DEVELOPMENT OF A HEXAGON AESTHETIC USER EXPERIENCE MODEL FOR AUGMENTED REALITY COMICS

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UNIVERSITI PENDIDIKAN SULTAN IDRIS

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ABSTRACT

This study aims to examine the potential of synergising models from two different theories, known as aesthetic experience (AX) and user experience (UX), which highlight a sizeable theoretical gap for augmented reality comics (AR comics). Thus, a new model called aesthetic user experience (AUX) was purposed in this study. Design Development Research (DDR) model was adapted through research design in this study. Two evaluation phases namely Fuzzy Delphi Method (FDM) and Structural Equation Model (SEM) were used to develop and to test the constructs and elements. Five experts from comics and five experts from AR were selected to obtain the initial AUX constructs. The analysis was conducted based on FDM conditions: threshold, $d \leq 0.2$, expert consensus percentage > 70% and fuzzy score, Amax > 0.5. The FDM results have established seven constructs namely storytelling, amusement, harmony, inspiration, incentive, mindfulness and efficiency. Model validation was performed using SEM through confirmatory factor analysis (CFA). A total of 193 samples (n = 193) comprised of generation Y and millennials (born in 1982–2010) who had knowledge in the creative fields and information technology were selected. This analysis is based on the condition of model fit in CFA: factor loading $\lambda > 0.7$, df < 5.0, CFI and TLI > 0.8, RMSEA > 0.05 to 0.09 and convergent validity (AVE) > 0.45. The CFA analysis confirmed six constructs namely storytelling, amusement, harmony, inspiration, mindfulness and efficiency, hence the name hexagon AUX model. The new proposed model has immense implications for emerging areas of art and technology. Potential applications for the hexagon AUX models can be extended beyond VR comic such as VR drawing, AR painting and immersive digital art installation.

PEMBANGUNAN MODEL PENGALAMAN PENGGUNA ESTETIK HEKSAGON UNTUK KOMIK REALITI TERIMBUH

ABSTRAK

Kajian ini bertujuan untuk mengkaji potensi integrasi model dari dua teori yang berbeza, yang dikenali sebagai pengalaman estetik (AX) dan pengalaman pengguna (UX), yang menonjolkan jurang teori yang cukup besar untuk komik reality terimbuh (augmented reality comics-AR comics). Oleh itu, model baharu yang dipanggil *aesthetic user experience* (AUX) dicadangkan dalam kajian ini. Model *Design Development Research* (DDR) telah diadaptasi melalui reka bentuk kajian dalam kajian ini. Dua fasa penilaian iaitu Kaedah *fuzzy delphi method* (FDM) dan *structural equation model* (SEM) digunakan untuk membangun dan menguji konstruk dan elemen. Lima pakar dari komik dan lima pakar dari AR telah dipilih untuk mendapatkan model awal AUX. Analisis dijalankan berdasarkan persetujuan FDM: threshold, d≤ 0.2, peratusan konsensus pakar > 70% dan skor fuzzy, Amax > 0.5. Hasil FDM telah membentuk tujuh konstruk iaitu *storytelling, amusement, harmony, inspiration, incentive, mindfulness* dan *efficiency*. Pengesahan model dilakukan menggunakan SEM melalui analisis faktor pengesahan (CFA). Sebanyak 193 sampel (n = 193) terdiri daripada generasi Y dan milenium (lahir pada 1982–2010) yang mempunyai pengetahuan dalam bidang kreatif dan teknologi maklumat telah dipilih. Analisis ini berdasarkan keadaan model sesuai dalam CFA: factor loading λ> 0,7, df <5,0, CFI dan TLI> 0,8, RMSEA> 0,05 hingga 0,09 dan convergent validity (AVE)> 0,45. Analisis CFA mengesahkan enam konstruk iaitu *storytelling, amusement, harmony, inspiration, mindfulness* dan *efficiency*, dan dinamakan *the hexagon of AUX* model. Model baru yang dicadangkan mempunyai implikasi yang besar untuk bidang integrasi seni dan teknologi. Aplikasi yang berpotensi untuk model *hexagon AUX* dapat diperluas di luar konteks komik seperti lukisan VR, lukisan AR dan seni installasi.

TABLE OF CONTENT

CHAPTER 2 LITERATURE REVIEW

CHAPTER 3 RESEARCH METHODOLOGY

CHAPTER 4 FUZZY DELPHI METHOD (FDM) ANALYSIS

CHAPTER 5 AR COMIC DEVELOPMENT

CHAPTER 6 CONFIRMATORY FACTOR ANALYSIS (CFA)

CHAPTER 7 DISCUSSION, SUGGESTION AND CONCLUSION

LISTS OF TABLE

LISTS OF FIGURE

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Since 2013, the printing industry, especially books, magazines, and newspapers, has been through a more robust challenge when there is a decline in sales and acceptances to the media (Abdulah and Ishak, 2016). The issue starting with the declining of newspaper sales like the New Straits Times (NST), which was recorded with the most significant drop of 32.4% to 37,885 copies a day followed by a 25% drop of *Harian Metro* sales. On the contrary, there was a considerable increase in each of these newspapers' digital platforms when NST recorded 12.65 million users in news and information categories. Simultaneously, *Harian Metro* registered 13.07 million users, and *Berita Harian* gathers 41.06 million users throughout 2017 (Alivi et al., 2018 ; Nielsen 2018)

Likewise, with the National book industry, the fall of physical book sales has made the iconic bookstore MPH close one of its shops located in *One Utama* Kuala Lumpur in August 2018, proving that the book industry is also going through a tough challenge. MPH also expects that there will be another branch closing down as the response to the demand of physical books is getting less and alarming.

Worryingly, Malaysia's desire to develop Kuala Lumpur as a world-class city book by 2020 under United Nations educational, scientific and cultural organizations (UNESCO) will be affected by the national book industry (Sanusi and Adnan, 2014). However, simultaneously, an increase of 2% demand to digital books recorded every month allows a substantial shift of reader trends to favourite books to a more interactive environment (Alivi et al., 2018 ; Nielsen, 2018 ; Santos, 2011)

Equally important, the comic book industry was also affected by this challenge when the two largest comic producers, DC comic and Marvel, announced a 6.5% drop in 2017 from US $ 1.015 billion down to US $ 70 million by 2016. One of the most prominent factors why this issue occurred is due to the rapid growth of digital environment around the world. By way of example, DC Universe platforms are among the highest platforms streaming content by user (Alivi et al., 2018 ; Nielsen, 2018 ; Santos, 2011; Abdulah and Ishak, 2016).

In August 6, 2015, a local comic magazine created an unexpected history when MOY publication that publishes popular magazines *Apo* and *Ujang* was officially closed for the magazine publication. MOY publishing director admitted that digital readers' trend contributes to the magazine's sale to collapse. Aligned with this, MOY

has taken a digital approach by setting up *Bekazon's*, which is focusing on e-comics and motion comics besides making online comic sale.

Since the new media's birth in 1995, the changes in life, social, way of thinking, and working environment grow gradually (Alivi et al., 2018). In the publishing area, the newspapers, books, or comics are holistically changing from content form presentation to book production processes involving editing, designing, printing, and distribution. In today's digital era, all conventional content is no longer tied to a particular form. It is more interactive and co-existed with the device that became its reading platform (Abdullah & Ish ak, 2016; Sanusi & Mustaffa, 2015). The birth of new media, as well as internet technology, directly boosts up the method of delivering information. In publication, Silva (2011), mentions that digital publishing is not merely conventional format transfer to digital-only but has distinctive characters such as; interactivity and motion, which completely changed its publication format from conventional to digital screen.

Recently, we are moving towards 4.0 industry revolution that comes with mix reality technology (MR), Virtual reality (VR), augmented reality (AR), and Hologram. They shift the landscape of the publication to something unexpected when text, sound, visual and animation appear in lines not only on screen but beyond that. This has caused greater impact on digital technology. By the same token, internet speed phenomenon and cloud computing has also became a significant contributor to the publishing industry when Nielsen (2018) reported that digital media had grown steadily through the usage of the internet.

More than 70% of Malaysians from the age of 15 years old and above use the internet, with 98% using the internet via smartphone, each subscribing to a data plan, and 63% using Wi-Fi. Nielsen (2018) also reported an average of 15 hours used by Malaysians using smartphones and the rest for other devices such as laptops and tablets. This trend data demonstrates that the landscape of Malaysian thinking and life has changed holistically and directly affects the national publishing industry.

1.1.Problem Statement

Digital technology allows comics to evolve from conventional printed media to more interactive digital comics, on-screen, non-sequential pages, animations, sound, and special effects. It was coupled with advancement in mobile technologies that plays a significant role in transforming comic art (Arroio, 2011; Smith, 2015).

The transformation of conventional comics into digital comics reflects the growth of comic's demands in digital environment. It started with comics on the web, and then switched to interactive comics and eventually to motion comics. Comics are no longer presented in the traditional forms, but the medium is relevant as technology progresses. In a practical sense, it can be said that comics are an ever-expanding aesthetic object.

The effect of today's digital technology has integrated augmented reality (AR) with virtual reality (VR) into mix-reality (MR) and is widely explored in various fields. AR itself is moving fast in content, visual, animation, media, and interactivity.

In addition, mobile technology's existent makes AR more relevant to users and achieving high user targets (Jamali et al., 2014). Under these circumstances, there is a wide range of AR-based products on the market such as AR coloring books, prosthetic reality, AR advertising, and AR shopper (Furht, 2011; Webel et al., 2011; Cowling et al., 2017).

Lately, AR products have been improved with new quality and experience to art objects such as drawing, painting, and posters. Undoubtedly, in comics, there has been an emergence of conventional comics that make an AR element a new experience for readers or comic fans. In 2014, an initiative in the Modern Polaxis AR comic book project by Sutu, has incorporated AR experience as a new comic reading medium. Destiny's Sword and the Masters of the Sun comics were involved where these comics are presented traditionally and supplemented with the AR experience. As the result, AR has become a bridge that transforms conventional comics to digital technology.

Theoretically, AR product relates to the science of human-computer interaction (HCI) and uses a user experience approach (UX) as a method of measuring an AR product (Law et al., 2008; Peng et al., 2009; Zaphiris, 2013). In Hassenzahl's (2007) study, there are two primary UX components, which are pragmatic and hedonic. Both components support each other to achieve positive UX. In a pragmatic approach, the focus is on UX products that are perceived to have the ability to support achievements or do-goals. On the other hand, hedonic refers to the ability to achieve goals.

In the study of Schrepp et al. (2013), pragmatic and hedonic elements were used as an impression guides for the product on its acceptance or rejection. The study stated pragmatics approach includes task-oriented quality aspects, efficiency, and learnability, whereas the hedonic approach focuses on stimulation, aesthetic impression, and novelty.

Empirically, Matcha and Rambli (2011) emphasize that positive UX elements are crucial in a technology product or device to determine the effectiveness and usability of a product to a user. It means that the UX approach is meant to avoid the negative UX into technology product (Azzawi, 2013). In other words, to test or implement a technology product, negative elements of UX such as dislike, frustration, and complexity will be avoided to improve a technology product.

Usability is also an essential component in UX where the aspects of time, function, priority, and positive experience are incredibly stressful. Considering how the user responds to a product and what is the UX element reaction before, during, and after using a product (Alenljung et al.,2017; Irshad & Rambli, 2016).

Irshad (2013) confirms that a significant UX component is designed to find the emotion. Each product that was created, takes into accounts the positive emotions that come from the user's response to the product. Olsson (2013) advocated in his research by proving a substantial UX in order to measure and collect the user positive feedback for designing UX products and avoiding negative UX (Ritos, 2011; Irshad & Rambli, 2016; Hassenzahl, 2007).

Conversely, comics are classified as one of the art forms or an aesthetic object and should be measured from an aesthetic perspective. There are narrative, visual and text elements in comics that can be used as a medium of expression to invoke emotion (Muliyadi, 2015; Eisner, 2000; McCloud, 1993).

Moens (2018) inspired AX's characteristics based on elements such as, formalities, content, cognitive, perceptions, and emotions to create a vital component which is essential in assessing and measuring aesthetic objects (Harrison & Clark 2016).

Markovic's (2012) study emphasizes that an art object's context seeks to determine the AX element that will be reflected from contemplating an art object. In the context of AX, the process of appreciating the artwork involves the spiritual sense born of its biological, psychological, and social functions, not just to see or appreciate the beauty of the work from a formalistic point of view. Still, it can evoke aesthetic emotions such as sadness, anger, joy, passion, motivation, or even annoyance.

Redies (2015) mentions that appraisal or appreciating a piece of art needs the beholder to go through five stages of aesthetic judgment which is, formalistic, cognitive, content, emotions, and ultimately AX. On the other hand, the beholder who can only appraise the beauty of a formalistic point of view (color, line, composition, and form) is considered providing a naive assessment and requires an expert appraisal to appraise an artwork.

Obviously, AX has essentially design to stir the emotion by captivating the negative and positive emotion. In the context of an aesthetic object, the art-forms determines the negative or positive emotional elements such as, joy, fun, amusement, sad, anger, fear and dislike that needs to be reflected on aesthetic object to measure the AX element in the comic (Redies, 2015; Leder et al., 2004).

Based on the literature review, it is safe to say that there was no element of AX in the AR product even though studies were done using aesthetic objects as its subject and vice versa, no UX element in the art-forms was found, despite using AR as its medium. Several studies involving AR products integrating arts as its subject matter were evaluated in UX terms such as time, efficiency, usability and design. However, from design context, the evaluation is limited, which only involves the formalistic elements and discard the emotion factor. In the facet of emotions, it is more than positive emotions such as motivation, passion, and encouragement. In other words, it avoids evoking the negative emotions (Radoslavov et al., 2015; Dirin et al.,2018; Qu et al.,2017; Olson et al.,2011).

By way of example, Morreall (2009) used elements of AX in his study to measure comics such as amusement, the paradox of tragedy, and mental jolt without reference to UX elements even though the comic was already integrated with technologies such as interactive, motion comics, webcomics, and AR comics (Smith, 2015; Ayer, 2014; Wang et al., 2019).

Empirically, there is a clearly a huge theoretical gap between AX and UX when managing art and technology-based products like AR comics. This requires a new

model to review this product. Among UX features that are featured in AR are efficiency, inspiration, motivation, creativity, and meaningfulness, while AX features in comics are; amusement, harmony, storytelling clarity, and mental jolt (Morreall, 2009; Klaehn, 2015; Plutchiks, 1980; Olsson & Mattila, 2011).

In short, this study suggests the synergising of UX and AX in AR comics should be based on several reasons 1) AR is an HCI-based product and highly relevant to UX as a measuring method while, comics are aesthetic objects and necessarily use AX as their measurement method, 2) UX evaluates users, usability, time, and design, while AX involves feeling, content, and expert appraise 3) UX involves technology products and usability, while AX is an aesthetic object and requires appreciation. AR is produced only in enhanced information, but it is imaginative and enhances emotion experience in AR comics.

1.2 Research Objective

1. To examine the similarity and dissimilarity of construct and elements in AX and UX
2. To explore the possibility of synergising both AX and UX construct as a new model for New Media Art.
3. To design a desirable AR Comic based from Aesthetic User Experience (AUX) model.
4. To validate AUX model using AR Comic as a stimulus.

1.3 Research Question

1. What is the similarities and dissimilarities of AX and UX construct?
2. What are the constructs and elements suitable to be synergised for AUX model?
3. How to integrate AUX model with exiting process to develop AR Comic?
4. How many construct in AUX model deem to be vital to design desirable AR Comic?
5. What are the vital constructs in AUX model in designing desirable AR Comic?

1.4 Hypothesis

H1 There is a vital construct in AUX model to design a desirable AR Comic

H2 There is a strong conformation construct in AUX model in designing AR Comic.

Table 1

The relationship between research objective and research question.

No	Research Objective	Research Question
1 2	To examine the similarity and dissimilarity of construct and elements in AX and UX. To explore the possibility of combining both AX and UX construct as a new model for New Media Art.	1. What is the similarity and dissimilarity of AX and UX construct? 2. What are the constructs and elements suitable to be synergised for AUX model?
3	To design a desirable AR Comic based on Aesthetic User Experience (AUX) Model.	1. How to integrate AUX model with exiting process to develop AR Comic?
4	To validate AUX model using AR Comic as a stimulus. .	1. How many construct in AUX model deem to be vital to design desirable AR Comic? 2. What are the vital construct in AUX model in designing desirable AR Comic?

1.5 Conceptual Framework

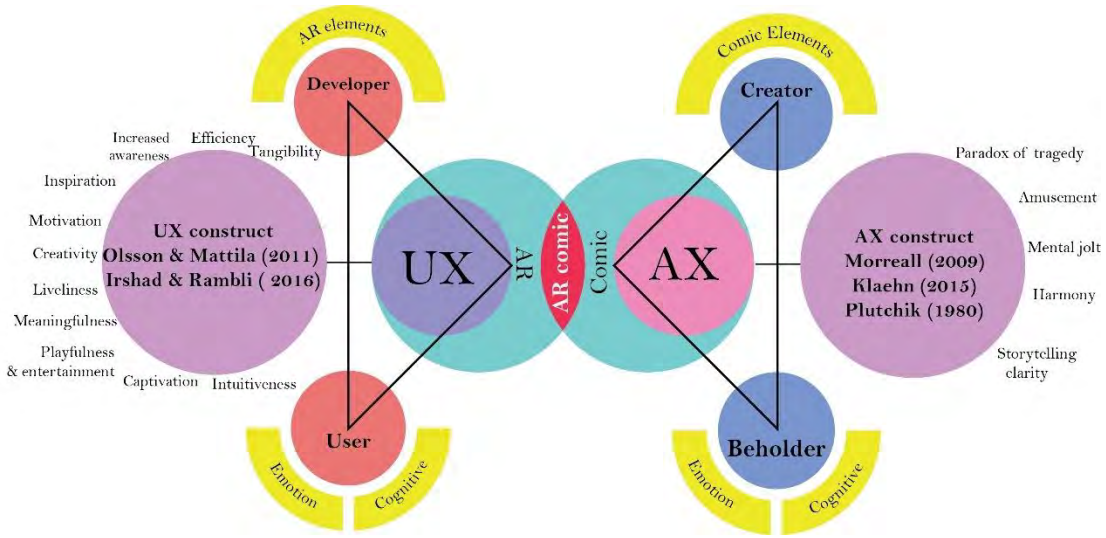

Figure 1. Conceptual framework of synergising the UX and AX in AR comic

In this conceptual framework, it illustrates how AR comic integration based on AX and UX theory. At the development stage, the AR elements are emphasised to meet an AR features such as, to sense properties about the real world, a process in real-time, output (overlay), to provide contextual information, to track real-world object, and mobility. In addition, AR techniques will also be applied in AR comic design, such as, situated visualization, object as context, sensor data as context, the scene as context, and uncertainty as context (Kalkofen et al., 2011; Stefan et al., 2014, Billinghurst et al., 2001 & Braun, 2003).

Meanwhile, at the creation stage, the comic elements become a guideline to create a comic content using AR. According to the comic principles, this element is essential for the content, technical and comics narrative. The intended element are trails, distance pacing, narrative subdivision and fidelity, sustained rhythm,

gradualism, motion, spatial depth, animated comic book panel, cinematic adaptation, screen-based format and genres (McCloud, 2000; Smith, 2015).

Users need to contemplate AR comics with cognitive and emotion in order to appreciate an AR Comics and reflects the experience in three focused time which are, before, during, and after using the AR comic products. The user cognitive elements need to be regulated because, according to Markovic (2011), prior knowledge is significant in order to contemplate an aesthetic object and give an assessment to an art-forms.

The appraisal of AX and UX ratings against AR comics depends on what elements evoke the user's emotion. In AR, several UX elements react to AR products such as, efficiency, inspiration, motivation, creativity, liveliness, meaningfulness, playful and entertainment, captivation and intuitiveness (Olsson & Mattila, 2011). Conversely, in comics, the cognitive shift occurs when the user reads the comics and produces an AX element. Cognitive shifts such as amusement, arouse, funny, the paradox of tragedy, tragic and mental mode jolt generating bizarre and fantastic modes toward comics (Morreall, 2009).

However, there are many AX and UX elements that need to be considered when measuring AX and UX in AR comics, as outlined by Plutchik (1980), such as contempt, aggressiveness, optimism, love, submission, awe, disapproval and remorse as well as technical elements in UX product such as time, effort, device and design (Parrot, 2001; Matsumo & Hwang, 2011).

1.6 Significant of research

This study aims to develop a model from a combination of AX and UX to the development of AR comics. The problem statement mentioned earlier clearly shows the need to carry out this research. Positive impacts are expected to few benefits, such as; 1) printed comics will be used extensively because AR comic requires image data to read AR content digitally. This means comics in physical form are needed in line with the AR content that will appear. 2) propose the addition of AX to UX theory since UX is a theory that works with HCI and aesthetic objects require AX as a measurement method and propose the addition of UX to AX theory since AX is a theory that works with aesthetic objects while AR products need to be measured in UX theory.

Next 3) propose a new model in product validation based on HCI technology and art-forms that is currently being developed. This leads to the need for a combination of new models to measure or evaluate the combined products in art and technology that is produced rapidly. 4) expand the combination of research methodology by proposing Fuzzy Delphi Method (FDM) and Structural Equation Model (SEM). FDM and CFA are two types of a powerful and reliable analysis instruments. The combination of the two analysers will make this research more credible, and 5) expand media use by integrating aesthetic, AR, animation, mobile and 4.0 industries revolution that touches on inter-media technology.

1.7 Limitation of research

1. Respondents are the generation of Y and Z (18-35 years old) who are the average mobile technology users, the usage internet and most exposed to new media. Cognitively, they also have prior knowledge of the comics and the revolution of technology that affect them.
2. Existing comics are selected from the latest comic works around 2016 to 2017.
3. Using only AR comic as a stimulus agent rather than a conventional comic or other digital comics.

1.8 Operational definition

1.8.1 User experience

As it is known that UX covers a wide range of areas, like usability, time, effectiveness, system, design, and aesthetics. However, UX in this study refers to HCI related to technology products relevant to MR in generals and AR in particular (Hassenzahl, 2007; Dirin and Laine, 2018; Irshad and Rambli, 2017)

1.8.2 AX

AX is a field affiliated with art and art activities, including dance, film, theatre, paintings, and sculptures. It is also referred to as an art-form or an aesthetic object. Relatedly to this study, AX refers to the comics as an aesthetic object that is part of illustration art (Harrison and Clark, 2016; Docherty, 2018; Scarles, 2020).

1.8.3 AR comics

AR comics is a combination of aesthetic objects (comics) with technology products (AR). The name AR comics has been popularized and widely used in AR comics released by Marvel namely Master of the Sun in 2017 and comic painter Sutu in 2014 by releasing AR comics titled "Sutu Eat World". Through this study, both entities are different in terms of their scientific field and two significant theories, namely AX and UX.