



Faculty of Cognitive Sciences and Human Development

**COMPARISON OF 2D AND 3D PRODUCT VISUALIZATION FOR
AN E-COMMERCE WEBSITE ON TELEPRESENCE, FLOW,
BEHAVIOURAL INTENTION, AND BRAND EQUITY**

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Final Year Project Report ☒

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**Comparison of 2D and 3D Product Visualization for an e-Commerce Website on
Telepresence, Flow, Behavioural Intention and Brand Equity**

Alan Lee Pik Jin

**This project is submitted
in partial fulfilment of the requirements for a
Bachelor of Sciences with Honours
(Cognitive Science)**

**Faculty of Cognitive Sciences and Human Development
UNIVERSITI MALAYSIA SARAWAK
(2015)**

The project entitled ‘Comparison of 2D and 3D Product Visualization for an e-Commerce Website on Telepresence, Flow, Behavioural Intention and Brand Equity’ was prepared by Alan Lee Pik Jin and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfillment of the requirements for a Bachelor of Science with Honours (Cognitive Science)

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ABSTRACT

E-commerce website due to its convenience is gaining rapid popularity. The representation of the products in the website is important as it may affect the intention to purchase of customers. This study compares between 2D and 3D product visualization on an e-commerce website in terms of Telepresence, Flow, Behavioural Intention, and Brand Equity. A single website that contains three different and separate product visualization pages (2D pictures, Video, and 3D Model) was developed and evaluated via an experimental research design. Ninety respondents with Human Computer Interaction background were chosen using convenience sampling method. Through the statistical analysis, it is shown that 3D product visualization is more significant for four constructs. It is also shown that there is a positive relationship between telepresence and flow; telepresence and behavioural intention; and between behavioural intention and brand equity. These results show that 3D product visualization is more significant and effective compared to 2D product visualization.

Keywords: telepresence, flow, behavioural intention, brand equity, e-commerce website, product visualization

ABSTRAK

Laman web e-dagang semakin meningkat popularitinya kerana kemudahannya untuk membeli barang atas talian. Pembentangan produk dalam laman web e-dagang penting kerana ia boleh menjejaskan niat pelanggan untuk membeli. Kajian ini membandingkan antara visualisasi produk dalam bentuk dua dimensi (2D) dan tiga dimensi (3D) dari segi Telepresence, Aliran, Tingkah Laku Niat, dan Ekuiti Jenama. Sebuah laman web e-dagang yang mempunyai tiga jenis visualisasi produk (gambar 2D, video, model 3D) dalam tiga halaman web yang berasingan telah dihasilkan dan dinilai melalui reka bentuk kajian experimentasi. Sembilan puluh orang responden yang mempunyai pengetahuan dalam Interaksi Manusia Komputer dipilih menggunakan kaedah persampelan mudah. Melalui analisis statistik, visualisasi produk 3D lebih berimpak untuk kesemua empat konstruk. Ia juga menunjukkan hubungan yang positif antara telepresence dan aliran; telepresence dan niat tingkah laku; dan di antara niat tingkah laku dan ekuiti jenama. Keputusan ini menunjukkan bahawa visualisasi produk dalam bentuk 3D adalah lebih berkesan berbanding visualisasi produk 2D.

Kata Kunci: telepresence, aliran, niat tingkah laku, ekuiti jenama, laman web e-dagang, visualisasi produk

CHAPTER ONE

INTRODUCTION

Background of the Study

Many are focusing on fully immersive virtual environment in terms of business due to the trend and growth of the Virtual Reality (VR) technology and research, where fully immersive environment allows full movement and navigation by copying human motion in virtual environment, thus allowing user to experience an increase in presence and details of the environment (Patel, Bailenson, Hack-Jung, Diankov, & Bajcsy, 2006). Ives and Junglas (2008) predicted that in 10 years, VR would be significantly improved compared to the progress of it since 1989 and it would be one of the top platforms for business. However, this study will not focus on fully immersive VR but focuses on non-immersive VR or in another term, desktop VR.

Nah, Eschenbrenner, and DeWester (2011) compared the effect of 2D and 3D virtual worlds on brand equity, telepresence, enjoyment and behavioural intention by using the theories of flow, and telepresence. Where behavioural intention is the feeling towards a brand or product and it can be either positive or negative. Nah et al. (2011) compared effect of 2D and 3D virtual worlds by instructing the users to navigate through a virtual hospital using 'next' and 'go back' button for the 2D version, then navigate in a collaborative virtual environment called Second Life using basic movement actions for the 3D version.

Telepresence, flow, behavioural intention, and brand equity are interconnected. Telepresence which is one aspect of flow which can improve brand equity through enjoyment, and high brand equity may lead to higher behavioural intention (Nah et al, 2011; Lee & Chen, 2010).

Problem Statement

Positive and negative effect may result from a 3D visualization of a product in an e-commerce website which may provide high enjoyment or it may result in cognitive overload (Nah et al., 2011) due to the distraction of content, called the distraction-conflict theory (Baron as cited in Spante, 2004).

The theory of flow has been identified as a major role player by other researches (Chen et al., 2000; Lee & Chen, 2010) because it is found that the different constructs especially telepresence and is connected to flow, while the behavioural intention is dependent on telepresence and is affecting the brand equity.

Nah et al. (2011) compared between a 2D and 3D tour of a virtual hospital to determine the effect on brand equity and behavioural intention using theories of flow and telepresence. Where participants in the 2D version navigate using left and right button to switch to the previous or next screen, and participants in 3D version navigate their avatars in a 3D virtual environment by following a set of instruction. Daugherty, Li, and Biocca (2008) compared between a 3D model of a digital video camera (can rotate and zoom) in an e-commerce website, and a two page printed advertisement poster of the video recorder that has identical layout and content to the website.

This study will focus on the comparison of 2D and 3D product visualization, where both types of product visualization will be in the same condition (e-commerce website), instead of comparing the different product visualizations in 2 different environment or conditions (Nah et al. compared fully immersive 3D virtual world and no immersive desktop VR; Daugherty et al. compared desktop VR and physically printed poster).

Objectives

The objectives of this study are to:

- develop a 3D model of product for the website.
- develop an e-commerce website with three different types of product visualization, one 2D product visualization (pictures) and two 3D product visualizations (3D model and video).
- compare the telepresence, flow, behavioural intention, and brand equity of consumers with different product visualization (2D and 3D) for an e-commerce website.
- investigate the relationship between telepresence, flow, behavioural intention, and brand equity of consumers.
- determine whether 3D product visualization causes negative effect as stated by the distraction-conflict theory by Baron (as cited by Spante, 2004).

Research Questions

Some basic questions that will act as a guideline to the study are as follows:

- What is the most suitable and efficient product illustration in an e-commerce website?
- What is the difference and effect of 2D and 3D product visualization in an e-commerce website based on the theory of flow, telepresence, behavioural intention, and brand equity?
- Does theory of flow, telepresence, behavioural intention, and brand equity affect one another? What are the relationships among them?

Research Hypothesis

H₁: There is a significant difference between 2D and 3D product visualization in terms of telepresence, flow, behavioural intention, and brand equity.

H₂: There is a positive relationship between telepresence and flow.

H₃: There is a positive relationship between telepresence and behavioural intention.

H₄: There is a positive relationship between behavioural intention and brand equity.

Definition of Terms

- **Telepresence**

Telepresence is the feeling of being there, being present in the computer mediated environment instead of the current physical environment where a particular participant or user is in (Steuer, 1993).

- **Flow**

Flow is the experience where a participant is so immersed and is fully absorbed in engaging the environment (Nah et al., 2011).

- **Behavioural intention**

Behavioural intention is the intention of consumer to buy or not to buy the products of an organization (Nah et al., 2011).

- **Brand equity**

Brand equity is the value of the product due to its brand name even if the product has same marketing stimuli and product attributes with other brands (Yoo & Donthu, 2001).

Significance of the study

The study produces an e-commerce website with 3 different types of product visualization, the first one is a conventional 2D pictured product illustration, the second with product illustration of a 3D model (can be manipulated), and the last being illustrated using a short video of the product (which is also categorized as 3D product visualization). This study enables future e-commerce web designer to choose the best type of product representation in

accordance to the theories of flow, telepresence, behavioural intention, and brand equity. This will increase the likelihood of consumer purchasing from the website.

Scope of the study

The study only involved the population of students undergoing Cognitive Science Undergraduate Program at Universiti Malaysia Sarawak (UNIMAS) and a sample of 90 students taking or taken Human Computer Interaction (HCI) courses participate in an experiment conducted in this study.

CHAPTER TWO

LITERATURE REVIEW

Telepresence

Telepresence is defined as the feeling of being present in a computer mediated environment with the help of a medium of communication rather than the feeling of being present in the actual physical environment (Steuer, 1993). Presence is a relatively important aspect in Virtual Reality (VR) environment since it is directly connected with immersion and it is defined as the sense or feeling of being present in an environment. Hoffman and Novak (as cited by Chen, Wigand, & Nilan, 2000) inferred that telepresence in the Web is the perception of two environments, one is the physical environment of the user, and the other is the environment defined by the Web.

When online consumers are presented with virtual environment with low telepresence, they tend to feel lack of social connection, trust, and help which will then make them feel uncertain and nervous (Lee & Chen, 2010). This will result in lowering the behavioural intention buying the product. Thus Lee and Chen (2010) suggest that e-commerce websites should increase the telepresence in an online environment to remove user's nervousness by reducing other additional information that could act as a distraction such as advertisement to increase user's concentration. Faiola, Newlon, Pfaff, and Smyslova (2013) stated that telepresence can potentially increase the desire to explore around in online environments. Pavlou and Fygenson (as cited by Lee & Chen, 2010) also argues that a website that is easy to use will remove the cognitive inhibitions when going through online activities.

Ettis (2013) stated that increased telepresence is one key advantage of the interactive web technologies, this increased sense of presence can increase the satisfaction of user and provide more immersive experience.

Flow

Flow is defined as the “optimal experience” of an individual has when he/she is engaging in an activity with full involvement and enjoyment such that the individual lost the sense of time due to immense interest during the engagement (Chen et al., 2000). Flow is also defined as a “psychological state in which an individual feels cognitively efficient, motivated, and happy” (Moneta & Csikszentmihalyi as cited by Chen et al., 2000; Ettis 2013). Flow is also the important component of enjoyment, it represents the “holistic sensation” felt when people are engaging in the activity with full involvement (Csikszentmihalyi as cited by Lee & Chen, 2010; Novak, Hoffman, & Yung, 1999). When a person or the participant is in the flow state, he/she becomes absorbed in the activity, the concentration of the participant becomes so high that irrelevant perception and thoughts are ignored (Novak et al., 1999). As the participants of the study by Chen et al. (2000) said, this is the most common feeling when they are engaging in activities online, and some say that this feeling is similar to when they are doing other activities such as reading, where they are so focused and enjoyed that they does not have extra attention for other things going on around them.

Chen et al. (2000) believed that flow theory can be applied to user in Web environment because they observed no big difference between the levels of consciousness in the flow experienced by the user while engaged in activities on the Web and when engaged in other physical activities. Siekpe (2005) in his study assessed how is flow related to an e-commerce system and found that flow could affect the repeated visits or returns to the same e-commerce website.

Behavioural Intention

Online consumer behaviour is a highly complicated phenomenon that cannot be explained fully using a single theory because it is affected by many interdependent factors from various field including marketing, psychology, economics, information system, and so on (Lee & Chen, 2010). Behavioural intention is the likelihood or willingness of a person to engage in an activity and in this case, is the likelihood of a consumer to browse the website and to purchase the product.

Hoffmand and Novak (as cited by Ettis, 2013) found that flow is related to behaviour. Flow can enhance learning, exploration, participation, and positive experience. Koufaris (2002) discovered that the purchasing intention and the intention to return to the same e-commerce website are possible outcomes of flow experienced by consumer during the previous session of online shopping. Lee and Chen (2010) also found that telepresence, enjoyment and concentration are the three important constructs of flow that can positively influence behavioural intention. The study by Lee and Chen (2010) collects information that is general without specifying any particular e-commerce website, this may produce result that can be generalized but they cannot be applied on a particular group of consumer.

Brand Equity

Yoo and Donthu (2001) defined consumer-based brand equity as the different response by consumer to the well-known brand and unbranded product when they both have “same level of marketing stimuli and product attributes”. Yoo and Donthu (2001) also state that there is no certain way for how brand equity is measured because although there are studies on brand equity, the focus was not to develop measurement method. However, there has been a general agreement on the definition of brand equity among the many definitions

by different authors and studies, which is the “incremental value of a product due to the brand name”.

Brand equity is a multidimensional concept which consists of “brand loyalty, brand awareness, perceived quality, brand associations”, and other related brand assets (Aaker as cited by Yoo & Donthu, 2001). Yoo, Donthu, and Lee (2000) focus only on the perceived marketing efforts rather than the actual because perceived marketing efforts have a more direct role in consumer’s psychology. The same study by Yoo et al. (2000) found that perceived quality, brand loyalty, and brand awareness are positively associated to brand equity.

Distraction Conflict Theory

As cited by Spante (2004), the distraction conflict theory by Baron suggest that when there is an extra individual present at the time a subject is engaging in an activity, the extra individual will become a distraction, hence there will be a conflict as to attend to the extra individual and to the task. However distractions are not limited to the presence of others, but to also cues and information that are not related to the task. According to Muller et al. (as cited by Nah et al., 2011), distraction conflict theory is when a person is conflicting between focusing his/her attention on the task at hand or to the distraction present and thus may resulting in cognitive load problem.

CHAPTER THREE

METHODOLOGY

Research Design

This study produced an e-commerce website with three different types of product visualization (pictures as product illustration, video for product illustration, and 3D model of a similar item). These three different visualizations were used to compare the constructs namely telepresence, flow, behavioural intention, and brand equity to determine which type of product visualization is more significant. Figure 1 below show the two important aspects of the methodology of the study.

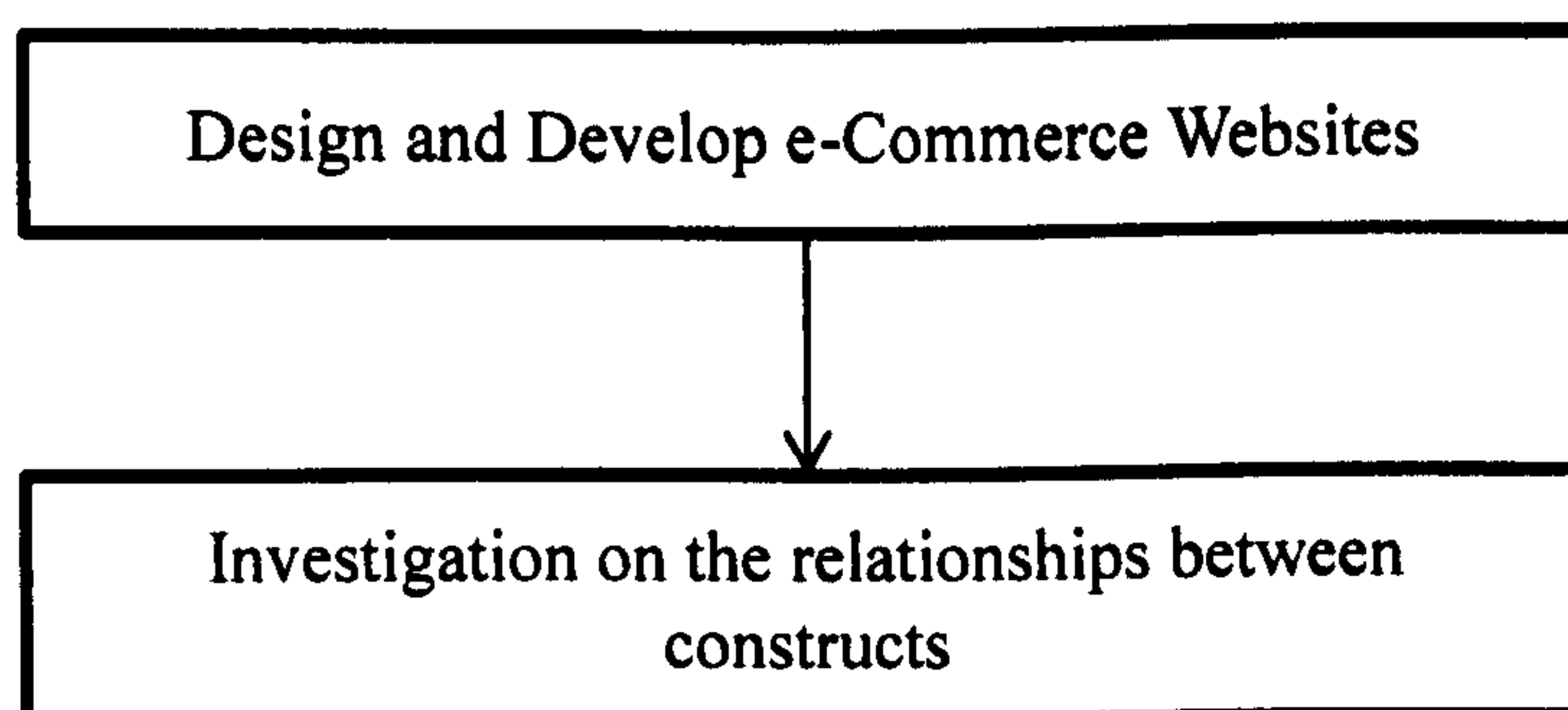


Figure 1. Aspects of methodology

Design and Development of Website

Prototype. The website design took into consideration the principles of HCI to create a website with high feasibility as well as high aesthetic value. As stated by Faiola et al. (2013), application of HCI design theory into computer mediated environment can increase the flow and can increase user's enjoyment.

One of the eight Schneider's Golden Rule of Design, *strive for consistency* is applied into the menu bar, the layout of the product page, colour of the website, and fonts type used throughout the website. The menu bar has the same items for all of the pages; the layout of the product page is constructed such that the specification info of the product is always below

the product illustration (as shown in Figure 2); the colour of the website (excluding the colour of the product illustration) is limited to four (black, grey, orange, and dark orange) for all the pages; *Rokkitt Regular* font family is used consistently throughout the website and the font size for content and heading is also consistent (CSS class for font family is as shown in Figure 3).

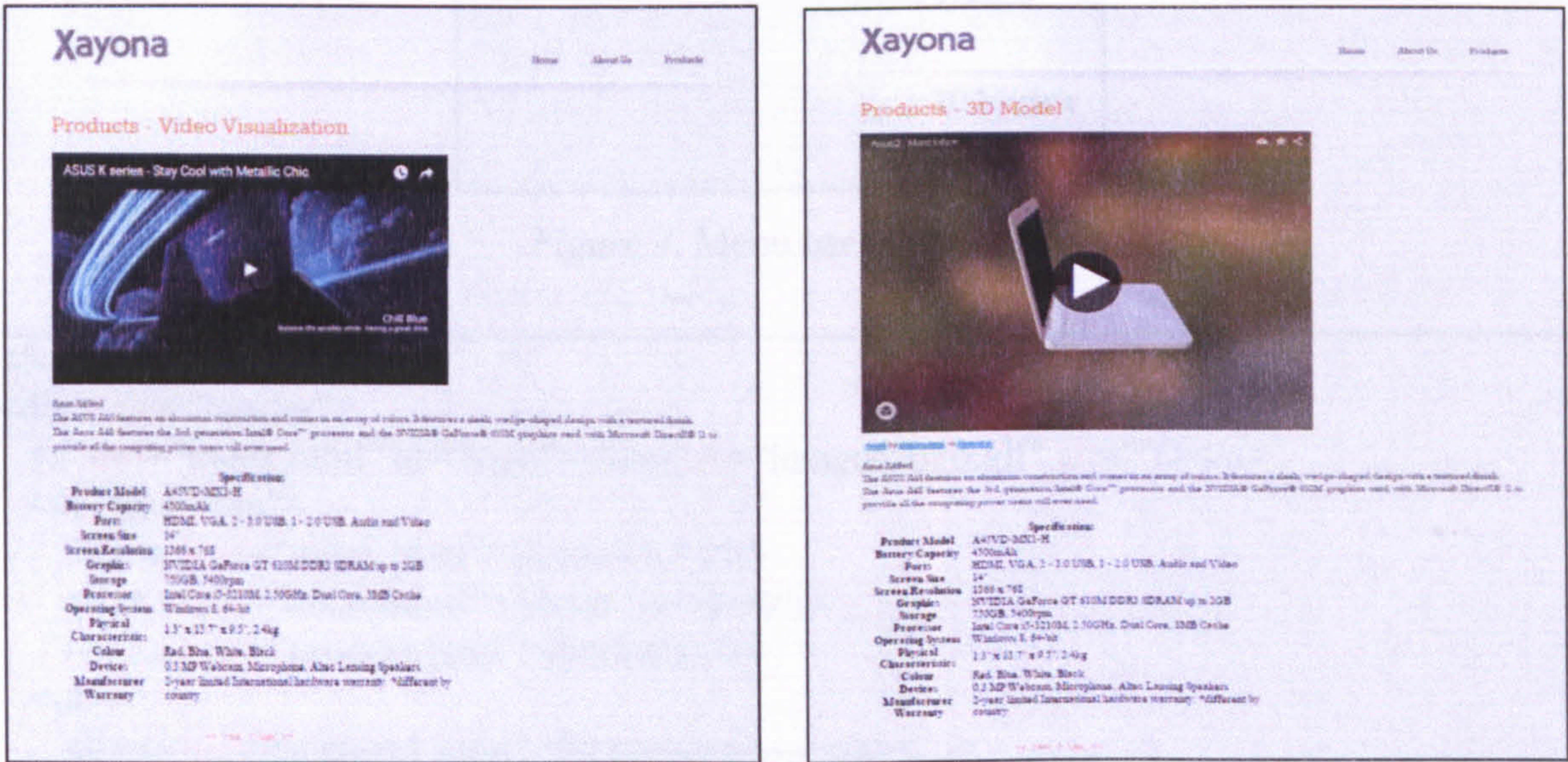


Figure 2. Video and 3D Model product page

```
@font-face {
  font-family: 'RokkittRegular';
  src: url('rokkitt-regular-webfont.eot');
  src: url('rokkitt-regular-webfont.eot?#iefix') format('embedded-opentype'),
    url('rokkitt-regular-webfont.woff') format('woff'),
    url('rokkitt-regular-webfont.ttf') format('truetype'),
    url('rokkitt-regular-webfont.svg#RokkittRegular') format('svg');
  font-weight: normal;
  font-style: normal;
}
```

Figure 3. CSS class for font family used throughout the website

Reduce short-term memory load, another of the eight Schneider’s Golden Rule states that human have limited information processing capacity in short-term memory (Shneider & Plaisant, 2010). Therefore the menu bar is set to six items, including the items from the

product page drop down menu (as shown in Figure 3, refer Figure 5 for the HTML coding of the menu bar).

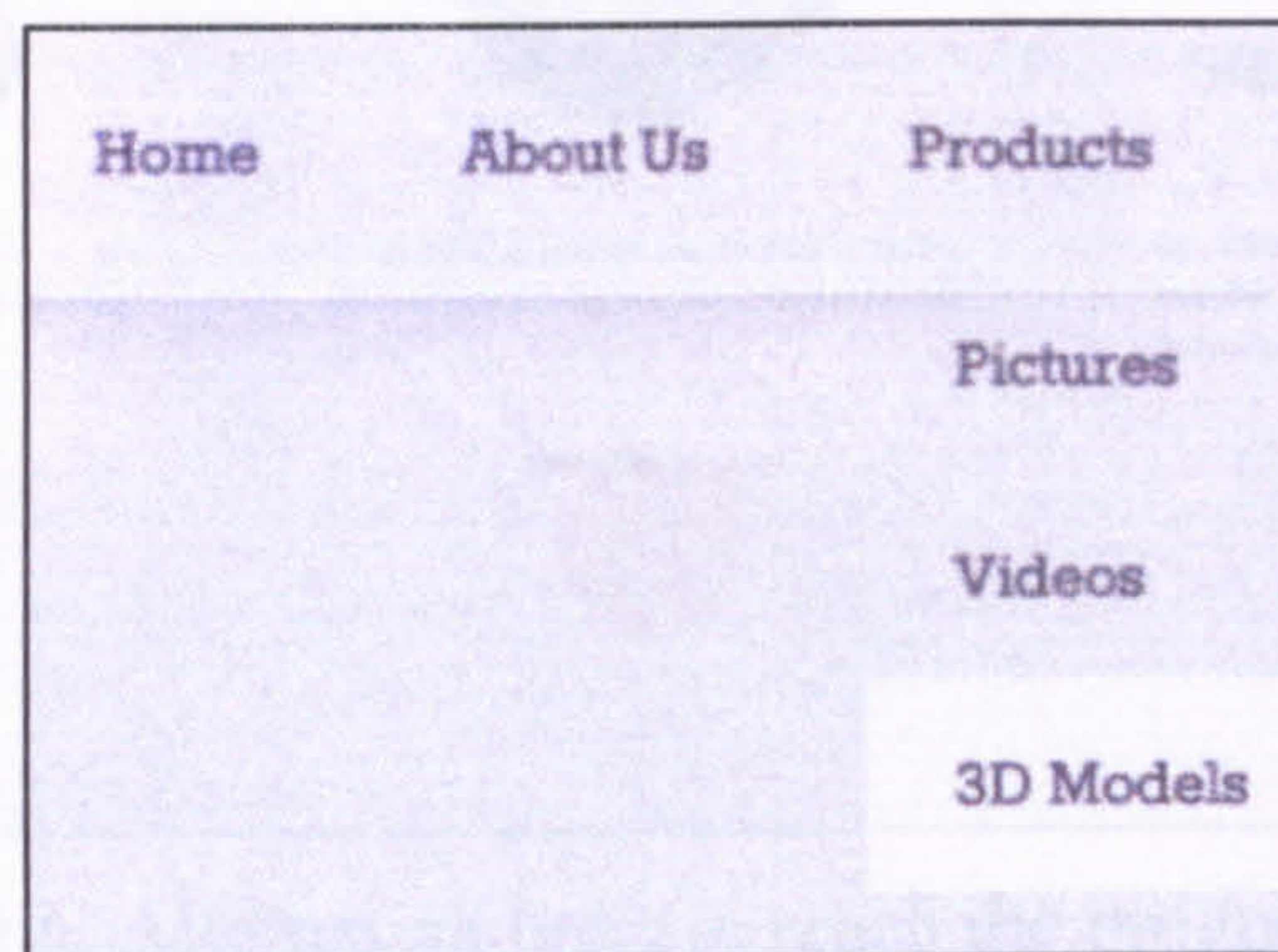


Figure 4. Menu bar of website

```

<!--header-->
<div class="header">
  <a href="index.html" id="logo"></a>
  <ul class="dm">
    <li><a href="index.html">Home</a></li>
    <li><a href="about.html">About Us</a></li>
    <li><a href="product.html">Products</a>
    <ul>
      <li><a href="picture1.html">Pictures&emsp;</a></li>
      <li><a href="video1.html">Videos&emsp;&emsp;</a></li>
      <li><a href="model1.html">3D Models</a></li>
    </ul>
  </li>
</ul>
</div>
<!--header-->

```

Figure 5. HTML coding for menu bar

Another HCI principle applied is to “provide alternative interfaces for novice and expert users” (Hearst, 1999, p. 259). Alternative interface provide user with more control and flexibility. This is shown in the three boxes (as shown in Figure) at the bottom of the ‘Home’ page and ‘About Us’ page that act as an alternative link for customer to reach the product page.



Figure 6. Alternative links to reach the product page

A prototype of the website was created using Notepad++ using programming language of HTML, CSS, PHP, and JavaScript. The website is developed using Evolutionary Prototyping Technique where the first prototype is not discarded, but serves as the basis for the next iteration of the development (Dix, Finlay, Abowd, & Beale, 2004).

Research Instrument. Survey questions (refer to Appendix A) was adapted from Nah et al. (2011) study on the brand equity but the focus was different. Therefore, the survey questions were modified to suit this study. The survey questions from Nah et al. (2011) contains question on all the constructs (telepresence, enjoyment, brand equity, and behavioural intention) except for flow. Flow is highly difficult to be extracted as data that can be generalized, because it is methodologically challenging study personal experiences and thus is even harder to study flow on the web. According to Chen et al. (2000), to have high quality data “flow must be operationalized as a situated experience, dynamically bound in time and space”, or else it will cause problematic validity issues. Therefore, three questions are extracted from the questionnaire produced by Chen et al. (2000) to measure flow and were modified to suit this study.