Anticipated User Experience Evaluation of Game Controller Designs

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ABSTRACT

Input and output components in interactive video game systems are important, especially when it comes to interaction style and experience. In particular, as a primary component of the user-interface control devices especially in interactive product systems that allow us to play are directly definitive in interaction and diverse in terms of form and functionality. Product features are considered important because they influence the UX. Therefore, two-phased study conducted in our study to review controllers from product design perspective with a certain game type and various controllers for better understanding effects of product features on anticipated user/player experience. Based on the existing AUX framework, we designed and implemented surveys to measure the expectation and evaluation of design features. As a result of the implementation, we obtained results that are consistent with the existing framework and easier to interpret and associate with AUX.

Keywords: Game control design, user-experience, anticipated user experience

INTRODUCTION

Within the scope of human-computer interaction field, video game systems are discussed based on the concepts of user characteristics and preferences, interaction style, and the resulting user-experience (UX). As the video game systems have an arbitrary use and independent of the real-life based goals they differ from other productivity-oriented applications in terms of interaction and experience.

Most research is carried out to investigate and measure the impact of various aspects of the game activity, such as the game's design, the way it is played, other software and hardware related to the game, on the game experience. There are studies showing that game controllers in particular have an impact on player experience (Skalski et al. 2011; McEwan et al. 2012; McGloin, Farrar & Krcmar, 2013; Birk & Mandryk, 2013). These studies take place within the framework of the UX, which is frequently used in the field of human-machine interaction, but the term player experience (gamer experience/gameplay experience) is used in a more specialized sub-form in the video games based researches. The gameplay experience can be defined within a framework that includes all of a player's emotions, thoughts, feelings, actions and the processes of making sense in the gameplay environment (Ermi & Mäyrä, 2005). As an interactive system the user-interface of the video-game system, consisting from the graphical user-interface where the game is displayed and the game controller where the user interacts with the system plays a crucial role in the interaction process.

The experience, which is an evaluative feeling arising from interaction with a product or system-focused design approach, aims to reveal the feelings of pleasure and fun rather than removing the feeling of discomfort. For this purpose, the dimensions of the interaction with the product and the relationship between pleasure and fun should be discussed. Some studies examine the relationship between experience and natural mapping style in studies on game controllers. However, there is a lack of studies that address the design features of game control devices. A recent study Akyaman and Alppay (2021) found that physical design properties of game controllers are rarely studied in product experience field. Therefore, the aim of this study was to review game controllers from product design perspective to better understand the role of design properties on the anticipated user experience as well as to gather data from users about their preferences and expectations in the anticipated user-experience framework. The form and characteristics of the products also give us the opportunity to make some meaningful associations with the processing of this information. Based on the visual, tactile and auditory characteristics of the product, it is possible to make an anticipation about the use of the product. Some studies show that users are aware of potential experiences and can make anticipations about possible positive and negative feelings. For this reason, our study aimed to perform an anticipated user experience (AUX) evaluation, where the design of the video game had a minimal impact on the evaluation. We focused on the investigation of AUX of different game control devices in terms of design features.

RELATED WORK

USER EXPERIENCE

User experience is defined by ISO (ISO 9241-210, 2010) as "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service". In fact, this definition does not require that we have to be experienced about the exact product or system before. For example, a person who has never used a gun can make anticipations about its real use according to the various visual experiences as a result of playing a video game. The experience resulting from the interaction between the player and the video game is directly influenced from game design, game peripherals and gaming environment. Among these factors, it is important to investigate the effects of game controllers on the UX, with which the users interact directly and physically during the game, in order to provide an immersive and enjoyable gaming process.

User-experience evaluations of game control devices have been carried out in many studies as instrumental (McGloin, Farrar & Krcmar, 2013; Birk & Mandryk, 2013; Brown & MacKenzie, 2013) and non-instrumental (Kim, Biocca & Jeong, 2011; Blomberg, 2018). Another important point is the inclusion of the experience during or after use. As can be seen from the definitions, UX is a state that can be evaluated not only after the use of a product or system, but also before or during use. Especially, knowing about the positive and negative situations that are anticipated to be experienced before use can provide data to designers in the early stages of new product development. This situation draws attention of the researches on the anticipation of UX. Since the design includes issues about how things work, used, and the nature of the interaction with them, it is important to explore the role of the design features of the products and the resulting experience

ANTICIPATED USER EXPERIENCE

Anticipation (or expectation, prediction) is more about the effect of expectation or prediction on our behavior, rather than simply looking forward to the future (Butz, Sigaud & Gérard, 2003). The expectations that a person shapes over his/her previous experiences (reviewing) can affect his/her future experiences (making choices) (McCarthy & Wright, 2004; Norman, 2009). Anticipations have a dynamic and variable structure in the process of experience and can be reflected as positive or negative feelings in the experience process (McCarthy & Wright, 2004). In addition, it is possible for people to anticipate the outcomes (including those associated with emotions) that will result from certain actions by reflecting on their past and / or present experiences (Von Glasersfeld, 1998).

Experience can direct and affect the interaction as it can arise as a result of the interaction between the user and the product (Hekkert & Schifferstein, 2008). This interaction can also

take place without requiring instrumental or non-instrumental physical action, based on perception or mental recall or imagination (Hekkert & Schifferstein, 2008; Desmet & Hekkert, 2007). Karapanos et al. (2010) and Roto et al. (2011) similarly, draws attention to the fact that the experience can be shaped in previous and following time periods, except for the "momentary" UX, which focuses the experience during use, and the "episodic" UX, which focuses on the evaluation just after a particular use episode.

Roto et al. (2011) specified AUX as the first step of the classification made by considering the user experience from a temporal perspective, and it is defined in a way to cover the pre-use situation of the experience. This includes a process where expectations are shaped and future experience can be imagined. Although awareness about the relationship of experience with time has begun to develop, it is seen that AUX related studies are limited. In one of these studies (Heikkinen, Olsson & Väänänen-Vainio-Mattila, 2009) researchers investigated the expectations of users about experience in their studies1 within the framework of haptic interaction with mobile devices. Olsson, et al. (2009) conducted a study examining the expectations of potential users about mobile mixed reality services over various usage scenarios.

Yogasara (2014) examined and compared anticipated and the real-life experience studies, developed a framework, and revealed the relationship between anticipation and experience. In the study, while the instrumental features of the product are dominant for the positive future experience when the users anticipate the experience, it was seen that both instrumental and non-instrumental features are important when evaluating the experience through the use of the real product. This framework was enhanced and used by Eilu and Baguma (2017) on the acceptance of the use of mobile phones for voting from the perspective of cognitive psychology. Sánchez-Adame, et al. (2018) also use Yogasara's work for to create an AUX framework concept for user tools provided by virtual community platforms.

In terms of player experience, the researchers state that in order to make a more holistic experience evaluation, during not only the playing but also the anticipations before playing should be included in the evaluation (Mäyrä, 2007; Schell, 2008). We create expectations for new games, ways of playing and our body-control interface relationships through our previous game and controller experiences. The necessity of considering different time fragments such as before, during and after use as a holistic within the scope of experience has been discussed in various studies. It is especially important to be able to get information about the potential experience before encountering the product, system or service, in order to integrate user information in the early design processes. In this direction, we think that the AUX studies will contribute to design field.

RESEARCH DESIGN

PRODUCT SELECTION

An online evaluation study was conducted with professional product designers, with an experience in video games, to group and screen the products to be used in the study. A total number of 11 designers were asked to classify 44 directionally mapped game controllers according to their design criteria. While selecting 44 products, we aimed to provide as much variety as possible in terms of form and features. The study was conducted on Miro (www.miro.com). Products are grouped according to the design features determined by the designers and the products that best represent these features have been selected. The descriptive criteria used in classification and the products matched with these criteria were evaluated comparatively.

In the study, it is possible to evaluate all of the criteria created by the designers under three groups: visual/formal, ergonomics related and usage related features. Under the visual/formal features, descriptive terms as colors, design styles (retro, modern, minimal, figurative, modular), aesthetic features, material properties, formal features (circular, linear, rectangular, etc.) of the products are used. In terms of ergonomics-related features, reference criteria are used for whether it is comfortable or ergonomic. Under the feature group related to usage, terms as simplicity, sophistication, complexity, practicality, multi-functionality, and user-friendly interface are included. Among the products considered to best represent the criteria in the designer data, the most frequently selected and classified products using criteria from all three groups were selected. Selected products are PlayStation 5 DualSense, Nintendo Joy-Con, 8bitDo N30 and Steam controller.

ANTICIPATED USER EXPERIENCE STUDY

In this phase of the study, Yogasara's (2014) AUX Framework was taken as the basis for AUX assessment. Yogasara’s framework shows the factors that influence positive AUX in a product or service to include: Intended Use (IU), Positive Anticipated Emotion (PAE), Desired Product Characteristics (DPC), User Characteristics (UC), Experiental Knowledge (XK), and Favourable Existing Characteristic (FEC) (Yogasara, 2014).

Yogasara's AUX framework (2014) has revealed the complex relationship between factors, but this relationship is somewhat difficult to interpret. In addition, when it comes to game controllers interfaces, it contains limited information on obtaining these factors. For this reason, we created an AUX evaluation questionnaire based on Yogasara's framework and including non-instrumental features. In the first stage, a questionnaire consisting of 21 items (12 instrumental, 9 non-instrumental) was used to measure the expectations of the users. In the second phase, AUX evaluation questionnaire, which will be filled out separately for each device, was used. In addition to the questions covering 4 instrumental and 5 non-

instrumental features, two questions evaluating the positive experience of form and functional features in the future and a question evaluating the future use intention are asked. In this way, we aimed both to clarify a method that is complex to interpret and to create a method that can be used in various products.

Yogasara (2014) expected the participants to design and convey the features of the imagined product with sketches while evaluating AUX in his study. As mentioned before, non-instrumental features are also effective in UX, which includes real use. For this reason, in our study, 4 product images that represent the current product diversity will be given to the participants and anticipation of UX will be evaluated. We used the questionnaire method in the study and organized remote online evaluation sessions with participants. We chose this method because time planning can be done more effectively and it is easy to reach participants in other geographical locations. During the interview, we asked the participants open and semi-open-ended questions prepared within the scope of Yogasara's AUX framework (2014), and obtained data on the opinions and expectations of the participants.

PROCESS

The second stage was carried out through online questionnaire and included 4 devices selected in the first phase of the study. The survey consisted of 3 parts. The first part included demographic question, the second part consisted of a 21-item expectation questionnaire and lastly the third part consisted of a12-item AUX evaluation questionnaire. The third part of the survey was separately answered concerning 4 different game controllers selected for the study. 50 participants, recruited from gaming related online forums, (43 M, 7 F; 60% of the participants were between the ages of 26-35 and 30% between the ages of 18-25, the remaining of participants were over 36 years) contributed to the second study where all the participants were experienced casual players to evaluate different types of controllers through online questionnaires. All of the participants are experienced in playing video games on a computer with a mouse and keyboard.

RESULTS AND DISCUSSION

An Exploratory Factor Analysis was performed to find and confirm the structural characteristics of both questionnaires separately. Firstly, we used the Kaiser-Meyer-Olkin (KMO) to analyze if the questions had enough common information. Then we perform extraction of factors accordingly and finalized 19-item expectation questionnaire.

When the expectation questionnaire was examined, no significant difference was found according to gender. Participants were asked to evaluate themselves according to the novice (Likert = 1) and expert (Likert = 7) scale of how experienced they saw themselves in using game controllers. 62% of the participants define themselves as well experienced in the use of game controllers, and 38% see themselves as low-level experienced.

Table 1: Factor loadings and descriptive statistics of expectation questionnaire items.

Items		M	SD	λ
Instrumental	(α =0.712)			
Inst1	I expect it to be light	4,800	1,761	0,861
Inst2	I expect it to be simple	5,100	1,644	0,856
Inst3	I expect it to be modular	4,100	1,821	0,850
Inst4	I expect it to be ergonomic	6,720	0,729	0,798
Inst5	I expect it to be durable	6,660	0,772	0,790
Inst6	I expect it to be small	3,200	1,498	0,790
Inst7	I expect it to be easy to use	6,340	1,188	0,753
Inst8	I expect it to have symmetrical buttons	4,280	2,099	0,691
Inst9	I expect it to be functional	5,300	1,488	0,658
Inst10	I expect it to be compatible	6,100	1,373	0,652
Non-	(α = 0.825)			
instrumental	I expect it to be customizable	4,820	1,999	0,946
N-inst1	I expect it to be suitable for personalization	4,760	1,846	0,922
N-inst2	I expect it to be similar to the products I used	4,600	1,702	0,892
N-inst3	before			
N-inst4	I expect it to be fun to use	6,080	1,140	0,813
N-inst5	I expect it to be produced from a quality	4,900	2,022	0,737
N-inst6	material			
N-inst7	I expect its material to be pleasurable to touch	5,920	1,382	0,701
N-inst8	I expect it to reflect my style and tastes	4,960	1,806	0,656
N-inst9	I expect it to be innovational	5,320	1,754	0,597
	I expect it to be attention-grabbing	4,140	2,050	0,579

Notes: N =50, M = mean, SD = standard deviation, λ = factor loadings, α = Cronbach's alpha.

According to their answers, it was observed that there were differences between those two groups in the answers to the expectation questionnaire, especially in terms of evaluating non-instrumental features. Based on this, we can argue that not only playing video games but also the type of game controller in question can be effective in expectations and evaluation.

The highest expectations are for the game controllers to be ergonomic, easy to use, durable, pleasurable to touch, compatible and fun to use. The lowest expectations are for the products to be small, attention grabbing, modular and similar to previously used devices.

The reliability and validity of both questionnaires were examined. Cronbach's al-pha values were used to evaluate internal consistency. Considering the instrumental and non-instrumental questions of the questionnaires separately, it can be said that the results for the expectation questionnaire indicate strong internal consistency (above 0.70) (seeTable.1). For the AUX questionnaire, a separate evaluation was made for each game controller and it was

seen that there was again strong internal consistency except for the 3rd device, 8bitDo N30, for instrumental questions (See Table.2).

Table 2: Factor loadings and descriptive item statistics of AUX questionnaire items.

Items		M^1	M^2	M^3	M^4
Instrumental	$(\alpha = 0.764)^1$, $(\alpha = 0.777)^2$, $(\alpha = 0.548)^3$, $(\alpha = 0.785)^4$				
Inst1	I expect it to be ergonomic	5,760	3,720	2,500	4,720
Inst2	I expect it to be easy to use	5,760	4,180	4,900	4,140
Inst3	I expect it to be simple	4,860	4,200	5,840	3,680
Inst4	I expect it to be functional	5,280	4,760	3,480	5,040
Non-instrumental	$(\alpha = 0.832)^1$, $(\alpha = 0.844)^2$, $(\alpha = 0.823)^3$, $(\alpha = 0.823)^4$				
N-inst1	I expect it to be pleasant	5,820	4,060	3,180	4,540
N-inst2	I expect it to be exciting	5,120	3,820	2,620	4,480
N-inst3	I expect it to be valuable	5,700	4,300	3,260	4,920
N-inst4	I expect it to be innovational	5,140	5,260	2,580	5,200
N-inst5	I expect it to be attention-grabbing	5,260	5,420	3,580	5,120
	$(\alpha = 0.757)^1$, $(\alpha = 0.810)^2$, $(\alpha = 0.802)^3$, $(\alpha = 0.779)^4$				
AUX	The formal/visual features of this product will create a positive experience for me.	5,580	3,980	2,880	4,560
AUX	The functional properties of this product will create a positive experience for me.	5,620	4,060	3,320	4,560
IU	I consider using this product in the future	5,740	3,540	2,840	4,220

Notes: N =50, M = mean, SD = standard deviation, λ = factor loadings, α = Cronbach's alpha.
[1]: PS5 DualSense, [2]: Nintendo Joy-Con, [3]: 8BitDo N30, [4]: Steam Controller.

We analyzed our item pool separately (instrumental and non-instrumental items) in both expectancy and AUX questionnaires. Adjusted expectation questionnaire item list determined by examining reliability and consistency can be seen in Table 1. The data of the AUX evaluation questionnaire can be examined in Table 2. When the evaluations made for all products are examined, we can say that functionality is the primary factor of anticipated positive experience based on functional properties. Functionality is followed by ease of use. We can see that the excitement related component is the determining factor of the positive experience depending on the formal features. Beauty, excitement and ease of use factors directly related to intention to use.

Participants were asked whether they have used the devices used in the AUX evaluation phase before. Among the participants there were people who used one or more of these devices. At this stage, we compared the data of users and non-users for 4 devices separately. Accordingly, it was observed that there was similarity and consistency between the experience evaluations (UX) of those who used the product before and the anticipated

experience evaluations (AUX) of those who did not. It can be said that the inexperienced people evaluate with lower scores than the experienced ones, but there is an insignificant difference in the scoring. By looking at these data, we can argue that the AUX evaluation questionnaire can consistently predict the post-use user experience evaluation.

CONCLUSIONS

This study provided a tool to assess the anticipated user-experience, which is a relatively new and developing research topic, in the context of game controllers. However, this tool needs to be improved using data from a larger sample as well as a wider range of products. The analysis of the findings of the study show that there is a consistency with Yogasara's (2014) data regarding the factors affecting AUX and their relations with each other. Non-instrumental features of game control devices are mostly not included in the existing evaluation scales. Our opinion on this subject is that the instrumental features of the products will not provide a holistic evaluation opportunity in experience studies involving both anticipated and usage. In this respect, we think that the data obtained will also contribute to the player experience literature.

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