Evaluating Computer Games for Children: Exploring Fun through the Concept of Flow

Mikael B. Skov, Michal Gajos, Jeanette D. Thomsen
Department of Computer Science, Aalborg University
Fredrik Bajers Vej 7, 9220 Aalborg East, Denmark
{dubois, gajos, jdahl}@cs.aau.dk

Abstract

This paper reports from an experiment on evaluating enjoyment of children playing computer games. The experiment involved 40 children playing the same computer game in different conditions. In order to measure enjoyment, we adapt the concept of flow that characterizes a state of consciousness experienced by people who are deeply involved in an enjoyable activity. Our results show that children playing the same game in the same physical context perceive the playing situation as more challenging than children playing in separate contexts. On the hand, the same children find it more appealing and fun to play and race against other children when they are located in the same physical context.

Keywords

Computer games, enjoyment, flow, children

INTRODUCTION

The causes and effects of enjoyment in computer usage is still insufficiently explored and studied as research topics (Pace, 2004). During the last years, enjoyment (or fun) has become increasingly more important as technologies no longer mainly support work-related activities, but contemporary technologies are profoundly used to support different leisure-based activities. Enjoyment in computer usage challenges traditional and well-established techniques for evaluating software products as these primarily address aspects of efficiency and effectiveness (Nielsen, 1993). However, Lindgaard (1999) states that these measures often are inadequate when evaluating more leisure-based technologies in her case web-sites, and she continues that we need tools to assess likeability and user satisfaction. Carroll and Thomas (1998) continue by stating that we need to develop research programmes in fun and motivation of user interfaces.

Children constitute a segment of contemporary computer users that use software for enjoyment (Gorriz and Medina, 2000). Children use different kinds of software technologies for enjoyment, e.g. computer games for individual or collaborative entertainment and educational technologies for learning or training. Children are currently emerging as a frequent and experienced user population (Druin, 1999). Even though several studies explore the involvement of children in the development of software technologies, cf. (Ellis and Bruckman 2001, Lester et al. 1997), less effort has been put into studies on enjoyment of children's technologies.

This paper reports from an experiment on evaluating enjoyment of children playing computer games. The experiment involved 40 children playing the same computer game in different conditions. In order to evaluate enjoyment, we adapted the concept of flow, cf. (Czikszentmihalyi, 1975), as a measure for enjoyment. Flow can be understood as a state of consciousness experienced by people who are deeply involved in an enjoyable activity (Pace, 2004). Arts (1996) continues and defines flow as the state in which people experience happiness. In the following section, we outline the experimental design of the study (including how we assessed flow), section 3 presents preliminary results, while section 4 discusses and concludes on these results.

METHOD

The objective of the study was primarily to explore how enjoyment of children's computer game playing can be measured. We adapted a situation where the children should play and compete against each other through a computer game. Therefore, we applied two different conditions for the playing sessions. The first condition, referred to as the physical condition, had the children playing the game in the same room allowing them to interact directly during play. The second condition, referred to as the virtual condition, had the children playing against each while in different rooms disallowing them to interact directly during play. Druin et al. (1997) argue that children naturally want to be with other children and children will constantly, despite the technology offered, form around one piece of technology, e.g. a desktop computer. We wanted to explore effects of this aspect of children's computer usage and to see how this potentially affects enjoyment.

Subjects: 40 children (14 girls and 26 boys) in the age of 11-15 years (mean=13.0, SD=1.6) participated as test subjects in the study. The children were all 5th or 7th grade pupils from one of four different primary schools in the greater Aalborg area, Denmark. The children did not receive compensation for their involvement in the study. The children formed all pairs themselves (thus all pairs knew each other in advance). Pairs were then randomly assigned to one of the two conditions making that 20 children played the computer game in the physical condition and 20 children played in the virtual condition. All the children except 3 girls had significant experience with computer games where almost half of the children, mainly boys, played computer games for more than one hour every day. The children mostly played as a single player at home.

System: The Need for Speed – Hot Pursuit 2 (NfS2) racing game was chosen for our study for several reasons. First of all, it aims at a broader audience at different ages including both girls and boys. Secondly, NfS2 is multiplayer computer game allowing more players to race against each other at the same time. This enabled us to explore any similarities and/or differences between the physical and virtual conditions. Thirdly, NfS2 is fairly straight-forward in the sense that it allocates immediate use and play without prior experience and relatively quick provides the opportunity to begin to race against each other.

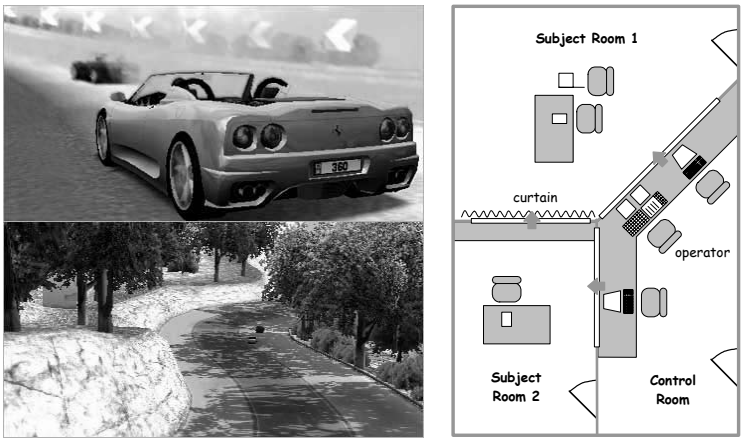

Figure 1: Illustrations from Need for Speed and the usability laboratory with separate subject rooms – children in the physical condition were placed in room 1 while children in the virtual condition were placed both rooms.

Procedure: Prior to the test sessions, all participating children had received a consent and information sheet that was to be signed by their parents or another guardian. The evaluation sessions took place at the usability lab at Aalborg University. This lab includes two separate test rooms and a control room allowing us to adapt the two conditions (see figure 1). The children arrived at the usability lab and were given an introduction to the test. They were told that they solve a number of assignments in computer game NfS2 and they were told that they should play against each other. They were not required to think-aloud, but they were welcome to do so. The children were placed in the same test room or in different test rooms depending on their assigned condition. After the playing sessions, each child individually filled in a questionnaire and participated in an open-ended interview.

Data Analysis: The flow experience can be investigated in different ways, e.g. using grounded analysis of interviews (Pace 2004). Czikszentmihalyi (1975) proposes a model of flow state in which action capabilities and action opportunities are attributed a value for the activity or situation. In this sense, the flow experience can be mapped into a two-axe coordinate of (skills) action capabilities and challenges (action). If skills and challenges are closely correlated, the person will be in a state of flow ("… *a state of consciousness experienced by people who are deeply involved in an enjoyable activity* …" Pace, 2004). On the other hand, if the challenges are much higher than skills, the person will be worried whereas when skills are much higher than challenges the person will be bored. We pursue this way in an attempt to gain a quantitative measure for the enjoyment experience.

In order to measure skills and challenges of the situation for the children, we applied a questionnaire with 28 questions. The questionnaire contained two sets of questions 1) 26 flow questions that were used to calculate the flow experience and 2) two control questions on the children's direct perception of the situation and the game. In the design of the flow questions, we were inspired by Jennings' six criteria for flow in web-sites: 1) merging of action and awareness, 2) limitation of stimulus field, 3) loss of ego, 4) control of actions, 5) clear goals and feedback, and 6) autoletic nature (Jennings, 2000). Also, we used the interview and questionnaire guides found in (Czikszentmihalyi 1975). Based on these sources, we designed 26 questions (18 challenge questions and 8 skill questions) for the skills of the children and the challenges of the playing situation. Each question was answered on a five point scale that was used in the calculation of the combined skill or challenge. The result was one value between 0 and 100 for both skills and challenges for each participating child. In addition to the flow questions,

we included two control questions on the questionnaire that provided the children in one single question to evaluate the fun of the playing situation (on a 5 scale) and a total rating of the computer game (on a five scale).

RESULTS

The children played the computer game in the two conditions and afterwards most of them would stress the enjoyment of the activity. Considering the outcome of the questionnaires, figure 2 maps the calculated skills and challenges of the 40 children. Overall, we found that the children in the physical configuration ranged from 47.18 to 79.44 (mean=59.55, SD=8.12) on challenges whereas the children in the virtual configuration ranged from 24.19 to 73.39 (mean=51.39, SD=11.17). On skills, the physical children ranged from 43.75 to 78.91 (mean= 63.49, SD=10.56) whereas the virtual children ranged from 28.91 to 76.56 (mean=58.91, SD=11.36). As figure 2 illustrates, the children in the physical configuration are more concentrated than the children in the virtual configuration. Also, some of the virtual children were very different from the rest of the virtual children. The same seemed not to be the case for the physical children.

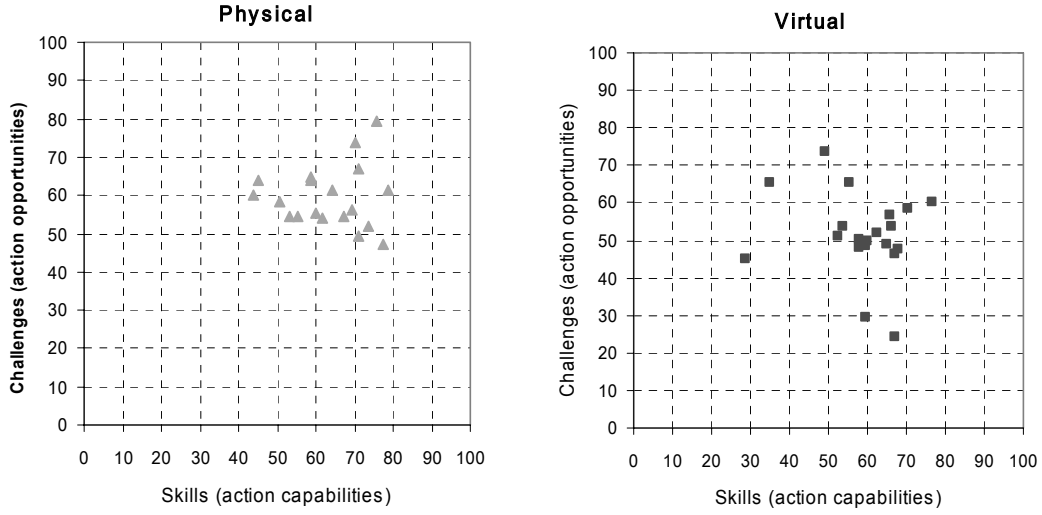

Figure 2: The distribution of the 40 children on challenges and skills in the two settings.

Considering the assessment of challenges, we found that the children in the physical setup found the challenge higher than the children in the virtual setup and this difference is significant according to a Wilcoxon test ($z=2.50$, $p<0.05$). On the other hand, we found no significant difference in the children's assessment of their own skills between the two setups.

In addition to the flow questions, we asked the children how fun they thought the playing situation had been and we asked them to rate the game. Most children in the physical configurations rated the fun experience high (mean=3.68, SD=0.67) where the children in the virtual configuration rated the fun experience lower (mean=2.90, SD=1.12). This difference is significant according to a Wilcoxon test ($z=2.34$, $p<0.05$). On the other hand, we found no significant difference in the rating of the game by children between the two configurations.

DISCUSSION

Our study explored how aspects of fun and enjoyment in computer games can be measured. For this purpose, we adapted the concept of flow by Czikszentmihalyi; flow is the state of consciousness experienced by people who are deeply involved in an enjoyable activity (Pace, 2004). We measured flow through the variables of action capabilities (skills) and action opportunities (challenges) and calculated these variables based on a questionnaire on skills and challenges. Our results showed that the children when playing against each other found it more fun to play when located in the same physical room. However, they did not consider their own skills in this respect to be significantly higher than the children sitting in separate rooms considered their skills. However, they still found the situation more appealing.

The challenges of the game playing in the physical setup were generally higher than in the virtual setup probably due to the competition element built up by the competing children. The following statements come from one of the physical sessions: The first player "*Are you in front of me?*" whereto player two responds "*No I think I'm behind you*", the first player "*Aren't you past that point yet? (laughing) I'm way ahead of you*". Such

communication was typical for the physical sessions where the children constantly talked about the racing situation. Such interaction was inherently not possible in the virtual situation. The children enjoyed the configuration where they could interact directly with each other – they rated the playing situation significantly higher. However, their skills were not significantly higher than the skills of the children in the virtual setup. This somewhat contradicts the assumption that skills and challenges should be correlated as you either risk that the person will get bored or worried.

Measuring the flow of experiences is still an immature discipline even though the concept of flow has been known for several years. Different attempts to measure flow when using software technologies have been done, e.g. (Jennings 2000; Novak and Hoffman 1997; Pace 2004). However, it is difficult to measure flow (thus the enjoyment) and the questions in our questionnaire constitute a potential limitation in the generalization of the results. Furthermore, we are still analysing the results from our study as we would like to see correlations between the enjoyment of playing the game and the introduction of usability problems.

REFERENCES

Arts, J. M. (1996) Computers and the quality of life: assessing flow in information systems. *ACM SIGCAS Computers and Society,* Vol. 26(3), pp. 7 - 12

Carroll, J. M. and Thomas, J. C. (1998) Fun. *SIGCHI Bulletin*, Vol. 19(3), pp. 21 – 24

Czikszentmihalyi, M. (2000) *Beyond Boredom and Anxiety – Experiencing Flow in Work and Play*. 25th Anniversary Edition, Jossey-Bass Inc.

Druin, A., Stewart, J., Proft, D., Bederson, B., and Hollan, J. (1997) KidPad: a Design Collaboration between Children, Technologists, and Educators. In *Proceedings of the Human Factors and Computing Systems CHI'97*, ACM, pp. 463 – 470

Druin, A. (1999) The Role of Children in the Design of New Technology. *HCIL Technical Report No. 99-23*, University of Maryland, USA

Ellis, J. B. and Bruckman, A. S. (2001) Designing Palaver Tree Online: Supporting Social Roles in a Community of Oral History. In *Proceedings of the Human Factors and Computing Systems CHI'01*, ACM Press, pp. 474 – 481

Gorriz, C. M. and Medina, C. (2000) Engaging Girls with Computers through Software Games. *Communications of the ACM*, vol. 43, No. 1, pp. 42 – 49

Jennings, M. (2000) Theory and Models for Creating Engaging and Immersive E-commerce Web-Sites. In *Proceedings of the 2000 ACM SIGCPR conference on Computer personnel research*, pp. 77 - 85

Lester, J. C., Converse, S. A., Kahler, S. E., Barlow, S. T., Stone, B. A., and Bhogal, R. S. (1997) The Persona Effect: Affective Impact of Animated Pedagogical Agents. In *Proceedings of the Human Factors and Computing Systems CHI'97*, ACM, pp. 359 - 366

Linggaard, G. (1999) Of babies, bath water and usability techniques for Web evaluations. In Proceedings of the OzCHI Conference, Wagga Wagga, pp. 149 - 151

Nielsen, J. (1993) Usability Engineering. Academic Press Professional, Chestnut Hill, MA

Novak, T. P. and Hoffman, D. L. (1997) Modeling the Structure of the Flow Experience among Web Users.

Pace, S. (2004) A Grounded Theory of the Flow Experience of Web Users. *International Journal of Human-Computer Studies*. Elsevier, Vol. 60, pp. 327 - 363

ACKNOWLEDGEMENTS

We would like to thank the participating children and comments from reviewers on previous versions.

COPYRIGHT