User experience on games development trends

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Abstract. Game industries are emerging and growing rapidly. Developing good game is becoming more complicated today. It required to achieve user satisfaction and good interaction. Designer has to learn more about social aspects alongside technical aspects. These activities embodied as user experience (UX). In fact, UX and game cannot be distinguished each other. However, it is difficult to be understood. Initial survey had conducted in order to test the statement. Students of Informatics Engineering, UII choose to take survey. Result revealed, even though students understand about UX and game development separately, they confused when asked about UX-based game development. Based on those problems, we conducted a literature review on UX-based game development. 36 papers are reviewed and generated three main discussions. First, usability issues in UX-based game development. Second, virtual reality (VR) is becoming the most popular topic. Third, how to measure children as personas in game development. Briefly conclusion, UX and game development are coherent each other in order to achieve user satisfaction and good interaction. Result of this study can be used as reference for students about the issues of UX-based game development. Even though, this study is not comprehensively produce method yet. It needs further study to strengthen the result and produce method.

1. Introduction

Today, human interaction is shifting games paradigm becoming more complicated and social-minded. Traditional paradigm focus on technological aspect. Recently, interaction is discussed more in games development. Better interaction requires intuitive design which is accommodated by fulfilling human’s psychological and physiological aspects. Those are social minded. Moreover, human sense such as motoric, sensory, and cognitive are becoming obstacles to designer. Human sensory are actively involved in games. There are diverse kind of game with their specific characteristics, such as serious game and VR. Concern on human sensory are useful to produce interactive design aims to simplify user’s efforts. To achieve high interactive level, usability principles is recommended to be used as guideline. Usability measurement is conducted in order to meet user’s learnability, efficiency, memorability, free of error, and satisfaction [1]. Discussion about usability is closely related to human-computer interaction (HCI). UX has been adopted to measure interaction level of game [1]. Based on Hassenzahl & Tractinsky, definition of UX is users with their internal state (expectations, motivation, mood, needs, predispositions,), the characteristics of the designed system (complexity, functionality, purpose, usability) and the context within the interaction occurs (meaningfulness of the activity, organizational/social setting, voluntariness of use) [2].
UX focuses on the experience during interaction between user and product [1]. UX is concretely represented by user interface (UI) which directly interacted with users. In game development, there are three cores of mechanic concept, they are story telling, narrative, and interactivity [3]. Mechanic concept focuses on technical and non-technical factors. Those are aiming to produce intuitive product. Briefly, intuitive product requires good interaction. Bad product is affected by bad interaction. Understanding user deeper is useful to reach users satisfaction. User is main object in game development. However, user’s entanglement in conceptual design is still minimum [4]. Participatory design is an approach which entangle user in design process. Designing game along side with user is useful to discover more about user, which leads to produce good interaction. There are many research found about game development. Some studies engage existing games as subject to be measured, some focus on the method itself. In game development, this process mentioned as playability [5]. Playability aims to engage, motivate, and entertain user during interaction. Playability has crucial role in order to ensure quality of the games. Another methods which found are usability testing, heuristic evaluation, biomatric, gameplay metrics, etc. [5].

Initial survey is conducted to observe students insight about UX concept in games development. Survey spreads to 31 Informatics Department (Universitas Islam Indonesia) students in Human-Computer Interaction class. Result reveals about 97 percent students have curiosity to develop games which they had been played. However, only 35 percent students realize the concept of interaction and usability. Students prefer to concern on technical, such as algorithm, animation tools, or even programming language, than social aspects, such as user interaction. Even though, 61 percent students realize the importance of UX. They realize the importance of UX, but not realize the importance of interaction. We conclude that games development based on UX is not understood by students yet. They need references in this topic. Therefore, goal of this study is proposing insight about UX related to game development.

In this study, we aim to find out about games development trends which is discussed from UX perspective. Based on initial survey stated that only 39 percent students understand about the role of UX in game development. So, it is relevant to conduct this study. Result of study is presented and discussed systematically based on interesting findings. Because of the rapidly growing of game technology, papers which collected is limited on last five years, from 2013 to 2018. There are 36 retrieved papers. In the rest of the papers, we divide discussion into four sections. First section is introduction. Second, methodology that is used during reviewing process. Third, result and discussion. Last, conclusion and future works.

2. Methodology

In this study, we start with the assumption of game development based on UX. Assumption is represented by result of initial survey. In order to answer revealed assumption, literature review on mentioned topic is conducted. Initial survey targets student’s perception on mentioned topic. Briefly assumption revealed, student is understand about UX but confused about UX in game development. They already understand about usability principles and interaction on game's concept. So, literature review aims to give insight about UX trends in games development. There are 36 papers are retrieved from library. Keywords are combined, those are user experience, game, and method. Those keywords are relevant to the mentioned topic. Papers are systematically retrieved from sciencedirect.com library. Paper retrieved must contain those combined keywords on content. Advanced search is customized on year and article type. Papers were being published between 2013 to 2018 and article type specified on research article. During literature review, we divide process into several phases. First, we retrieve all papers related with combined keywords. Second, we conducted abstract filtering in order to remove papers which have irrelevant discussion. Third, we review and present result demographically. Last, we discuss interesting topics. Briefly, methodology of research is simplified into:

- Initial survey by observing students insight.
- Provide assumption based on result of initial survey.
- Conduct literature review to answer assumption.
3. Result and Discussion

3.1. Demographic

First step aims to filter result. This step useful to obtain relevant topics to be discussed. Filtering step is conducted based on two conditions, before and after demographic presentation. Before-demographic, filtering aims to collect relevant papers and eliminate irrelevant papers from collection. There are 36 papers collected from literature review. After-demographic filtering aims to provide interesting topics. Five papers are eliminated in first filtering. Result of second filtering is presented as demographic chart. Result are presented on these following tables and figures. First, Table 1 presents published year of collected papers.

| Year Published | Total Papers |
|----------------|--------------|
| 2013           | 5            |
| 2014           | 2            |
| 2015           | 4            |
| 2016           | 3            |
| 2017           | 11           |
| 2018           | 6            |

Papers are less found due to the implementation of search combination which contain keywords, they are user experience, games, and methods. On Table 2, presented words/sentences which are related to combination keywords user-experience, game, and method. Within this result, we can observe words/sentences comprised in papers.

| Average       | Average / article |
|---------------|-------------------|
| User-Experience| 6.6               |
| Game          | 98.4              |
| Method        | 20.3              |

Sentences of user experience is less found than game and method. Although, almost all papers are paid attention on user’s behavior during interaction. Game is found more that other because it is the main subject. Next demographic chart presents UX approaches classification. UX as Outcome and UX as Method have determined, as shown in Figure 1. As an outcome focuses on user’s behavior and their experience during interaction with game than discuss technically about the method. Otherwise, as a method focuses on the refined and revised method itself.
Figure 1. UX approaches on games development.

Information revealed on Figure 1 is relevant to information on Table 2, whereas UX as method was less found in papers. Next figure, presented type of users which are involved. Games user means all game users without specified on such kind of games. Games user significantly predominate than other. There are four specific type of users, and General user. General means users which can not be classified into five other types.

Figure 2. Users found on paper reviewed.

There are significant number of different between Game User and other. There is no detail description about users in Game User. Even though, detailed description of user is mandatory required in UX-based’s user-research. Another finding is the children as user of game. Special treatment is needed while involve them as subject of measurement [6], [7]. Treating children has different paradigm than adult. It requires special approach to adjust their psychological and cognitive process. Moreover, they need being supervised personally while measurement. Student as game user is another finding. It may relevant to the topic of education game. Develop education-based game could consider student’s developing process, learning process, education curriculum, interaction between teacher and students. Another type of users are patient and operator. Whatevoever types of game user, it needs specific treatment, user is mandatory to be discovered deeper. Failure on understanding user means failure on treating them. Good treatment leads the fulfillment of user’s desire when playing game. This is the key of good interaction. Type of user related to domain of the research. In Figure 3, domain of researches are presented.
Specifically, there are four domains of game which are found, they are concept, medical, education, and entertainment. Medical found as the most discussed as topic. Medical researches are conducted related to the medical standards. Main goal on this subject aims to prevent malpractices by providing simulation tools. On certain case, collected of data are challenging to designer to be simplified, so it is easier to be read. Second most discussed is games which is focus on conceptual analysis than technical aspect. Third is entertainment. In this case study, games are developed in order to lure user’s attention. So, it is ignoring more about conceptual analysis. Education-based games is still emerging too. There are a lot of games product that we can found but it is rare to found papers related to this. Deeper topic of researches is presented on Figure 4. It futile to present them all. Two major topics discussed are concerning on game and VR.

Two topics which dominantly discussed, concerning about various game and VR. Concerning on Games means specific game theme where discussed in each paper. There are diverse game themes found in papers. Each theme is discussed as case study. Specific on VR, it is challenging to Informatics Engineering UII students who want to explore this topics because more than 90 percents respondents do not understand about how to develop interactive VR. Whereas, this topic still flourish to be studied. Discuss about VR is complex, it requires adequate environment, live experience, and controller standardization. Apart from these two topics, we cannot produce another pattern because they consist of
heterogeneous topics and each of them has insignificant number. The number of heterogeneous topics dominates more than half of total papers.

3.2. Discussion
General result show that papers which are reviewed are not specifically discuss about UX as method in game development. Some papers are put UX as an outcome on user’s behaviour consequenced by interaction. So, it is too weak to formulate UX methodology based on this study. Nevertheless, finding on reviewing papers still useful to to improve theoretical issues about games development. Some issues about specific domain such as medical, education, entertainment are useful to map researches about games development. Moreover, discovering user and identifying technology used in games development are interesting to be discussed in further researches.

Interaction and human behaviour are revealed as issues. Software engineering as a scientific base, requires good integration between theoretical and practical aspect in order to produce high-quality product [8]. These issues related to the initial survey which revealed most of students were not understood how to develop game based on UX approach. However, students are understood about the importance of interaction between user and game. UX approach are related to user-centered design (UCD), whereas user is standpoint. Even though, most of reviewed papers are not specific user clearly. They prefer focus on technical goal on technology than discover user. Moreover, user was treated generally than treated specially as human-being.

3.2.1. Usability Measurement
Usability measurement is useful to reach good interaction. A lot of method had been found to measure usability of product. Each method has indicators to measure specific target. There are diverse indicators which found to measure usability. It is classified into technical and social aspect. Technical aspect focuses on utilization of tools in measurement. Social aspect focuses on implementation of human sensory and capability during measurement. Sanchez and Vela mention usability aspect in game development as playability [5]. Playability is mentioned to illustrate measurement process on children. Nielsen in 2010 stated that usability is comprised from five attributes, they are learnability, efficiency, memorability, error, and satisfaction. Kim and Lee (2015) used effectiveness, efficiency and satisfaction [11]. They also consider Ten’s Heuristic Principles by Nielsen. In other research, Brade et al (2017) used attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty [9]. So far, effectiveness and efficiency are used in almost all methods.

Luse et al (2013) used modified-UTAUT to measure user’s behavior [10]. They measure human-social impact such as performance expectancy, effort expectancy, and social influence affect behavioral intention. Jangraw et al (2014) prioritize two elements, support and flexibility [11]. UXA (user experience assestment) proposed by Cano et al (2017) to measure specify on children [12]. UXA comprises direct observation, thinking aloud, drawing intervention, picture card, wizard of oz, fun toolkit, and surveys. These found describe how important discovering user based on their characteristics.

Social aspect is then revealed, contradiction between universalism versus uniqueness, affective versus neutral, are arised [5]. Cognitive science is urging to be included in measurement. Norman was mentioned on Sánchez and Vela, motivation is key factor in provoking better interaction [5]. We can conclude that social aspects are found in this discussion more than technical aspects. Indicators in usability measurement that found are collected randomly in Table 3.
3.2.2. Virtual Reality

Implementation of virtual reality (VR) is recently raising. VR goal is aim to improve experience when users presence are achieved [9]. Experience is key of success in VR. VR is helpful to simulate the real case into simulation model. It requires usability measurement to ensure this goal is achieved. So, it is more cost-efficient than field or laboratory test [9][11]. As simulation tool, it is required to reach satisfaction experience. Satisfaction experience distinguish between simulation and real world as thin as possible. So, user will feel real experience during inside the simulation. Moreover, other multimedia supporting such as sound effect is required to fulfill those experience. We can simplify into two key-factors, user and experience. However, age of user had negative correlation to the VR [13]. Those two factors determine successful of the usability. Usability impacts, affected by the implementation of VR are still conflicting. As we can see in Table 4, conflicting results are presented [9].

Table 3. Usability indicators found.

| Learnability       | Efficiency    | Memorability            |
|--------------------|--------------|------------------------|
| Effectiveness      | Satisfaction | Error                  |
| Attractiveness     | Perspicuity  | Dependability           |
| Stimulation        | Novelty      | Performance-expectancy  |
| Effort-expectancy  | Social influence | Behavioral intention   |
| Support            | Flexibility  | Direct observation      |
| Thinking aloud     | Drawing intention | Picture card      |
| Wizard of oz       | Fun toolkit  | Surveys                 |
| Motivation         |              |                        |

Table 4. Conflicting result regarding to usability of VR.

| Improve Usability | Not Necessarily Improve |
|-------------------|-------------------------|
| Kaikkonen et al. (2005) | Duh and Chen (2006)    |
| Busch et al. (2014)   | Sun and May (2013)     |
| Nichols (2004)        | Kjeldskov et al. (2004) |

Some framework are found in literature review aim to measure usability of VR product. Brade et al in 2017 used SUS within four factors, they are sense of physical space, engagement, ecological validity, and negative effects [9]. UEQ used attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. Balancing measurement between real and virtual world is recommended to be conducted in order to compare linkages between usability and business process needs.

De Georgino et al (2017) revealed the key elements required to produce better experience, they are virtual world, immersion, feedback, interactivity, and participants [14]. Inability to convert real object into VR properly may impact on usability quality [15]. Quality of display which is implemented on the interface fidelity and the responsiveness had massive impact on performance [16]. Controller is one of the main obstacles because VR does not has control standard. Difficulty in controlling, potentially reduces usability quality. Devices which are used in control schemas are controller, depth cameras, haptic devices, and tracking [14]. Those controllers should be handled properly in order to improve usability. Brief summary about VR and UX are completely complex. It is required to not distinguish
between user interaction and hardware aspects. Moreover, user interaction aspects, such as convenience and suitability between real and simulation are important to be noticed.

3.2.3. Special Approach for Children
User is a key factor aim to develop an interactive product. It should be discovered deeply. In UX, this domain represented by personas. Interesting challenge may be met when involving children as personas. Discovering adult is easier than discovering children as personas. Children need special approach adjusted to their age. Children need to be supervised while measurement process. It requires more effort to measure children. Instead of traditional questionnaire tools where user must answer to-do-list question, they need joyful ones. UX is appropriate to measure engagement and joyful emotion effectively than traditional usability measurement [17] on [18]. How to treat children was studied in researches on educational perspective [7]. As we have mentioned, UX is closely related with social science. It is impossible to ignore social aspect behind technical aspect. In order to discuss about children as personas and its development, psychological aspect is an essential part [19]. Technical aspects need to be formulated as their understanding. By supervising them, to-do list and list of questions should be replaced by *play around them*. Joyful and interactive measurements aim to attract their attention, so they will feel play than work on to-do list and questions.

While measuring children as personas, we prefer to meet them face-to-face than using questionnaire tools [6]. However, questionnaire with graphically fun such as utilizing smileometer are helpful [18]. Moreover, we still need to supervise them. Smileyometer can encourage children to answer questions [18]. Sim et al (2016) recommended fun toolkit [6] and PIPC (problem identification picture card) [20]. Fun toolkit is luring children during measurement process. Similar method, PIPC is recommended, utilizing picture card to attract their visual attention. Psychologically, children is more attracted by graphical than text-based. This is suitable to encourage their experience and optimize their cognitive abilities. As Alhussayen, et al. (2015) stated, seven to eleven years old children is unable to formulate hypothesis and understanding abstract concept [18]. They need more such fun things than systematic task.

Related to the kind of games, physical abilities should be considered used in gameplay. However, it is optional to be applied based on certain games characteristics. Children admires more playful activities, they difficult to expressing their feeling, but their feeling is reflected by their playful activities [21] on [18]. Exceed their motoric movement potentially impacts on their confidence [21]. Simple interaction, such as button, keyboard, and gesture are better to be implemented. It is challenging to design simple but contain a lot of materials should be accommodated. Minimalist design is recommended to avoid crowded material only in one page. Moreover, colourful material staining is helpful to attain children attention.

4. Conclusion
There is ambiguous explanation about UX in this study. It founds wide contradiction about UX in games development. We divide UX meaning into *UX as a method* and *UX as an outcome*. UX as a method discusses about methodology used aim to develop interactive aspects of game. UX as an outcome discusses about the interaction between user and game. Moreover, there is no distinguish difference between game method and other development. Although it is found some case, such as treating children as personas and live experience measurement on VR. Instead of generating method, this study producing insight about interaction aspects so student can pay attention aside with technical aspects. This study is formulated based on demographic data. Another interesting finding is number of game products with specific theme not alignment with the number of papers which found. Briefly, we can divide discussion into following result.

- User interaction can be measured utilizing usability aspects. Briefly, we can classify indicators into cognitive, social, and technical aspect. Specifically, effectiveness and efficiency are found in almost all usability principles. In order to produce better interaction, it is required to entangle
those aspects. Cognitive aspects, such as learnability and memorability, made game to be more interactive and easy to be used. Social aspects, such as social influence and behavioral intention, give values on game. Technical aspects, such as utilization of fun toolkit and surveys, useful to measure personas as game user.

- Topic of VR is most popular topic found. Live experience on VR-based game is closely related to UX concept. Experience is more difficult to be entangled in VR, cause it is involving human sensories in one time. User’s convenience should be observed deeper. There are contradiction findings about usability impacts. Some researches argue VR able to improve usability, but some others argue contradictively. Generally, only half of reviewed papers are observing user deeply. Discussion in this research is still beginning. It needs further research to encourage comprehensive result.
- It needs special approaches when involving children as personas. Psychologically, children is attracted by something fun and joyful. It is recommended to avoid traditional questionnaire and to-do-list questions. There are some fun technique found to attract children’s attention such as fun toolkit and picture card.

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