Usability Heuristics for Virtual Worlds

Cristian Rusu[1], Roberto Muñoz[1,2], Silvana Roncagliolo[1], Sebastian Rudloff[1], Virginica Rusu[3], Arturo Figueroa[1]

[1]Pontificia Universidad Catolica de Valparaiso,
Valparaiso, Chile
e-mails: cristian.rusu@ucv.cl, roberto.munoz.s@mail.pucv.cl, silvana@ucv.cl, sebastian.rudloff.p@mail.pucv.cl, arturo.figueroa.r@mail.pucv.cl

[2]Universidad de Valparaiso,
Valparaiso, Chile
e-mail: roberto.munoz.s@uv.cl

[3]Universidad de Playa Ancha,
Valparaiso, Chile
e-mail: virginica.rusu@upla.cl

***Abstract*— Usability evaluation for applications based on emerging information technology brings new challenges. Virtual Worlds (VWs) are computer-simulated virtual environments accessed by multiple users, through their avatars. VWs constitute a growing space for collaborative play, learning and work. When evaluating VWs' usability, there is a need for new evaluation methods or at least for the use of traditional evaluations in novel ways. A set of heuristics is proposed, in order to help the usability evaluations of VWs applications.**

Keywords- usability; usability heuristics; virtual worlds

I. INTRODUCTION

Virtual worlds (VWs) are computer-based simulated persistent spatial environment that supports synchronous communication among users, who are represented by avatars [1]. Users have to choose or create theirs avatars, which will be able to interact with objects, the virtual environment and other avatars. Avatar's identity frequently differs from user's identity.

VWs are a growing space for collaborative play, learning and work. Usually researches focus on the use of VWs and the phenomenon they represent; it is hard to find studies on VWs' usability, especially on VWs' usability evaluation methodology.

The ISO/IEC 9241 standard defines the usability as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use [2]. Usability evaluation methods are commonly divided into inspection and testing methods. Inspection methods find usability problems based on the expertise of usability professionals. Testing methods find usability problems through the observation of the users while they use (and comment on) a system interface [3].

Heuristic evaluation is a widely used inspection method [4] [5]. A group of evaluators (usually from three to five) inspect the interface design based on a set of usability heuristics. In order to ensure independent and unbiased evaluations, the inspection is performed individually. After all individual evaluations have been completed, the evaluators are allowed to communicate and have their findings aggregated in a single list of usability problems. Later on, each evaluator assigns scores to each problem's severity and frequency (on a 0 to 4 scale, from minor/less frequent to major/more recurrent). Severity and frequency are summed in order to get problem's criticality. Problems are ranked based on their average severity, frequency and criticality. The usability evaluation report includes usability problems, solution proposals, as well as positive findings.

Heuristic evaluation is easy to perform, cheap and able to find many usability problems (both major and minor problems). However, it may miss domain specific problems. That is why the use of appropriate heuristics is highly significant.

Usability evaluation for applications based on emerging information technology brings new challenges. Is it the classical concept of usability still valid? Which are the dimensions of the (new) usability? How can it be measured? How should we develop for (better) usability? There is a need for new evaluation methods or at least for the use of traditional evaluations in novel ways [6].

The paper focuses on usability evaluation of VWs applications, by heuristic evaluations. A set of 16 specific usability heuristics is proposed. Section 2 presents the methodology that has been used in heuristics' development. Section 3 highlights the main characteristics of VWs. The VWs usability heuristics proposal is presented in Section 4. Section 5 shows the proposal's preliminary validation. Section 6 presents preliminary conclusions and future works.

 ISBN: 978-1-61208-148-9

II. DEFINING VIRTUAL WORLDS USABILITY HEURISTICS

In order to develop usability heuristics for VWs, a specific methodology was applied [7]. The methodology to establish new usability heuristics includes 6 stages:

- STEP 1: An *exploratory* stage, to collect bibliography related with the main topics of the research: specific applications, their characteristics, general and/or related (if there are some) usability heuristics.
- STEP 2: A *descriptive* stage, to highlight the most important characteristics of the previously collected information, in order to formalize the main concepts associated with the research.
- STEP 3: A *correlational* stage, to identify the characteristics that the usability heuristics for specific applications should have, based on traditional heuristics and case studies analysis.
- STEP 4: An *explicative* stage, to formally specify the set of the proposed heuristics, using a standard template.
- STEP 5: A *validation* (experimental) stage, to check new heuristics against traditional heuristics by experiments, through heuristic evaluations performed on selected case studies, complemented by user tests.
- STEP 6: A *refinement* stage, based on the feedback from the validation stage.

Based on the well-known and widely used Nielsen's 10 heuristics, and extensively analyzing several VWs case studies (*Second Life, Club Penguin, Habbo Hotel, World of Warcraft, Ragnarok Online, ScienceSim*), a set of 16 new usability heuristics was developed for heuristic evaluations of VWs applications.

The methodology was applied iteratively; the set of new heuristics was refined in various steps. A specific usability checklist was also developed, detailing usability heuristics, in order to help the evaluation practice.

Section 3 synthetizes the findings of STEP 1 and STEP 2. Section 4 presents the results of STEP 3 and STEP 4. It specifies the refined heuristics proposal (based on STEP 5 and STEP 6). Section 5 presents the main results of STEP 5.

III. VIRTUAL WORLDS CHARACTERISTICS

Nowadays VWs have a wide range of applications almost everywhere: organizations, educations, entertainment, training, virtual communities, e-commerce, scientific research, etc. There is no unique, widely accepted VWs' classification. Based on Porter's proposal (2004), Messinger, Stroulia and Lyons (2008) proposed a set of criteria, in order to establish the VWs typology [8] [9]:

- *Purpose* (content of interaction): The VW may be age focus, content focus, or open.
- *Place* (location of interaction): Players may be collocated or geographically dispersed.
- *Platform* (design of interaction): Communication may be synchronous, asynchronous, or both.
- *Population* (pattern of interaction): Is defined by the group's size, social ties, and characteristics of the target user market.
- *Profit model* (return on interaction): The VW may support single purchase price/registration fee, fee per use, subscription – based, advertising – based, pay – as you – go extras, and sale of ancillary products.

Some common features of VWs may be identified:

- *Avatar*: Each user is represented by its own (and only) avatar.
- *World's rules*: Each VW has its own unbreakable (physics) rules.
- *Shared environment*: A VW is shared by many users.
- *Interaction and communication*: User – user (through their avatars) and user – world interactions take place in real time.
- *Persistency*: The VW is (partially) persistent, regardless if individual users are logged in or out.
- *Customization*: VWs allow users to alter, develop, build, or submit customized content.
- *Graphic environment*: VWs offer computer-based graphic 2D, 2.5D or 3D environments.

Usability evaluations specifically focus on users, their needs and goals, and not on the inner part of the interactive software systems. Therefore, usability heuristics for VWs are meant to evaluate such products from the user perspective. As VWs are usually distributed systems, it is assumed that a set of basic (hardware, network, and platform related) requirements have to be accomplished. If not, the evaluation of applications' usability will be very difficult or even impossible.

IV. A VIRTUAL WORLD USABILITY HEURISTICS PROPOSAL

VWs usability heuristics were specified using the following template:

- *ID, Name and Definition*: Heuristic's identifier, name and definition.
- *Explanation*: Heuristic's detailed explanation, including references to usability principles, typical usability problems, and related usability heuristics proposed by other authors.
- *Examples*: Examples of heuristic's violation and compliance.
- *Benefits*: Expected usability benefits, when the heuristic is accomplished.
- *Problems*: Anticipated problems of heuristic misunderstanding, when performing heuristic evaluations.

The 16 proposed usability heuristics were grouped in three categories: (1) *Design and Aesthetics*, (2) *Control and*

 ISBN: 978-1-61208-148-9

Navigation and (3) *Errors and Help*. A summary of the proposed heuristics is presented below, including heuristic's ID, name and definition.

Design and Aesthetics Heuristics:

(H1) *Feedback*: A VW interface should keep user informed on both avatar's state, and the relevant facts and events that affect him.

(H2) *Clarity*: A VW should offer an easy to understand user control panel, using clear graphic elements, text and language, grouping elements by their purposes, and offering easy access to the main functionality.

(H3) *Simplicity*: A VW should provide easy and intuitive interaction with the environment's virtual objects. Only relevant information should be given, in order to avoid the control panel's overload.

(H4) *Consistency*: A VW should be consistent in using language and concepts. Avatar's actions and their effects on the VW's environment should be coherent and consistent. User – avatar, as well as avatar – VW's objects, should be consistent.

Control and Navigation Heuristics:

(H5) *Low memory load*: A VW should maintain main objects, options, elements and actions always available or easy to get to. It should provide ways to mark and remember places already visited and/or of user's interest.

(H6) *Flexibility and efficiency of use*: A VW should provide customizable shortcuts, abbreviations, accessibility keys or command lines. The user interface/control panel should be customizable.

(H7) *Camera control*: A VW should give user control over camera, allowing a customizable user's view.

(H8) *Visualization*: A VW should give user control over the objects and visual effects that he/she will get visible.

(H9) *Avatar's customization*: A VW should allow fully avatars' customization.

(H10) *Orientation and navigation*: A VW should provide full (customizable) information on avatar's position, paths to a desired destination, and passage ways from one position to another (according to VW's rules).

(H11) *World interaction*: A VW should clearly indicate the objects that user may interact with, as well as the actions that user may perform over the objects.

(H12) *World's rules*: A VW should clearly indicate its own rules and the rules that govern avatars, especially the actions that are impossible in the real (user's) world, but are possible in the VW (and vice versa).

(H13) *Communication between avatars*: A VW should allow easy communication among users, through their avatars.

Errors and Help Heuristics:

(H14) *Error prevention*: A VW should prevent users from performing actions that could lead to errors, and should avoid confusions that could lead to mistakes, during user – control panel interaction, as well as during (user's) avatar – VW interaction.

(H15) *Recovering from errors*: A VW should provide user appropriate mechanisms to recover from errors, and exit ways from unwanted situations. It should include clear messages, hopefully indicating causes and solutions for errors.

(H16) *Help and documentation*: A VW should provide an easy to find, easy to understand, and complete online documentation, accessible from both inside and outside of the world itself.

Table 1 presents the mapping between VWs 16 heuristics and Nielsen's 10 heuristics [5].

TABLE I. MAPPING BETWEEN VIRTUAL WORLDS HEURISTICS AND NIELSEN'S HEURISTICS

Virtual Worlds Heuristics		**Nielsen's Heuristics**	
ID	***Definition***	***ID***	***Definition***
H1	Feedback	N1	Visibility of system status
H2	Clarity	N2	Match between system and the real world
H3	Simplicity	N8	Aesthetic and minimalist design
H4	Consistency	N4	Consistency and standards
H5	Low memory load	N6	Recognition rather than recall
H6	Flexibility and efficiency of use	N7	Flexibility and efficiency of use
H7	Camera control	N3	User control and freedom
H8	Visualization		
H9	Avatar's customization		
H10	Orientation and navigation		
H11	World interaction	Various	
H12	World's rules		
H13	Communication between avatars		
H14	Error prevention	N5	Error prevention
H15	Recovering from errors	N9	Help users recognize, diagnose, and recover from errors
H16	Help and documentation	N10	Help and documentation

VWs usability heuristics H1, H2, H3, H4, H5, and H6 particularize Nielsen's heuristics N1, N2, N8, N4, N6, and N7 (respectively), based on the VWs' characteristics.

Heuristics H7, H8, H9 and H10 are related to Nielsen's N3 heuristics. "*User control and freedom*" was detailed, considering relevant VWs aspects: visualization

customization and navigation through the virtual environment.

Heuristics H11, H12 and H13 have no direct one – to – one relation to Nielsen's heuristics. They may be related to various Nielsen's heuristics (in different degrees of relevance).

Finally, heuristics H14, H15 and H16 put Nielsen's heuristics N5, N9 and N10 (respectively) into the context of VWs.

Based on the experiments made up to the date, the nature of the usability problems identified when applying VWs usability heuristics, and the problems that some evaluators had when applying such heuristics, a usability checklist was defined. It details the set of 16 heuristics and helps their use in heuristic evaluation practice. The checklist includes a total of 49 items (from 2 to 5 items per heuristic).

V. VALIDATING THE PROPOSAL: EARLY EXPERIMENTS

The 16 proposed VWs usability heuristic were checked against Nielsen's 10 heuristics, using *Club Penguin* as case study.

Club Penguin is a VW designed for 8-14 year olds children, a place where they can play games, have fun and interact with each other [10]. Users' avatars are penguins. Each player chooses a penguin, gives it an identity, and explores *Club Penguin*, interacting with other penguins by chatting, playing games, sending greeting cards, or using emoticons and actions (i.e. wave, dance, sit, walk or throw a snowball). By playing games, players earn virtual coins which they can eventually use to buy clothing and accessories for their penguin or furniture for their igloo.

Club Penguin was examined by two groups of 3 evaluators each. All 6 evaluators had similar (medium) experience in heuristic evaluations (with Nielsen's heuristics), but no experience in usability evaluation of VWs. The first group performed a heuristic evaluation of *Club Penguin* using only VWs usability heuristics, while the second group performed a similar heuristic evaluation, but using only Nielsen's heuristic.

A total of 52 problems were identified by the 6 evaluators. More usability problems were captured using VWs usability heuristics than using Nielsen's heuristics:

- 14 problems (26.9%) were identified by both groups of evaluators,
- 22 problems (46.2%) were identified only by the group which used VWs usability heuristics,
- 14 problems (26.9%) were identified only by the group which used Nielsen's heuristics.

The results seem to prove that VWs usability heuristics work better than Nielsen's heuristics. However, these are preliminary results, and more experiments are necessary. The experiments provided an important feedback for VWs usability heuristics (and the associated checklist) refinement.

VI. CONCLUSION AND FUTURE WORKS

VWs have nowadays a wide range of applications. Research usually focuses on VWs' use and the phenomenon they represent. There is a need for new usability evaluation methods or at least usability evaluations should be particularized for VWs applications.

A set of 16 specific usability heuristics and an associated (49 items) usability checklist were developed. Early validation proved their usefulness and potential. However, more experiments are necessary.

A right balance between specificity and generality should be follow. If heuristics are too specific, they will probably become hard to understand and hard to apply. General heuristics, complemented by specific usability checklists, will probably work better, most of the time.

ACKNOWLEDGMENT

The authors would like to thank to all the participants involved into the experiments that the present study required. The work was highly supported by the *School of Informatics Engineering* of the *Pontifical Catholic University of Valparaiso – Chile*, especially by the members of *"UseCV" Research Group in Human – Computer Interaction*.

REFERENCES

[1] Y. Jung and H. Kang, "User goals in social virtual worlds: A means-end chain approach", Computers in Human Behavior, vol. 26 (2010), pp. 218–225.

[2] International Organisation for Standardisation, ISO 9241, "Software Ergonomics Requirements for office work with visual display terminal (VDT)", Geneva, 1998.

[3] R. Otaiza, C. Rusu, and S. Roncagliolo, "Evaluating the Usability of Transactional Web Sites", Proc. 3rd International Conferences on Advances in Computer-Human Interactions (ACHI 2010), IEEE Press, pp. 32-37, ISBN-13: 978-0-7695-3957-7, 2010.

[4] J. Nielsen, "Usability Engineering", Morgan Kaufmann Publishers, 1993.

[5] J. Nielsen, "Ten Usability Heuristics", Available at www.useit.com/papers/heuristic/heuristic_list.html (last access 21/03/2011).

[6] C. Wiberg, K. Jegers, and H. Desurvire, "How Applicable is Your Evaluation Methods – Really?", Proc. 2nd International Conferences on Advances in Computer-Human Interactions (ACHI 2009), IEEE Press, pp. 324-328, ISBN: 978-1-4244-3351-3, 2009.

[7] C. Rusu, S. Roncagliolo, V. Rusu, and C. Collazos, "A Methodology to establish usability heuristics", Proc. 4th International Conferences on Advances in Computer-Human Interactions (ACHI 2011), IARIA, pp. 59-62, ISBN: 978-1-61208-003-1, 2011.

[8] C. Porter, "A Typology of Virtual Communities: A Multi-Disciplinary Foundation for Future Research", Journal of Computer-Mediated Communication, vol. 10/1 (2004), DOI: 10.1111/j.1083-6101.2004.tb00228.x.

[9] P. Messinger, E. Stroulia, and K. Lyons, "A Typology of Virtual Worlds: Historical Overview and Future Directions", Journal of Virtual Worlds, vol. 1/1 (2008), ISSN 1941-8477, Available at http://jvwresearch.org (last access 21/03/2011).

[10] "What is Club Penguin?", Available at www.clubpenguin.com (last access 21/03/2011).

 ISBN: 978-1-61208-148-9