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Interactive Academic Papers: The Role of Interactivity on Retention and Attitude

1. Introduction

Currently, academic research is widely read by students and researchers alike. It is estimated that there are over 2.5 million academic articles published each year (Pickard 2012). However, it is difficult for the information discovered in a research study to spread outside of academia. A majority of peer reviewed journals have subscription fees, restricting access to current research to a variety of potential readers. Even with the rise of open access journals, there are still many barriers to entry for nonacademics to read and engage with academic research. Besides the fees, traditional academic papers feature dense language and unwelcoming formatting, making grading these papers time consuming and difficult. Although the first academic journal was founded in 1665, and despite the rise of the internet and advanced communication technologies, there has been limited changes to the process of publishing academic research for hundreds of years (Vesnic-Alujevic 2014).

Scholars have acknowledged the issue of disseminating academic research outside of academia, with some calling for greater access and others for a complete shift in how research is presented. Specifically, Wilson (2018), calls for academic research “to be written in a way that captures the imagination of, and engages, the reader”. This study will explore the efficacy of

using interactivity to translate academic information for a wider audience with the goal of increasing engagement between nonacademics and academic research.

Enhancing engagement with academic research not only increases the visibility of scholars and empirical research, but some argue that these changes could impact society as a whole. By increasing active participation in a wider, nonacademic community, Vesnic-Alujevic (2014) posits that there will be an increase of knowledge production and will result in a democratization of knowledge. By increasing engagement, the entirety of the academic community, as well as society, will likely benefit from an increase in diverse knowledge available, as well as more active discourse between academics and professionals.

2. Literature Review

2.1 Interactivity

The role of interactivity and communication is continuously being researched as new technology and media emerge. Though many definitions have been proposed over time, many scholars refer to Steuer's (1992) definition of interactivity as a base-line definition, which refers to interactivity as "the extent to which users can participate in modifying the form and content of the mediated environment in real time". The specific type of interaction varies from scholar to scholar, but Oh et al. (2018) categorized physical interactions with a website as a variety of mouse-based actions used to retrieve information, such as mouseover, click, drag, and slide.

One method of exploring the complexity of interactivity is differentiating between person and machine interactivity. Person interactivity is defined as the interaction between people, both mediated and unmediated, such as face to face communication and chatrooms. Machine

interactivity is the ability for users to synchronously change the content and structure of a mediated environment (Teo et al. 2003). Whereas people interactivity refers to interaction via the medium, machine interactivity is the interaction with the medium. As machine interactivity has been shown to influence a user's cognition and attitude (Sundar et al. 2014), it will be the focus of this study.

Changing the method of interaction is shown to have significant impacts on retention and attitudes towards the medium's content. Sundar et al. (2014) conducted a study on the relationship between memory and engagement with six different methods of interaction: click, slide, zoom, mouseover, drag, and 3D carousel. Mouseover was found to increase engagement with users while slide resulted in better memory. Additionally, content was found more credible when the website featured mouseover, click, and zoom interactions. According to this study, increasing the access to underlying information results in increased credibility and positive attitudes of users (Sundar et al. 2014). As information-based interaction techniques were found to have the greatest impact on users' attitudes and memory, this study will focus on two forms of information-based techniques: click and mouseover.

2.2 Media Richness

Media richness theory is important to understanding the ability of interactivity to transfer information across a medium. Media richness theory, a framework developed by Daft and Lengel, proposes that media can be ranked by richness, positing that richer media are more effective forms of communication (Daft and Lengel 1986). Though rich environments and highly interactive media are not mutually exclusive, there has been a significant amount of research on

the interactions between the two. Some scholars argue that interactivity is connected with media richness (Rafaeli and Ariel, 2009) and by reacting to the "bells and whistles" of rich media, users interact more intuitively and naturally with richer environments (Oh et al. 2018). Sukoco and Wu posit that the two have a direct variation; richer media possess a stronger ability to facilitate interactive actions, thus rich media expose users to more interactivity (Sukoco and Wu 2011).

Additionally, research suggests that media richness and interactivity are necessary precursors to developing telepresence (Sukoco and Wu 2011). Telepresence is the perception of an experience that occurs through a virtual, mediated environment, as opposed to one felt in a physical environment. Steuer (1992) defines telepresence as "the experience of presence in an environment by means of a communication medium". While highly rich websites have been shown to increase feelings of being present, increasing the level of interactivity of a website can enhance the quality of a user's telepresence (Sukoco and Wu 2011). Other research has supported the connection of interactivity and telepresence, with Li et al. (2002) and Coyle and Thorson (2001) proposing that increasing the level of interactivity correlates to increased feelings of telepresence in computer media.

2.3 User engagement

The level of engagement that a person perceives in medium-based interaction is known as user engagement. Scholars have defined user engagement as the attraction to a medium (Jacques, Preece, & Carey, 1995) and "a state of playfulness which includes attention, focus, curiosity, and intrinsic interest" on multimedia (Webster & Ho, 1997, p. 65). Oh et al. (2018) operationalizes user engagement as including both the medium's perceived quality, such as visual appearance,

and the outcomes of this interaction experienced by the user, such as heightened attention and increased empathy. Research suggests that interactivity-based user engagement has positive influences on a user's perception of the medium's content (Oh et al. 2018). Additionally, changing only the interaction techniques has been shown to result in significantly different user experiences (Sundar et al. 2014).

The stronger the user engagement is, the more that users feel absorbed into the medium's content, known as absorption. Studies have revealed a correlation between high levels of interactivity and high levels of absorption within a medium (Oh et al. 2018). The level of absorption a user experiences has been shown to influence cognitive and behavioral responses. As interactivity and absorption increase, so should positive attitudes and retention rates increase (Sundar et al. 2014).

2.4 Education and Retention Rates

Though many studies have explored the role of person interactivity in online environments on learning, suggesting that person interactivity positively influences understanding (Maddux et al. 1997), fewer have focused on the role of machine interactivity in education. Interactivity has been shown to improve students' levels of satisfaction (Liaw and Huang 2000) as well as enhance attitudes and cognitive responses (Sun and Hsu 2012). Pacing control in interactive media has been found to enhance learning outcomes of students (Oh et al. 2018).

There are conflicting results regarding the role of interactivity in educational learning. The interactivity effect is a hypothesis which posits that increasing interactivity in media should

enhance learning in users (Evans and Gibbons 2007). Supporting the interactivity effect, some studies have shown that interactivity positively influences retention rates of students (Oh et al. 2018). Users who explored an interactive website were found to process information more thoroughly compared to users exploring a non-interactive website (Sicilia et al. 2005). Although there is limited, yet conflicting, research, there is evidence of a relationship between interactivity and retention rates, therefore the following hypothesis will be tested:

> **Hypothesis 1 (H1)**: Compared to standard academic papers, interactive papers will increase readers' retention rates.

2.5 Role of Interactivity on Attitude

Studies have shown that introducing interactivity in media leads to improved affective responses (Sukoco and Wu 2011), such as increase feelings of satisfaction and positive attitudes in users (Sundar et al. 2014). In advertising, interactivity has been shown to improve user engagement and evaluations towards a website (Sundar and Kim 2004) as well as enhance positive perceptions of brands (Macias, 2003). Furthermore, as feelings of absorption and telepresence increase, users' attitudes towards the medium and content are positively influenced (Oh et al. 2018). Research suggests that interactivity in a medium influences multiple components of a user's attitude, including "satisfaction, effectiveness, efficiency, value", towards a medium (Teo et al. 2003).

Regarding education, higher levels of interactivity have been found to positively influence attitudes towards learning (Hackman and Walter, 1990). Additionally, studies have

shown that interactivity increases feelings of satisfaction with learning processes in students (Sun and Hsu 2012). Therefore, the following hypothesis will be explored:

> **Hypothesis 2 (H2):** Compared to standard academic papers, interactive essays will increase readers' positive attitudes towards the content.

3. Method

Participants (N = 93, 48 were female) were randomly split into three groups: control (N=30), click (N=32), and mouseover (N=31). In the control group, participants read a section of the paper in its original journal format (Appendix A), while the click (Appendix B) and mouseover (Appendix C) groups read a web-based version of the paper, featuring click and mouseover based interactions respectively. The content of each paper was identical, except for the interaction techniques available, in order to isolate the effects of the interaction techniques on participants' retention rates and attitudes.

A pre-test was conducted (N=5) in order to measure how long it would take to complete the survey, suggesting an average time of 5 minutes to read and 2 minutes to answer questions.

The specific paper chosen, adapted from Quandt et al. (2015), is a communications survey study focusing on digital games research. Before reading the paper, participants were asked questions about their demographics (age, gender, and education) as well as the frequency of their relevant habits (using the internet, reading academic papers, and playing video games) in order to determine participants' familiarity with the topic. As this survey was meant to understand how different users respond to the papers, a wide variety of participants from the United States were chosen. 85% of participants were between the ages of 18 and 29. ANOVA

tests found no significant difference in demographics and frequency of relevant habits between the three groups.

Participants were instructed to read the paper and then complete a questionnaire. Retention rates were measured using six retention questions, focusing on terminology defined in the paper. Percentage of overall correct scores were calculated and used as the overall retention rate of a participant. The time it took participants to read the paper and answer the retention tests was also measured. Attitudes towards the content of the papers were assessed by asking participants questions pertaining to feelings of satisfaction, value, interest, and curiosity. Satisfaction, value, and interest scales were adapted from Teo et al. (2003). The curiosity scale asks participants about their desire to learn more (Appendix D). All self-reported measures used a 7-point Likert-type scale (1=strongly disagree, 2=disagree, 3=slightly disagree 4=neither agree nor disagree, 5=slightly agree, 6=agree, 7=strongly agree).

4. Results

To examine the dependent variables of retention rate and attitude, composed of four scales (satisfaction, value, interest, and curiosity), an ANOVA test was conducted. While manipulating interactivity did not have a statistically significant impact on retention rates ($p = 0.4$), it did impact overall attitudes felt towards the research papers ($p = 0.0001$). Means and standard deviations for the dependent variables are listed in Table 1. Though there is a statistical difference between overall attitudes towards content in the control group and the click group ($M_1=3.69$, $SD_1=1.56$, $M_2=4.59$, $SD_2=1.65$, $p < 0.0001$) as well as the control group and the mouseover group ($M_1=3.69$, $SD_1=1.56$, $M_2=4.52$, $SD_2=1.41$, $p = 0.0003$), there is no difference

between the click group and the mouseover group (p = 0.78).

Table 1 Main Dependent Variables

	Control group (n=30)		Click group (n=32)		Mouseover group (n=31)	
Variable	Mean	SD	Mean	SD	Mean	SD
Retention Rate	76%	21%	74%	17%	80%	23%
Satisfaction						
Engagement	3.09	1.66	4.56	1.83	4.29	1.59
Satisfaction	3.82	1.65	4.44	1.83	4.43	1.50
Favorable Impression	3.82	1.74	4.48	1.78	4.90	1.14
Value						
Useful	4.18	1.53	4.88	1.81	4.76	1.45
Important	4.18	1.33	4.92	1.68	4.48	1.54
Valuable	4.50	1.44	4.84	1.57	5.14	1.24
Interest						
Interesting	3.41	1.82	4.32	2.19	4.24	2.10
Enjoyable	3.36	1.84	4.56	1.89	4.33	2.01
Like	3.77	1.97	4.80	1.87	4.67	1.88
Curiosity						
Read rest of paper	2.86	1.70	4.08	1.89	3.67	1.71
Learn more about topic	3.68	1.86	4.24	1.85	3.81	1.66
Read similarly formatted papers	3.64	1.97	4.92	2.06	5.57	1.29

Satisfaction (p = 0.01), value (p = 0.03), and interest (p = 0.003) scales were statistically different; however, the curiosity (p = 0.22) scale was not. In the curiosity scale, there is no significant difference regarding participant's desire to learn more about the topic (p = 0.537) and to read the rest of the paper (p = 0.068), though interactivity did have a statistically significant impact on participants' desire to read similarly formatted papers (0.003).

Timing was tracked to measure how long participants spent reading the research papers and answering questions. Results well outside of the time suggested by pre-tests were excluded. Multiple participants spent over 1 hour on the survey, suggesting that they were distracted and did not complete the survey in one sitting. Ignoring the outliers, timing (measured in seconds) shows that participants spent less time reading the interactive papers than those who read the control paper (M_1=709.70, SD_1=537.46, M_2=277.13, SD_2=136.50, M_3=390.62, SD_3=250.42, p=0.03). Specifically, there was no statistical difference between the control and mouseover (p=0.10) and hover and mouseover (p=0.25), though there was a difference between the control and click (p=0.044), showing that the click group was able to answer the questions faster than the control group.

Regarding the timing it took participants to answer the retention questions, ANOVA tests show that there is no overall significant difference (M_1=231.10, SD_1=238.73, M_2=168.62, SD_2=124.84, M_3=119.52, SD_3=85.99, p=0.09). There was no difference between control and mouseover (p=0.28) and mouseover and click (p=0.13); however, there was a difference between the control and click (p=0.05), showing that the click group was able to answer the questions faster than the control group.

5. Discussion

5.1. Retention Rates

This study was looking for a positive relationship between interactivity and short term retention rates. However, average retention rates (M_1=76%, SD_1=21%, M_2=74%, SD_2=17%, M_3=80%, SD_3=23%.42, p=0.400) did not differ between the groups and therefore does not fully

support H1. None of the demographics, including age, education level, frequency of playing video games, and the frequency of reading academic papers had significant impact on participants' retention rates. Though this does not support Oh et al. (2018), this study does support the findings by Sun and Hsu (2012), who posited that there is no significant difference of retention rates found in users exposed to interactive media and those not. However, other forms of learning, including long term retention and understanding, could be enhanced by interactivity, as posited by Evans and Gibbons (2007), who proposed that interactivity is better suited to improving deep learning. While this study did not show a positive correlation between interactivity and retention rates, further investigations into the effects of interactivity on other forms of learning are warranted.

In order to better understand the retention rates of participants, the time it took each participant to read the paper and answer the retention tests were recorded. The participants in the click and mouseover groups spent less time reading the paper than those in the control group, suggesting that the way that participants read the papers in the interactive papers differs from those reading the traditional paper. This difference could be the result of more participants skimming the paper in the interactive-based groups, or perhaps the participants were able to retain the information faster. The participants in mouseover group finished reading the paper faster than the other two groups, which may suggest that the mouseover interaction increases the speed at which participants retain information. It is possible that the participants in the mouseover group were able to understand the information more quickly than those in the other groups.

Conversely, participants in the click group were found to answer questions faster than the control and mouseover groups, which could indicate that the click interaction technique increases retention rates. This supports the study by Evan and Gibbons (2007), which suggests that introducing interactivity in media reduces the time needed for users to answer questions, supporting the positive influence of interactivity on retention rates. By answering questions faster, Evan and Gibbons (2007) posits that users are retaining information better. Although there was no difference the percentage of correct answers, this study suggests that the time that participants are able to read the paper and answer questions about the content are influenced by interactivity. Participants in the interactive groups were not able to correctly answer more questions; however, their faster timings indicate that they were able to understand the information at a faster rate than those in the control group. Though this survey does not fully support H1, the difference in timings of the participants in different groups suggests that H1 is inconclusive and shows that further research needs to be done regarding interactivity and retention rates.

5.2 Attitudes

This study also investigated the impact of interactivity on participants' attitudes towards the paper and its content, specifically looking at scales of satisfaction, value, interest, and curiosity. Overall, this study shows a significant difference in the attitudes of the participants towards the paper. Participants in the interactive groups felt more satisfied with, found greater value in, and had more interest in the papers. This supports H2 and suggests that interactivity enhances the positives attitudes readers have towards academic papers. By increasing feelings of

satisfaction, value, and interest in research papers, interactivity has the possibility to increase overall readership and interest in academic papers.

Though the overall curiosity scale was not statistically different between the three different groups, participants were more likely to indicate a desire to read similarly formatted papers in the interactivity groups as opposed to the control group. The data suggests that while participants would like to read more interactive papers, they do not have a desire to read more papers about digital games research. One possible reason for this could be the lack of power user participants. Power users, according to Sundar et al. (2014), are users who are willing to invest time into learning more about topics they are interested in. Non-power users, on the other hand, are less likely to be involved in such activities. Power users were found to respond to interactivity in websites stronger than non-power uses. As only 19% of respondents reported playing video games frequently, it is possible that there were not enough power users participating in the study. This suggests that interactivity may not be enough to foster a desire to learn more about digital games research in non-power users, or users without a prior interest or investment in the topic. However, participants in the interactive groups were more likely to want to read similarly formatted papers, showing that there is a desire for more interactivity-based articles.

In all four scales measured for testing attitude, there was no statistical difference between the click-based group and the mouseover-based group. The findings support the study by Sundar et al. (2014), which posited that information-based interactions increased overall positive attitudes in users. However, this failed to differentiate differences in satisfaction, value, interest, and curiosity between click-based and mouse-over based interactions. Overall, this research

suggests that information-based interactions, specifically click and mouseover, increase feelings of satisfaction, value, and interest, though there is no difference in attitude between the two techniques.

5.3 Limitations and Future Research

While this study researched the influence of interactivity on retention rates, it did not explore the role of interactivity in other forms of learning. This survey focused on short term retention rates regarding the retention of terminology introduced in the paper. Without testing previous knowledge, it is impossible to tell how much participants learned from reading this paper. Pre-testing participants and comparing the scores to post-tests would address this issue. Furthermore, due to time constraints of this research, a panel study was unable to be conducted. A panel survey would offer insights into the long term retention rates of participants. As posited by Evan and Gibbons (2007), exploring deep learning, such as participant understanding, is important to understanding how interactivity influences overall learning and cognitive responses. By pre-testing all participants, conducting a panel survey, and measuring different forms of learning in future studies, a more holistic understanding of the role of interactivity in learning can be better uncovered.

As this study surveyed 93 participants, the methodology could be improved upon by increasing the number of and having better control over participants. Increasing the sample size could offer more insights into trends occurring between different variables. When looking at the timing of participants throughout the survey, there were multiple outliers, indicating that some participants were distracted, possibly detracting from the quality of the results. Better control

over the environment would decrease this inconsistency as well as encourage participants to actively engage with the research study.

This survey compared two forms of information-based interaction. Increasing the number of dependent variables and the types of interactions researched in future studies could improve the current understanding of how interactivity influences retention rates and attitudes when participants are reading research papers. Evans and Gibbons (2007), posit that pacing control is an important form of interactivity that increases user engagement and absorption. Based on the results of this survey, other methods of interaction as well as combinations of interactions should be explored in order to better understand the role of interactivity in education.

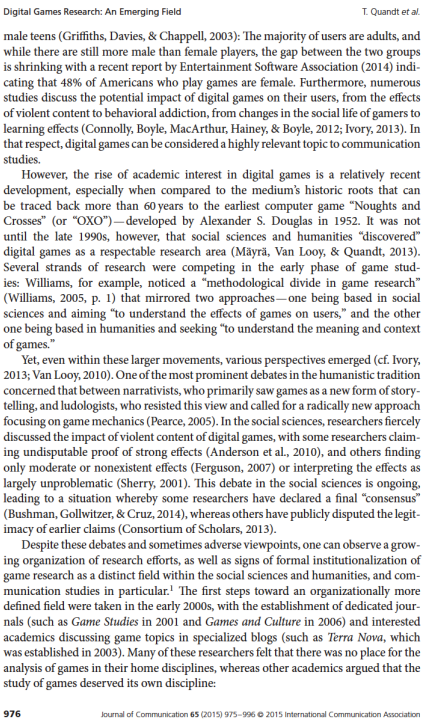
5.4 Conclusion

Though this study did not fully support H1, it did support H2, suggesting that participants' attitudes are influenced by interactive techniques. Differences in participants' timings suggest interactivity may have a positive influence on retention, though it does not increase overall retention rates. With further study, it is possible there will be more correlations between interactivity and enhanced user experience. This study shows that integrating interactivity into academic papers will increase feelings of satisfaction, value, and interest in participants as well as the speed at which participants read papers and respond to questions. Additionally, participants in the interactive based groups were more likely to have a desire to read more similarly formatted articles, showing that there is a demand for interactive-based academic papers. With the 2.5 million academic articles being published each year, there are countless opportunities to integrate interactivity into research and spread academic information

outside of academia. This research shows that interactivity has the potential to better engage nonacademics with empirical research, which may lead to an overall increase in development of knowledge and intellectual discourse.

Appendix

Appendix A. Image of traditional paper



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male teens (Griffiths, Davies, & Chappell, 2003): The majority of users are adults, and while there are still more male than female players, the gap between the two groups is shrinking with a recent report by Entertainment Software Association (2014) indicating that 48% of Americans who play games are female. Furthermore, numerous studies discuss the potential impact of digital games on their users, from the effects of violent content to behavioral addiction, from changes in the social life of gamers to learning effects (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Ivory, 2013). In that respect, digital games can be considered a highly relevant topic to communication studies.

However, the rise of academic interest in digital games is a relatively recent development, especially when compared to the medium's historic roots that can be traced back more than 60 years to the earliest computer game "Noughts and Crosses" (or "OXO")—developed by Alexander S. Douglas in 1952. It was not until the late 1990s, however, that social sciences and humanities "discovered" digital games as a respectable research area (Mäyrä, Van Looy, & Quandt, 2013). Several strands of research were competing in the early phase of game studies: Williams, for example, noticed a "methodological divide in game research" (Williams, 2005, p. 1) that mirrored two approaches—one being based in social sciences and aiming "to understand the effects of games on users," and the other one being based in humanities and seeking "to understand the meaning and context of games."

Yet, even within these larger movements, various perspectives emerged (cf. Ivory, 2013; Van Looy, 2010). One of the most prominent debates in the humanistic tradition concerned that between narrativists, who primarily saw games as a new form of storytelling, and ludologists, who resisted this view and called for a radically new approach focusing on game mechanics (Pearce, 2005). In the social sciences, researchers fiercely discussed the impact of violent content of digital games, with some researchers claiming undisputable proof of strong effects (Anderson et al., 2010), and others finding only moderate or nonexistent effects (Ferguson, 2007) or interpreting the effects as largely unproblematic (Sherry, 2001). This debate in the social sciences is ongoing, leading to a situation whereby some researchers have declared a final "consensus" (Bushman, Gollwitzer, & Cruz, 2014), whereas others have publicly disputed the legitimacy of earlier claims (Consortium of Scholars, 2013).

Despite these debates and sometimes adverse viewpoints, one can observe a growing organization of research efforts, as well as signs of formal institutionalization of game research as a distinct field within the social sciences and humanities, and communication studies in particular.[1] The first steps toward an organizationally more defined field were taken in the early 2000s, with the establishment of dedicated journals (such as *Game Studies* in 2001 and *Games and Culture* in 2006) and interested academics discussing game topics in specialized blogs (such as *Terra Nova*, which was established in 2003). Many of these researchers felt that there was no place for the analysis of games in their home disciplines, whereas other academics argued that the study of games deserved its own discipline:

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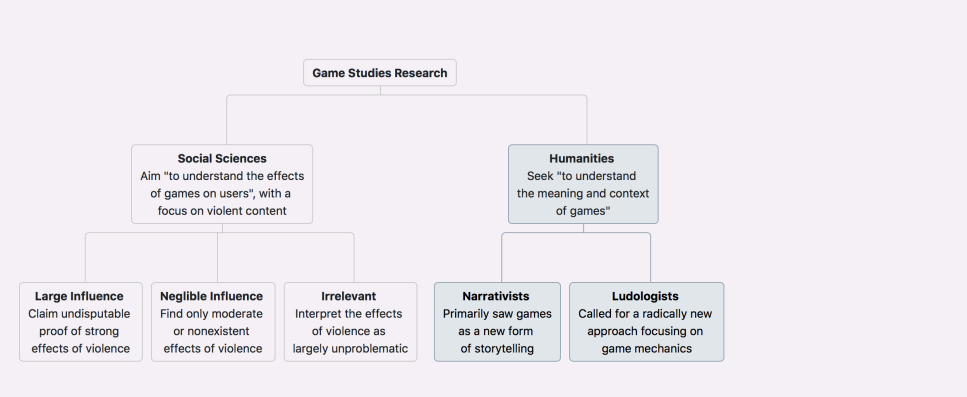
Appendix B. Image of click-based paper

Appendix C. Image of mouseover-based paper



Appendix D. Survey Questions for Measuring Attitude

(I) Satisfaction

Please rate on a scale of 1-7, where 1 represents strongly disagree, 4 represents neutral, and 7 represents strongly agree.

I felt a sense of engagement with the information.

I feel satisfied with my experience reading the essay.

I have a favorable impression of the essay I have read.

(II) Value

Please indicate on the scale the extent to which you agree with the adjective that represents your assessment of the value of the Web site.

not useful 1 2 3 4 5 6 7 useful

not important 1 2 3 4 5 6 7 important

worthless 1 2 3 4 5 6 7 valuable

(III) Attitude

Please indicate on the scale the extent to which you agree with the descriptions that match the attitude you have towards the Web site.

boring 1 2 3 4 5 6 7 interesting

not enjoyable 1 2 3 4 5 6 7 enjoyable

dislike 1 2 3 4 5 6 7 like

(IV) Curiosity

Please rate on a scale of 1-7, where 1 represents strongly disagree, 4 represents neutral, and 7 represents strongly agree.

I would read the rest of this essay

I would actively learn more about digital games research

I would read similar articles

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