social media elements and the communication in virtual worlds has been identified (IM, VoIP).
- Breaking geographical and physical laws (e.g. flying) gives participants pleasure despite no prior experiences.
- Rapid movements were perceived as being unpleasant.

5 Conclusion

In summary we can state that digital immigrants are used to use traditional web features but lack skills in using game-based functionalities in virtual worlds. Despite the limited gaming experiences, the users quickly adjusted to the navigation via keyboard buttons. After a short learning phase they had acquired the proficiency to control their avatars fluently. The control via mouse (by clicking on direction arrows) on the other hand caused more problems. The avatar's motions were more abrupt and took more time to handle. When using the first-person-perspective the mouse reacted very sensitively resulting in rapid movements in the perspective. These were perceived as unpleasant and criticized by most users.

In contrast to this, the breaking of geographical and physical laws (e.g. flying or teleportation) gave participants pleasure despite no prior experiences. However, flying too high resulted in the loss of orientation points on the ground which caused the avatar to get lost. The same problem occurred when avatars got teleported to unknown locations far away from their origin. Without any hints of how to return to their original position, users were left confused.

Interesting is that, although the digital immigrants have experiences in using 2D-based software systems, they had problems to find menu bars in Second Life. This became apparent in particular when trying to find and communicate to other users. Nonetheless, participants learned how to control several functions within a short period of time and were highly motivated in the execution of the tasks.

It has to be mentioned that, based on the data, certainly no general statements can be concluded. Future research activities could be based on a bigger sample size. The research discussion profits from a first juxtaposition of skills and requirements for the usage of virtual worlds by digital immigrants. For practice, on the one hand, implications for the design of 3D-environments could be derived. Based on our results, companies could decide more differentiated whether the use of virtual worlds can generate advantages based on the available human capital. This can be validated based on the target group profile in this study and the skills of the employees.

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