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The state of mobile-friendly websites in the New Zealand tertiary academic sector

Auckland University of Technology (AUT) | Exegesis

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Abstract

Tertiary academic institute websites act as an important marketing medium for targeting prospective students (Jabar, Usman, & Awal, 2013; Williams, 2013). Younger New Zealanders, aged 16-19, are the highest Internet users for information seeking, and mobile phones have become one of the most used devices for this in New Zealand (Gibson, Miller, Smith, Bell, & Crothers, 2013; Research New Zealand, 2015; Statistics New Zealand, 2013; The Nielsen Company, 2013). Chances are mobiles may have also become important for course related information seeking by NCEA Level 3 students, aged 17 to 18 (New Zealand Qualifications Authority, 2014), intending to pursue tertiary education. Therefore, websites suitable for viewing on mobile phones, known as mobile-friendly websites (Google Developers, 2015), have become crucial for both marketing and information seeking (Ho, Ooi, & Amri, 2010; Pegoraro, 2006). The presentation of institute websites, which host an enormous amount of web content, is a technically challenging endeavour for viewing on mobile phones (Marcotte, 2011; Williams, 2013; Wroblewski, 2011a).

This research aimed to examine how well New Zealand tertiary institutes, namely Universities and Institutes of Technology and Polytechnics (ITPs), have utilised the current technology to offer mobile-friendly websites to potential students. The significance of this research is to inform future practical implementations and research, focussed on the creation of mobile-friendly websites. Collectively, three interconnected queries were investigated: First, a comparison was undertaken of the three contemporary technological methods, including: Dedicated mobile websites, Responsive Web Design (RWD) and Adaptive Web Design (AWD) (Google, 2013), to create mobile-friendly websites for tertiary institutes. Secondly, an exploration of the exclusive target audience needs for course related information seeking, some of which include device preferences, importance of mobile-friendly websites and how their performance impacted the student opinions about an institute. Thirdly, discovering the current state of mobile-friendly offerings by the targeted institutes and key considerations for future development.

Secondary research combined with several primary research activities of a quantitative and qualitative nature, involving a range of participants, ensured a comprehensive investigation. Given that the domain of this research was contemporary technology, and

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that this field changes rapidly, there was an understandable lack of traditional peer-reviewed academic literature at hand. To ameliorate the lack of academic credentials, care has been taken to ensure authors have professional credentials and are authorities in the field.

Following are some key conclusions. Under the current circumstances, RWD has proven to be the most appropriate solution for building mobile-friendly websites for New Zealand tertiary institutes. The predominant use of mobile phones to access academic institute websites for course related information was unexpectedly low, with a preference for bigger screens indicated. However, there were high ratings on the perceived importance for tertiary institutes to offer mobile-friendly websites. Also, there was a strong correlation between the effective performance of an academic institute's mobile-friendly website and perception of an institute's professionalism. Out of 24 institutes, all but one had mobile-friendly websites. A clear gap existed between the well-executed websites and the ones in need of significant technical improvement. ITP websites were more in need of improvement. Well-executed websites formed a majority, were effective in their implementation with many commendable traits that would aid information seeking and decision making for the prospective students. Based on this majority, the current state of mobile-friendly websites in New Zealand seemed to match the presently desired outcomes.

Academic institutes need to be mindful that technologies and devices continue to evolve rapidly and must be continually examined. Consequently, several areas of potential research have been identified throughout this thesis.

* See glossary

Keywords

Mobile-friendly, Dedicated mobile websites, Responsive Web Design, Adaptive Web Design, Mobile first, Content strategy, RESS: Responsive Design + Server Side Components, Tertiary academic websites.

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Attestation of authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Vikrant Batra

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One-off interviews were conducted with personnel from UCOL, Whitireia Community Polytechnic, Auckland University of Technology and Enlighten Designs. Thanks are extended to these people whose input was most valuable, enlightening and greatly appreciated.

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Chapter 1. Introduction

Overview

The context of this research is underpinned by the researcher's background in computer graphics and information technology (IT). The researcher has both worked in the respective industries and taught across a range of visual and IT disciplines including web design, time based media and eLearning. The researcher is currently employed as the Senior Project Manager of Digital Development at Massey University. During the researcher's previous employment as a Lecturer in computer graphics at the Universal College of Learning (UCOL), he became interested in Responsive Web Design (RWD). It is a web development based system, which aims to create websites that can automatically adjust their layout and seamlessly deliver the same content to end users with different sized devices (Marcotte, 2010).

While researching RWD it was discovered that mobile phones have gained a great deal of popularity as an Internet access device amongst students worldwide for a range of online activities (Hill, 2010). As a result of this ubiquitous success, universities worldwide started realising the importance of mobile phones as an online marketing tool for student recruitment both domestically and internationally (Williams, 2013). Mobile phones have a small screen and are limited to the amount of content they can display in comparison to other conventional devices used for Internet access, such as desktop computers (Wroblewski, 2011a). This presents a challenge for web developers for creating websites that are suitable for viewing on mobile phones, also known as mobile-friendly websites (Google Developers, 2015). For the creation of mobile-friendly websites there are three technical methods available at present, namely dedicated, responsive and adaptive (Google, 2013).

During the period when the researcher was learning about RWD, UCOL was considering the creation of a mobile-friendly website. However, which method to choose out of the three mentioned above was unclear to UCOL and was part of discussions between various teams including technology, marketing, communications and management. The selection of a suitable technical approach is dependent on several variables including, but not limited to, use case scenario, target audience, available resources, timelines and post deployment maintenance (McGrane, 2015). Additionally each of these methods has

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various pros and cons and these differences must be thoroughly understood before one is chosen over the others for building an organisation's mobile-friendly website (Williams, 2013).

Due to occupational relevance, keen interest in web development and close proximity to UCOL's enrolment process, the researcher undertook this Masters research project to investigate the following:

- Selection of a method - Which method out of the three is the most suitable for creating mobile-friendly websites for tertiary academic institutes?

- Target audience needs - What are the unique characteristics of the potential students including device preferences, Internet accessibility, information seeking patterns, importance of mobile-friendly websites amongst this group and how the performance of these websites impacted the student opinions about an institute?

- Current status of technology usage by New Zealand tertiary institutes – How many tertiary institutes in New Zealand offer mobile-friendly websites, what technical methods have been appointed and are there any future improvements required to better meet the target audience needs and remain abreast of technological advancements?

It may be felt that the order of these sections is the reverse of the way it should be approached. However, it was felt that it is important for the reader to understand the technologies prior to the explication of how they were being used in the tertiary sector.

The key research question formed was - How well have New Zealand tertiary institutes utilised the current technology to offer mobile-friendly websites to potential students? The targeted institutes were Universities and Institutes of Technology and Polytechnics (ITPs).

* See glossary

1.1 Rising popularity of mobile phones as Internet access devices

Accessing web content for a variety of online activities such as information seeking, news, education, shopping, entertainment and social media is an integral part of New Zealanders' daily lives (The Nielsen Company, 2013). The World Internet Project New Zealand (WIPNZ) is a part of The World Internet Project (WIP), a highly respected international level collaborative project conducted in 40 countries (Allan, Andy, Charles, & Phillipa, 2015). It is conducted every two years by the Auckland University of Technology (AUT) and funded by the National Library at the Department of Internal Affairs, Ministry of Business, Innovation and Employment, InternetNZ and Buzz Channel Marketing (Allan et al., 2015). After surveying 1200 participants around New Zealand about digital device usage, online behaviours and the adaptation of new media technology, the WIPNZ released a report called "*The Internet in New Zealand 2013*". Figure 1 presents a graph from this report. It shows amongst other online activities, Internet has become the most prevalent source of information seeking in New Zealand, surpassing other traditionally popular means such as television and newspapers (Gibson et al., 2013).

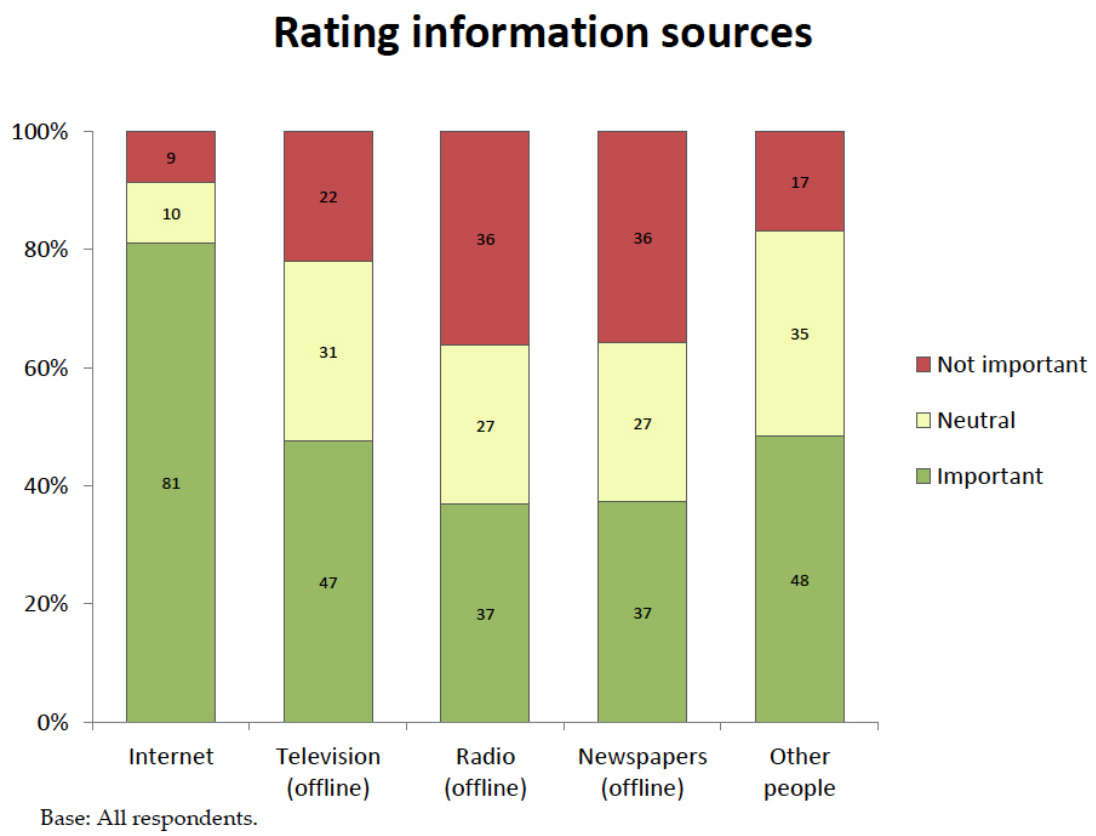

Figure 1. 81% of the respondents rated Internet as the most important information source (Gibson et al., 2013, p.7)

* See glossary

To access the Internet both Kiwis (Research New Zealand, 2015) and Internet users worldwide (Deloitte, 2015) have a range of digital devices from which to choose, including desktop computers, laptops, smart phones, tablets, personal digital assistants, gaming consoles, televisions and eBook readers. Furthermore within the array of device categories there are varying screen sizes available. Figure 2 illustrates this phenomenon.

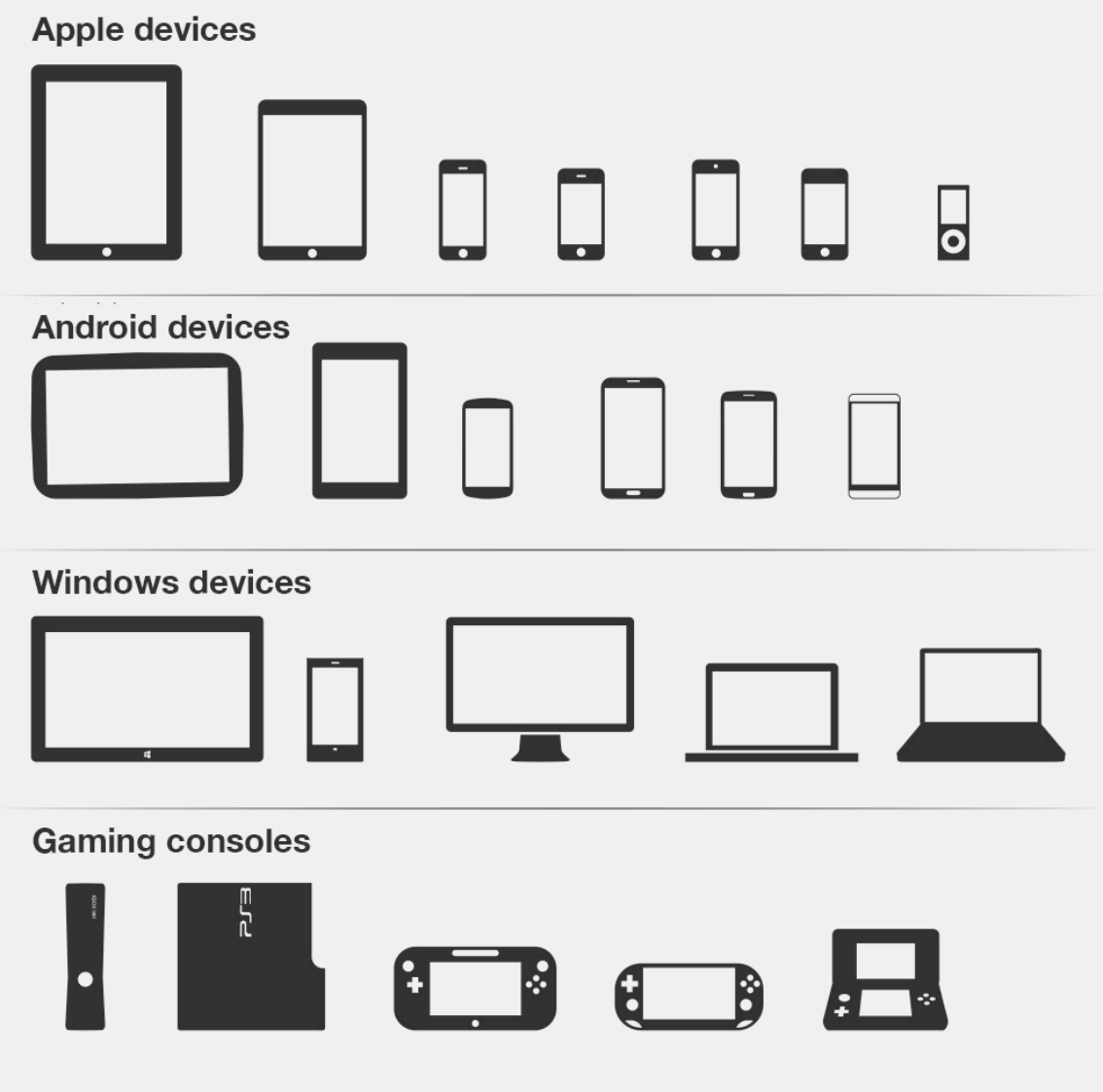

Figure 2. Different types of display devices (Crisafulli, 2013)

Out of all the above-mentioned digital devices, mobile phones have become the preferred medium to access the Internet both globally (CISCO, 2014) and in New Zealand (Research New Zealand, 2015). Due to the high rising popularity of mobile phones, specifically smartphones*, it was forecast that the worldwide smartphone sales would exceed the combined sales of laptop, desktop, and notebook computers by 2012

* See glossary

(Wroblewski, 2011a). However, as presented in Figure 3 the forecast came true, but in the last quarter of 2010, which was two years earlier than expected.

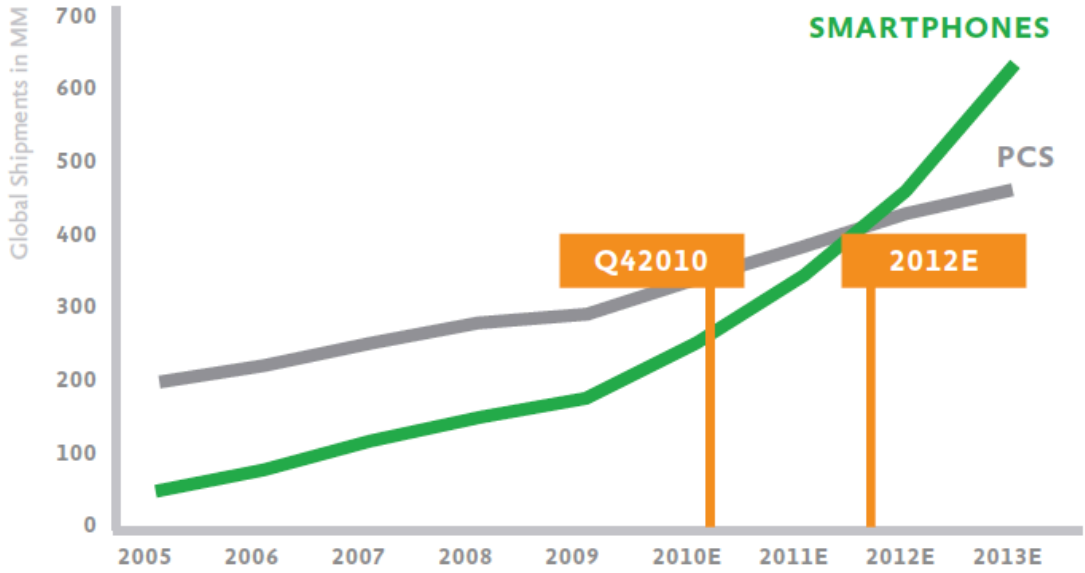

Figure 3. Global smartphone shipments surpassed global PC shipments two years earlier than predicted (Wroblewski, 2011a, p.8)

The popularity of using mobile phones as Internet access devices will continue to flourish. The Cisco® 'Visual Networking Index (VNI)' is an on-going initiative, which provides an insight to the existing and forecasted performance of the global networks (CISCO, 2014). In 2014, CISCO published a report called "*Global Mobile Data Traffic Forecast Update, 2014 - 2019"* which presents the current and predicted worldwide growth of mobile phone sales and mobile data traffic between the years 2014 to 2019. This report states that in 2014 there were 7.4 billion mobile devices and connections, and by 2019 there will be 11.5 billion mobile-connected devices, exceeding the world's projected population of 7.6 billion at that time. It also states that between 2014 and 2019, there will be nearly a tenfold increase in the mobile data traffic globally and the mobile network connection speeds will become more than twice as fast.

Adding to the triumph of mobile phones is not only the improvements in their performances and capabilities over the past several years (Marcotte, 2011), but the increased affordability for both the equipment and associated data plans. It is much more inexpensive to buy a mobile phone and an Internet plan than a desktop or a laptop computer and a broadband connection (McGrane, 2012a; A. Smith, 2012). Another factor which makes mobile phones the most frequently looked at device is the

* See glossary

convenience of constant companionship they can offer (Deloitte, 2015). On Device Research is a research company based in London, Singapore and Dubai that specialises in researching global trends of mobile usage and its associated commercial applications (On device research, 2015). In one of the reports titled "*The Mobile Only Internet Generation*", co-founder and Senior Mobile Analyst, Alistair Hill (2010), states that a trend of 'Mobile Only' users is emerging worldwide. A significant percentage of the global population is starting to either solely or exclusively rely on mobile phones for Internet access in comparison to other devices, such as desktop computers, laptops and tablets for the same (Hill, 2010).

Notably, individuals hailing from developing nations, lower socio-economic groups and students are the most common users of mobile phones over other devices globally, due to monetary constraints (Bhavnani, Chiu, Janakiram, Silarszky, & Bhatia, 2008; Hill, 2010; A. Smith, 2012). For example, in 2010 out of the entire Indian population who accessed the Internet by mobile phones, 59% were found to rarely or never use desktop computers for the same. Furthermore, out of this demographic, 55% of the *mobile only* users in India were school or university level students (Hill, 2010). On the other hand, in developed countries like USA, 76% of the *mobile only* users hailed from lower socio-economic groups (Hill, 2010). Furthermore, 51% of the African-American and 42% Latino mobile phone owners were found to be *mobile only* users for a variety of online activities (A. Smith, 2012). Figure 4 presents statistics accumulated by On Device Research, which highlight the quantitative comparisons of *mobile only* users after surveying participants across twelve countries.

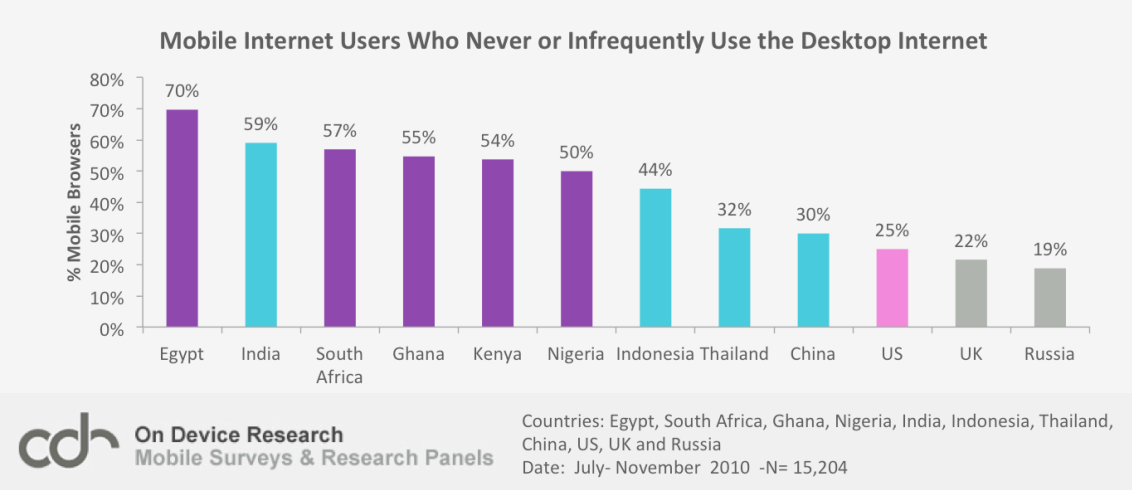

Figure 4. Mobile only users surveyed in twelve countries (Hill, 2010, p.8)

* See glossary

Although the aforementioned research suggests that in developed countries, a considerable percentage of mobile phone users continue to use desktop devices, the *mobile only* trend has gained significant momentum in New Zealand over the last few years (Research New Zealand, 2015). By 2012 there were over 2.5 million Internet connections made through mobile phones in New Zealand in comparison to over 1.6 million broadband connections (Statistics New Zealand, 2012). Interestingly, the number of mobile phones reached over 5 million surpassing the population of 4.43 million at that time (NZME, 2012). In 2013, Statistics New Zealand published a survey report called "*Household Use of Information and Communication Technology: 2012*". This report presented a major shift in the preference of devices used to connect to the Internet in New Zealand. As shown in Figure 5, in 2009 where the most popular combination was that of a desktop and a laptop, by 2012 laptops and mobile phones became the preferred mix (Statistics New Zealand, 2013). By 2015 smartphones became the most used digital device in New Zealand on a daily basis (Research New Zealand, 2015) with 91% of the smartphone users using their smartphones everyday in comparison to only 52% daily usage of other devices, as illustrated in Figure 6. Also, 59% of the smartphone users preferred using their smartphones rather than desktops, laptops and tablets to access the Internet.

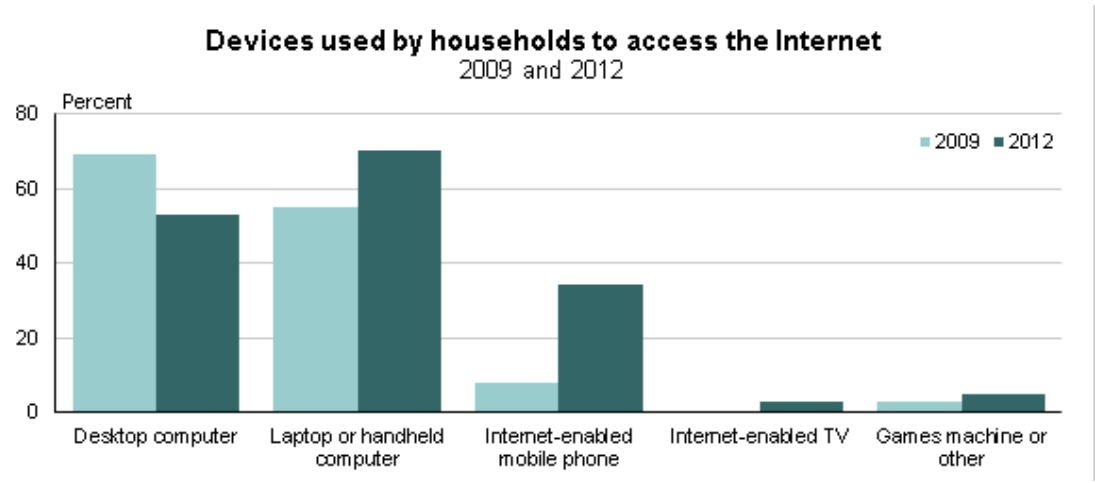

Figure 5. Devices used by households to access the Internet (Statistics New Zealand, 2013, p.4)

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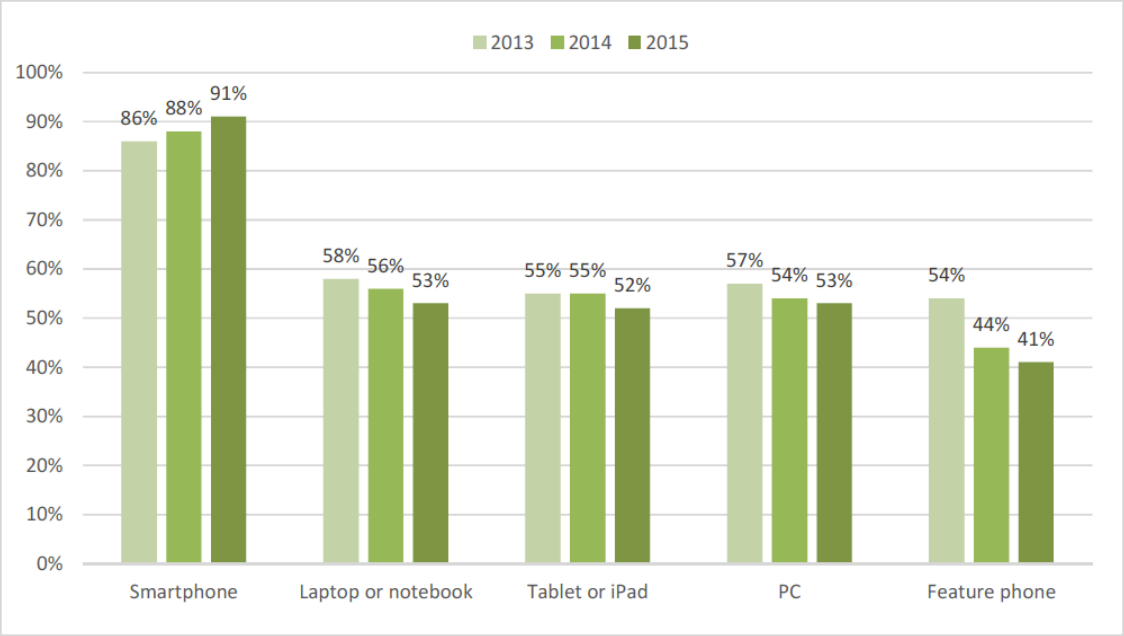

Figure 6. Daily usage of digital devices by device owners (Research New Zealand, 2015, p.9)

1.2 Defining the problem – Choosing a suitable technical approach for the creation of mobile-friendly websites

An increasing number of trades and organisations (Google, 2016b) including the educational sector and academic institutes (Williams, 2013) have realised the importance of pronounced recognition of mobile phones as Internet access devices, for their business goals. Organisations appreciate that many of their target audiences are relying on mobile phones to access their websites (McGrane, 2012a). Offering web content suitable for viewing on mobile phones is highly critical to an organisation's success. However, mobile phones have a small screen space in comparison to desktop computers and therefore are limited to the amount of content they can display.

Websites for tertiary level educational institutes such as universities and ITPs act as an information resource for a range of site visitors including students, teachers and researchers (Bernier, Barchéin, Cañas, Gómez-Valenzuela, & Merelo, 2002). This results in an enormous amount of information that these websites need to carry. The default behaviour of a mobile phone's web browser is to scale a website to fit within its small screen size (Google Developers, 2015). Figure 7 compares a full-scale version of UCOL's website with a mobile phone's screen and also a scaled down version of the website to fit the mobile phone's screen. The high number of visual elements such as text, imagery and hyperlinks* are drastically scaled down, making them difficult to comprehend and require a lot of pinching and zooming to access various sections of the website (Marcotte, 2010).

* See glossary

Figure 7. Limited screen size of mobile phones (UCOL, 2015)

Google (2015) states that the pinching and zooming could make the user experience challenging and most probably leading to lack of interest and abandonment of a website. The challenge is especially escalated when a user has to interact with a lot of content. Therefore, Google (2015) recommends that organisations should serve mobile-friendly versions of their websites to mobile phones users for ease of readability and navigation of the provided content. A mobile-friendly website's interface and content are either specifically created or repurposed for viewing on mobile phones (Google Developers, 2015). Figure 8 depicts a desktop version of a website viewed on a mobile phone in comparison to its mobile-friendly version. The mobile-friendly version presents a readjusted layout of the desktop site showing less content. Users can scroll down to access the remaining content. This readjustment aids legibility, accessibility of content and navigation on a mobile phone's screen.

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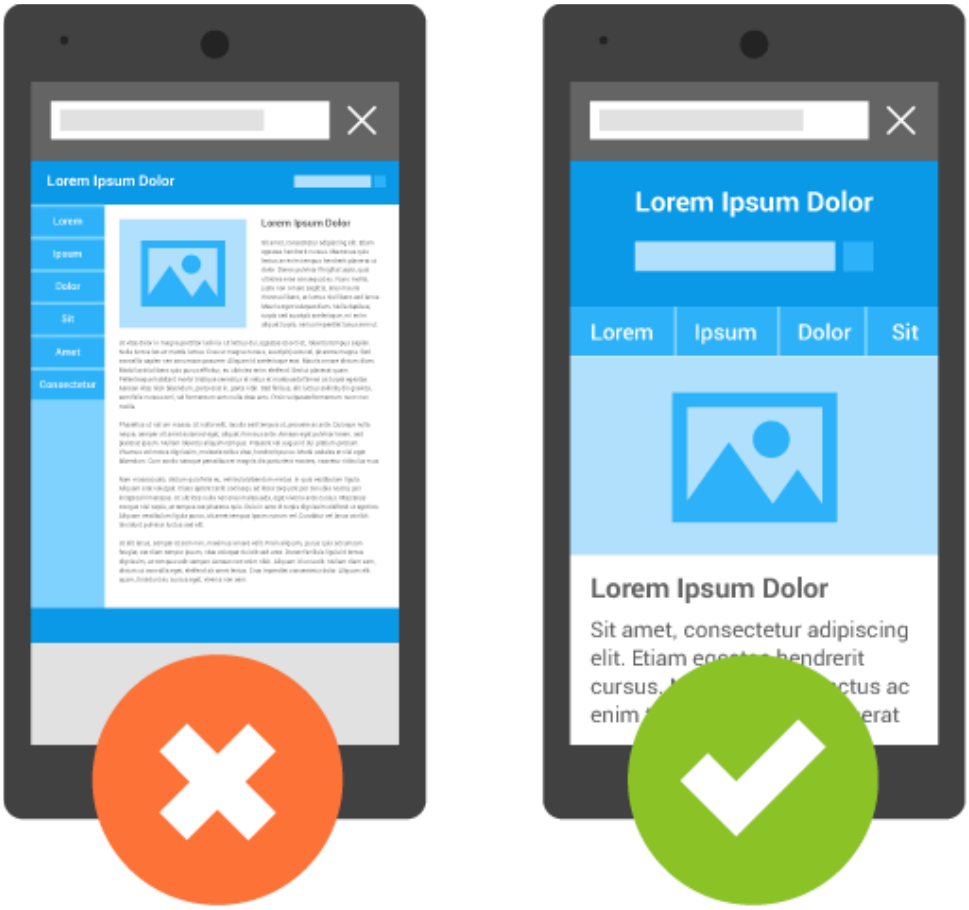

Figure 8. Desktop version Vs. Mobile-friendly version of a website (Google Developers, 2015, para.5)

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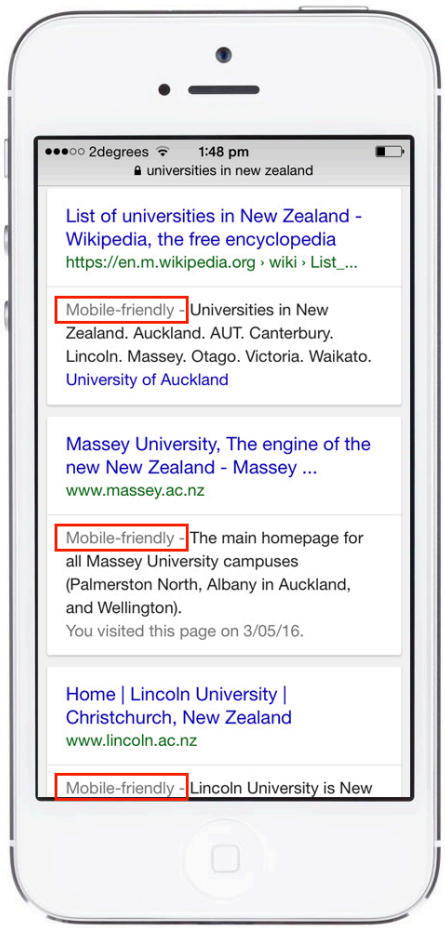

Figure 9. Google search results showing mobile-friendly labels

Furthermore, in 2015, Google initiated new search engine advancements aimed at making the search of mobile-friendly websites faster (Google, 2016b). In fact having a mobile-friendly version has now become one of the criteria for a website's Search engine optimisation (SEO)*. Figure 9 shows the end result of a Google search on universities in New Zealand. It shows an added mobile-friendly label, which is highlighted in red by the researcher, in front of the search results to indicate to the user that it is a mobile-friendly website[1].

Creating mobile-friendly websites requires the selection of an appropriate technical method (McGrane, 2012a). Apart from their technical differences, the different methods available for the creation of mobile-friendly websites also contrast in quantity of content delivery. Some web developers suggest that mobile phone users may be content with a limited amount of information on mobile-friendly websites, since the viewing area is quite small; and it should be left to the desktop versions of websites to provide full information (McGrane, 2012a). On the contrary, other web developers contend that mobile users may still want full access to information, and providing limited content could be handicapping the users of mobile phones or any other small screen device.

[1] By the submission of this thesis, it was noted that this practice has been discontinued, which is likely the result of the significant prevalence of mobile-friendly sites.

* See glossary

1.3 Research purpose and industry focus

This research will examine the current state of mobile-friendly websites in the New Zealand tertiary academic sector, namely universities and ITPs.

In order to do so, the three areas of interest listed in the overview, will be investigated. These are: selection of a technical method, target audience needs and the current status of technology usage by New Zealand tertiary institutes. Consequently, the body of this research is broadly divided into three parts. The first will compare and contrast the suitability of the three contemporary technological methods available for the creation of mobile-friendly websites in a tertiary academic setting. The second will explore the exclusive target audience needs for course related information seeking and decision-making using the range of criteria listed in the overview. The third will explore the current state of mobile-friendly offerings by New Zealand tertiary academic institutes and ascertain the need for future improvements.

Secondary research conducted under the literature review will address the first part of this research. As literature is scarce on the specific mobile uses in New Zealand's tertiary sector, secondary research will be augmented by primary research to address the remaining two parts. To ensure a comprehensive investigation, various stages will utilise a range of quantitative and qualitative methods for gathering primary data from a range of participants. This includes secondary school students enrolled in NCEA Level 3 in the city of Whanganui, intending to pursue tertiary education and utilise the Internet to find course related information for decision-making. NCEA Level 3 is offered in the year 13, the final year of New Zealand's secondary school education and the students enrolled are usually aged around 17 to 18 years (New Zealand Qualifications Authority, 2014). Interviews will be conducted with website managers at academic institutes and web developers specialising in the creation of mobile-friendly websites for the New Zealand tertiary academic sector. Also, an analysis of the websites offered by tertiary institutes will be conducted.

Statistics New Zealand (2013) and the World Internet Project (2013) have both identified that the highest Internet usage in New Zealand occurs between the ages of 15 to 44. Also as depicted in Figure 10, within this age group, 16 to 19 year olds have been found to be

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the highest users of the Internet as an information-seeking source (Gibson et al., 2013; Statistics New Zealand, 2013).

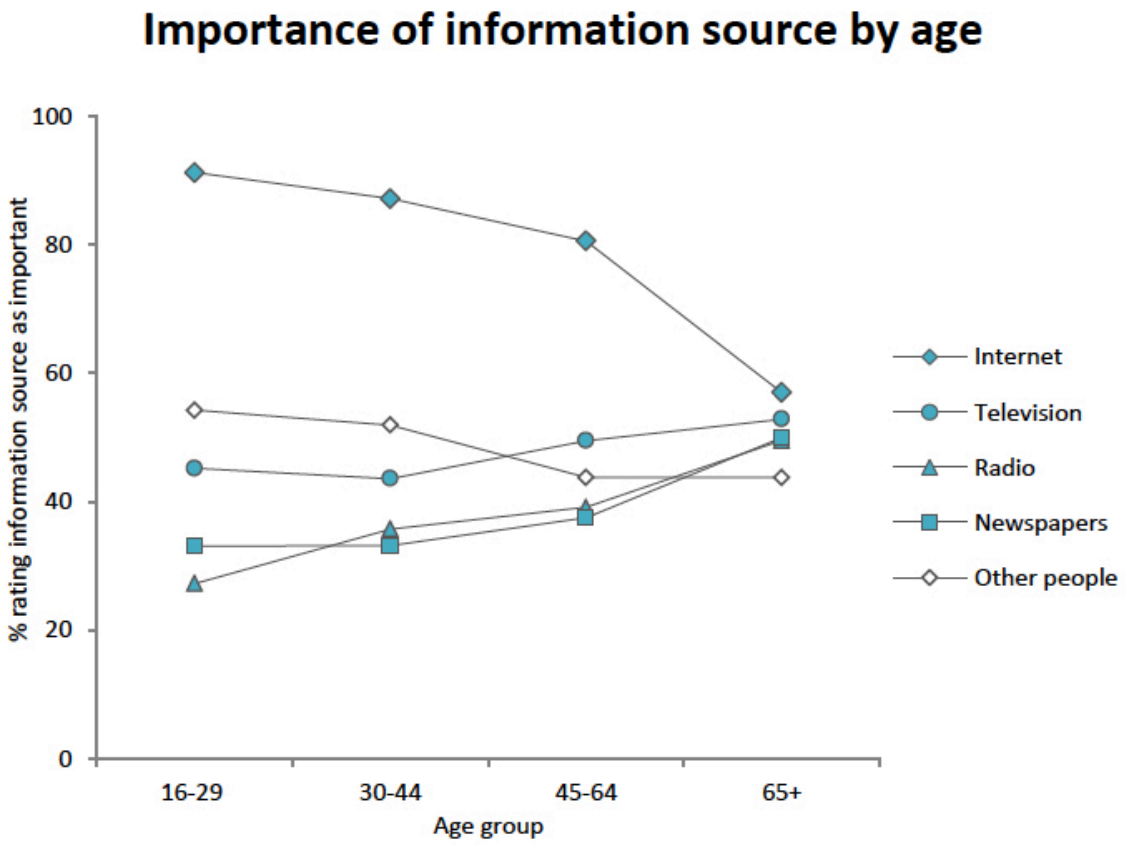

Figure 10. Information seeking by age (Gibson et al., 2013, p.19)

The overlaps mentioned above, suggest there is a high probability that mobile phones have become a very important tool for NCEA Level 3 students to find out course related information and decision making before enrolling into an area of study.

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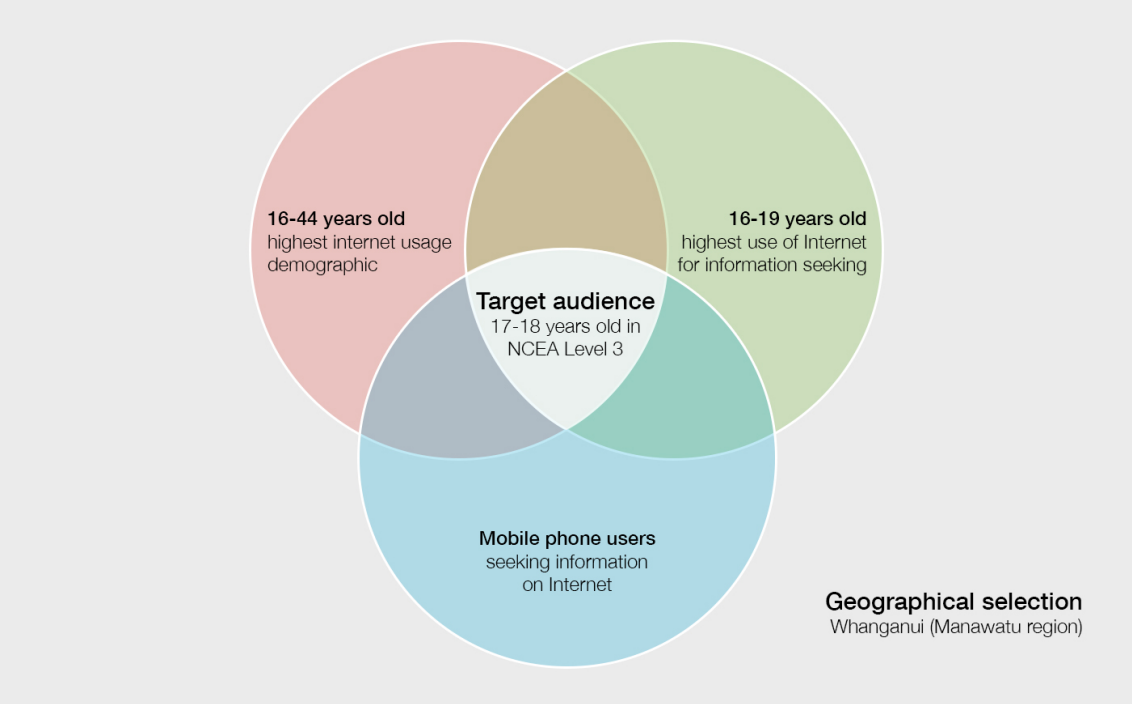

Figure 11. Narrowing the target audience

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1.4 Significance of study

The selection of a technical method for the creation of mobile-friendly websites is a topic of considerable debate amongst web developers (McGrane, 2015). Also, the website owners may have very little or no knowledge of what method will be most suitable for their organisational needs. This research intends to produce a body of knowledge that informs future practical implementations and research focussed on the creation of mobile-friendly websites. Although the scope of this research is targets a tertiary academic setting, other areas may benefit from the knowledge assimilated. Establishment of any gaps in the existing knowledge and the identifications of various issues surrounding the implementation of mobile-friendly websites will suggest future recommendations. Other potential beneficiaries may include students pursuing a career in web development, web developers working in a commercial arena, web tutors, fellow academics researching similar topics and web consultants.

* See glossary

Chapter 2. Methodology

2.1 Restatement of purpose

This research aimed to investigate the current state of mobile-friendly websites in the New Zealand tertiary academic sector, namely universities and ITPs; with specific reference to UCOL's proposed development of a mobile-friendly web approach. The purpose is to provide an information resource that can assist in strategic planning for this sector's Internet based information services, with particular attention to the consideration of, and uptake through mobile technologies.

In order to do so, the body of this research was broadly divided into three parts to investigate the three areas of interest listed in the Introduction overview and respecified as follows:

- Selection of a method - The first part compared and contrasted the suitability of the three contemporary technological methods available for the creation of mobile-friendly websites in a tertiary academic setting. These included: Dedicated mobile websites; Responsive Web Design (RWD) and Adaptive Web Design (AWD).

- Target audience needs – The second part explored the exclusive target audience needs for course related information seeking and decision-making. These included device preferences, Internet accessibility, information seeking patterns, importance of mobile-friendly websites amongst this group and how the performance of these websites impacted the student opinions about an institute?

- Current status of technology usage by New Zealand tertiary institutes – The third part explored how many tertiary institutes in New Zealand offer mobile-friendly websites, what technical methods have been appointed and ascertained key considerations for future development.

* See glossary

2.2 Research design

Different sectors including education, retail, entertainment, tourism and food services, build mobile-friendly websites for different purposes (Marcotte, 2011; McGrane, 2012b). Furthermore, the appointed technical method of creating mobile-friendly websites by an organisation is dependent on several variables including, but not limited to, use case scenario, target audience, available resources, timelines and post deployment maintenance.

A focus on New Zealand tertiary academic sector was chosen because this is the site of the researcher's direct experience, and a deductive research approach allows for the testing of known theories, ideas or phenomena for a specific situation (Neville, 2005). As stated in the introduction, the researcher's former employment at UCOL and close proximity to UCOL's enrolment process were some of the leading factors that underpinned the motivation behind this research. UCOL is a government-funded ITP and has four campuses (UCOL, 2009). Three campuses are located in and around the Manawatu region in the lower North Island of New Zealand, namely Palmerston North, Whanganui and Wairarapa. The fourth campus is located in Auckland.

A thorough understanding of the current situation involved investigating both the quantitative and qualitative aspects of the supply and demand of mobile-friendly websites. Thus, a combination of positivist and phenomenological paradigms formed the overarching approach for this research.

Originating from physical science, positivism or a positivist approach to research uses a fact-based investigation and leads to the usage of quantitative methodological approaches (Mukherji & Albon, 2009). Quantitative studies intend to generate numerical data, which forms the basis of measurable outcomes such as scale, range and frequency of phenomena (Macdonald-Ross, 1977). The positivist approach is occasionally also referred to as the scientific approach (Neville, 2005; Walsh, 2001). Hughes (2010) explains that under this approach knowledge on a topic can be created and validated by systematic observations and recordings of surrounding events and phenomena. The recorded data is statistically analysed and underlying numerical patterns are identified and quantified (Mukherji & Albon, 2009). Quantification of patterns forms a determinate knowledge base with which findings can be generalised (Straub, Boudreau, & Gefen,

* See glossary

2004). This also allows for correlational understanding of the cause and effect of variables in a system (Collis & Hussey, 2013). The paradigm not only aims to discover knowledge but also proposes its relevant and logical applications (Fraser & Robinson, 2004).

The quantitative research activities under this methodology are carried out in a controlled fashion with the intention of gathering numerical facts and figures (Walsh, 2001). Some examples of the data collection methods used under this approach and that allow for the desired control are: questionnaires; structured interviews; observational checklists; experimental studies; and longitudinal studies (Fraenkel, Wallen, & Hyun, 1993; Macdonald-Ross, 1977). With a combination of controlled and quantitative mechanisms, one of the key advantages that positivism provides is the ability to examine data for a large cohort of participants (Mukherji & Albon, 2009). However the foundational principles of this methodology are not without criticism, particularly when a deep understanding of an issue is required (Coolican, 1990; Howitt & Cramer, 2011).

Phenomenology or a phenomenological approach to research developed out of the criticisms and limitations of positivism, and uses qualitative methods of data gathering (Neville, 2005). Qualitative studies intend to describe and categorise the natural qualities of data, including its subtleties and complexities (Howitt & Cramer, 2011). Phenomenology seeks to gather information on a topic or particular phenomenon based on subjective experiences and perceptions of the individuals participating in the research (Larkin & Thompson, 2012). In comparison to a statistical knowledge of a cohort, phenomenology aims to understand how individuals think and feel, in the most direct ways, about their conscious experiences (Gray, Young, & Blomfield, 2015). Some of the qualitative data gathering methods under this approach include open interviews, focus groups, case studies, participant observation and empathic understanding of the participant's viewpoint (Junge & Linesch, 1993). In order to gain deeper and more nuanced understandings, the sample sizes are usually quite small, compared to quantitative research approaches. The processing of gathered data happens by description, translation, explanation and interpretation of events (Neville, 2005; Sandelowski, 2000). The paradigm is most suitable to situations when there is a lack of, or no research, about a topic (Howitt & Cramer, 2011). As noted further in the chapter there was a lack of traditional peer-reviewed academic literature pertaining to the research topic, therefore the usage of phenomenological methods at the relevant phases proved fertile. It was also particularly useful as the research kept the investigation to an

* See glossary

issue specific to a geographical location and industry sector, where little previous research was available. In cases such as these, it is useful to have more nuanced and in-depth participant perspectives to ameliorate the dangers of researcher assumptions contaminating the information. Lastly, and related to this, phenomenology also aims to challenge existing and assumed knowledge and attempts to inform or support new policies and solutions (Lester, 1999).

As indicated above, data collection under a phenomenological approach to research, usually involves fewer cases and idiosyncratic aspects of participating individuals. Consequently, the findings may provide a deeper understanding of a topic but cannot necessarily be generalised for a larger population (Howitt & Cramer, 2011). This is one of the key limitations of this paradigm (Neville, 2005; Patton, 1999), and suggests that in this particular research case, a combination of positivist and phenomenological approaches was most appropriate.

Correlations to phenomenology were also present in the significance of this research. This research intended to produce a body of knowledge that informs future practical implementations and research focussed on the creation of mobile-friendly websites. This was based on the establishment of any gaps in the existing knowledge and the identifications of any issues surrounding the implementation of mobile-friendly websites.

Following are the positivist and phenomenological methods used under this research.

Table 1. Research methods used in this research

Positivist
1. Surveys
2. Observational tests
Phenomenological
1. Open interviews
2. Case study
3. Website analysis

* See glossary

The categorisation of stage-relevant methodologies for the three areas of interest in this research is listed as follows:

The first part aimed to investigate, using a range of secondary sources, which method out of the three contemporary technological methods—namely dedicated, responsive and adaptive—was the most suitable for creating mobile-friendly websites for tertiary institutes generally. The comparisons were done with a combination of descriptive and exploratory approaches. Where descriptive research states the constituency of a system and how it works, it is typical of the explanatory methodology to ask the why and how questions around a topic (Walsh, 2001). Consequently, individual functionality of the three methods was investigated to enable the comparisons, which were done using a range of technical criteria. These included, but were not limited to, construction methods, individual functionalities, performance on mobile phones, success stories, search engine optimisation (SEO), cost of construction and maintenance, content delivery approaches and user experience parity and issues surrounding other devices. Collectively, the descriptions and comparisons contributed to the development of recommendations on why and when a certain method should be preferred over others.

Given that the domain of this research was contemporary technology, and that this field changes rapidly, there was an understandable lack of traditional peer-reviewed academic literature at hand. Although this was used when possible, the literature review has also made use of topic books, journal articles, trade articles, trade magazines and technology relevant websites. These were often designed more for technology training than academic evaluation, but as such, still contained valuable information. To ameliorate the lack of academic credentials, care has been taken to ensure authors have professional credentials and are authorities in the field. For this reason, a number of author credentials are noted throughout the literature review.

The second part of this thesis aimed to investigate the distinctive information-seeking needs and characteristics of the prospective students in a New Zealand context. The issues being investigated here included device preferences, Internet accessibility, information seeking patterns, importance of mobile-friendly websites amongst this group and how the performance of these websites impacted the student opinions about an institute. To this end, student surveys were instigated, in partnership with the respective institutions. As UCOL was being used as the case study, Whanganui schools specifically

* See glossary

identified as one of UCOL's target markets in terms of prospective students, were surveyed. Although these results are noted as being limited to this geographical region, some extrapolation to other regions may be possible, and certainly aspects of the methodology and questionnaires may be of value in other institutional research. As the survey was carried out under the auspices of UCOL, therefore AUT ethics approval was not required. Question types included demographic questions, dichotomous questions, multiple choice and rating scales. This information could then be utilized not only for conditions specific to New Zealand, but also to make comparisons between New Zealand and other countries, to discover the country's position with respect to global trends. The full questionnaire is available under "*Appendix 02. Secondary schools student survey"* and its detailed explanations are listed under "*Appendix 03. Student survey explanation".*

The third part aimed to discover the current status of technology usage by New Zealand tertiary institutes. This involved investigating how many tertiary institutes in New Zealand offer mobile-friendly websites, what technical methods have been appointed, and whether there any future improvements possible to better meet the target audience needs within the context of technological advancements. In order to do so, a combination of five qualitative and quantitative research activities were used, which are listed as follows:

1. An observational test was performed to determine quantitative statistics on how many institutes have implemented mobile-friendly websites. The observational test and an analysis, details of which are mentioned in the following point, were performed on the eight universities (Universities New Zealand, 2015) and sixteen ITPs (New Zealand Qualifications Authority, 2016) in New Zealand currently.

2. An analysis was conducted to ascertain what technical methods the listed institutions commonly deployed in the creation of mobile-friendly websites and how well these were implemented. As per the intended aims of an analytical method, this analysis involved identifying the various factors in a system to comment on why or how something works (Neville, 2005). It also aimed to discover meaningful patterns in a set of data. Astute pattern recognition is a process with which ideas are originated for further investigation (Patton, 1999; Yin, 2013). This analysis was focussed specifically on the key research question: How well have New Zealand tertiary institutes utilized the current technology to offer

mobile-friendly websites to potential students? This further contributed to the discovery of the country's position in comparison to global trends.

3. A qualitative case study on UCOL's newly created mobile-friendly website was done. To carry out the case study, UCOL's Senior Communications Advisor, who also managed the website project, was interviewed. This was done to understand the rationale behind the project and the selected method, associated processes, experienced shortcomings and recommendations for future improvements. It was acknowledged, since the researcher was a former employee of UCOL, there was a need to ensure that there was no potential bias. Therefore, the researcher ensured that no sense of the research findings thus far were provided to the interviewee, so that the information obtained was unbiased.

4. To further extend the qualitative data, a combined interview was conducted with the Project Manager and Front End developer assigned to UCOL's project from Enlighten Designs, the company that built UCOL's mobile-friendly website. Apart from the aforementioned aims, this was also done to seek the company's expertise on general issues with the creation of mobile-friendly websites in a tertiary academic setting, and to suggest any improvements required. Enlighten Designs is a leading web and software development company located in Hamilton. The company's portfolio includes some reputable names in New Zealand education. These include Waikato Institute of Technology, The University of Waikato and Te Wānanga o Aotearoa (Enlighten Designs, 2016). As part of a phenomenological approach (Neville, 2005) a case study involves the systematic investigation of the typical example of a phenomenon and allows for the generalisation of the findings (Walsh, 2001). The interview questions are available under "*Appendix 04.Interview questionnaire for UCOL"* and "*Appendix 05.Interview questionnaire for Enlighten Designs".*

5. Qualitative case studies on institutes who had not implemented mobile-friendly websites were conducted to understand the reasoning and planned future measures. In order to do this, an interview was prepared and carried out with the relevant personnel from these institutes. The interview questions are available under "*Appendix 06. Interview questionnaire for institutes who had not implemented mobile-friendly websites"*

* See glossary

2.3 Documentation methods

Following are the documentation methods for the primary and secondary research activities.

Secondary research

Majority of the secondary sources for this research were acquired in digital formats. Any important and relevant material from printed resources was scanned. All material collected was archived in a digital repository.

Surveys

Introductory emails followed by telephonic communications, were utilised to seek permission from the school authorities, to allow student participation in the surveys. Upon approval, printed questionnaires were distributed to the participating schools. Logistically, it was felt that hard copies would ensure maximum reach, rather than digital tools for conducting surveys, given the timing of the survey. Upon the digital collation of data into statistical format, the completed survey forms were destroyed.

Interviews

Similarly to the surveys, a combination of emails and phone calls provided the communication methods for inviting the interviewees. Upon agreement, questionnaires were emailed to the participants. Also, all the interviews but one were conducted via email, due to participants' preference. The combined interview conducted with Enlighten Designs' staff members was the exception. It was conducted by telephone and recorded using an audio recorder, with the participants' permission. Responses from all the interviews were synthesised and summarised into the relevant sections in this thesis.

All the gathered data was archived digitally in the researcher's computer, with backups in an external hard drive. Software programmes used to create this thesis document and the required diagrams, images, tables, graphs and text included Adobe Photoshop, Microsoft Word, Microsoft Excel and Endnote. A Microsoft Word based reflective journal provided the means for processing of ideas, progress dashboards and timelines. Infographic diagrams were created to discover linkages between concepts and information flow within the thesis.

* See glossary

Chapter 3. Literature review

Overview

The literature review addresses the first part of this research. It sets out to discover the three contemporary technological methods available for the creation of mobile-friendly websites and compare their suitability for a tertiary academic setting. These included: Dedicated mobile websites; Responsive Web Design (RWD) and Adaptive Web Design (AWD).

It has been suggested that one of the important functionalities of websites for tertiary level educational institutes is to act as a marketing medium targeted at prospective students both domestically and internationally (Jabar et al., 2013; Williams, 2013). There is an increasing number of younger New Zealanders who rely on information seeking online and mobile phones have now become one of the most used devices for information seeking in New Zealand (Gibson et al., 2013; Research New Zealand, 2015; Statistics New Zealand, 2013; The Nielsen Company, 2013). Similar trends have been identified in other countries (Hill, 2010). Besides domestic enrolments, New Zealand tertiary institutes attract a significant number of International students (Ministry of Education, 2013) therefore effective mobile-friendly websites have become crucial to aid information seeking for both the targeted demographics (Ho et al., 2010; Pegoraro, 2006). The presentation of an enormous amount of web content hosted by tertiary academic websites on small screens of mobile phones is a technically challenging endeavour (Marcotte, 2011; Williams, 2013; Wroblewski, 2011a). Furthermore there are three technological methods of creating mobile-friendly websites (McGrane, 2015). The selection of one over the others requires a thorough consideration of individual strengths and weaknesses of all the methods. This will ensure that the chosen solution suits an organisation's purpose for making the website, financial constraints, timelines, human resources and meeting the exclusive needs of its target audience.

Although several literature sources have been cited, the works of some key authors have had a significant influence in shaping the body of knowledge produced and discussions conducted. The names of these authors are listed as follows in no particular order; Ethan Marcotte, Luke Wroblewski, Karen McGrane, Kayleigh Williams, Aaron Gustafson, Jakob Nielsen, Raluca Budiu, Graham Charlton and various technical training sources offered by

* See glossary

Google. Viewpoints and arguments from various authors were considered to gather up-to-date information.

Findings were summarised in the literature review conclusions and validated against a brief analysis of the websites for top twelve academic institutions globally.

* See glossary

3.1 Importance of mobile-friendly websites in the tertiary academic sector

One of the important functionalities of the websites for tertiary level educational institutes such as Universities and Institutes of Technology and Polytechnics (ITPs) is to act as a marketing medium targeted at prospective students (Jabar et al., 2013; Williams, 2013). One of the key reasons being a cost-effective means with the ability to reach a large number of prospective students not only domestically but internationally as well (Ho et al., 2010; Pegoraro, 2006). Institutes with higher financial capabilities may have an advantage over smaller institutes when utilising traditional media of marketing and promotion like television advertising. However information delivery over the Internet via an academic institute's website can provide an equal opportunity for institutes with varying financial capabilities.

Smartphone* ownership in New Zealand is currently 64% for the age group of 15 to 65 and it is expected that the ownership will steadily grow to 90% penetration by 2018 (Frost & Sullivan, 2013). Internet has become the most regarded source of information seeking in New Zealand (Gibson et al., 2013) and mobile phones have become one of the most preferred devices for Internet access around New Zealand (Gibson et al., 2013; Statistics New Zealand, 2013; The Nielsen Company, 2013). Statistics New Zealand (2013) and the World Internet Project (2013) have both similarly identified that the highest Internet usage in New Zealand occurs between the ages of 15 to 44, and within this age group 16 to 19 year olds have been found to be the highest users of Internet as an information-seeking source (Gibson et al., 2013; Statistics New Zealand, 2013).

The overlaps in the statistics mentioned above suggest there is a high probability that mobile phones have become a very important tool for NCEA Level 3 students intending to pursue higher education at tertiary institutes, to find out course related information and on which to base a decision before enrolling into an area of study. Williams (2013) states that mobile-friendly websites are essential for universities as a marketing and recruitment medium in the contemporary time period. Considering that high school graduates are one of the most targeted demographic for universities, and the students in this bracket are accustomed to access information via mobile phones on a regular basis. One of the primary investigations under this research is to establish the prevalence amongst domestic NCEA Level 3 students of relying solely or mainly on mobile phones for course related information seeking and decision-making. However the *mobile only* trend for

* See glossary

Internet access and information seeking is on the rise not only in New Zealand (Research New Zealand, 2015) but globally as well (Deloitte, 2015). Especially in the developing countries such as India, China, Egypt and South Africa (Department of Foreign Affairs and Trade, 2015), school or university level students form a majority of the *mobile only* category (Hill, 2010; Williams, 2013). Universities and ITPs in New Zealand attract a significant number of International student enrolments with China and India being the leading countries of international student origin (Ministry of Education, 2013). It becomes crucial for universities and ITPs in New Zealand to offer mobile-friendly websites that provide a user-friendly experience and make information seeking easier, leading to improvements in student recruitment and retention both domestically and internationally.

Tertiary academic institute websites host an enormous amount of information to meet the needs of a range of site visitors, including prospective and existing students, teachers and researchers (Bernier et al., 2002). Traditionally websites have been created for viewing on desktop computers only (Marcotte, 2011). The large viewing area offered by computer monitors ensures that different site visitors can comfortably view the website and navigate around its different segments of information. Figure 12 showcases how Universal College of Learning's (UCOL) website appeared on a computer monitor before it was updated in 2016. There is considerable room provided by the screen and the website fits comfortably within its boundaries. A potential student can conveniently scroll up and down to access different parts of the site and navigate to the intended sections.

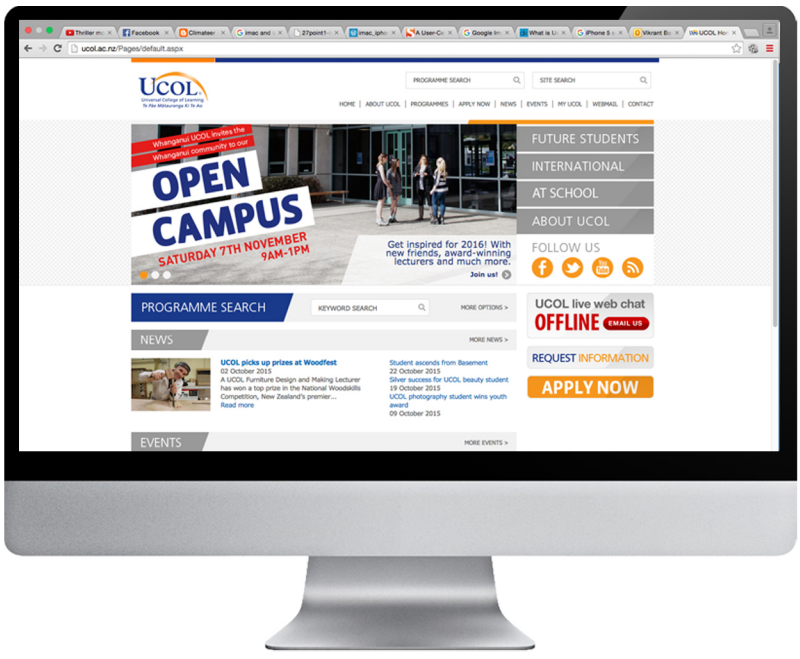

Figure 12. An academic institute website viewed on a desktop (UCOL, 2015)

* See glossary

Conventional website development practices have utilised fixed grid systems calculated in pixels (Gardner, 2011) for the creation of webpages with specific measurements. However, when a fixed grid website is viewed on a device other than that originally intended, it introduces a range of visual and navigational issues resulting from the disparity of screen sizes, ultimately leading to poor user experiences (Marcotte, 2011). The version of UCOL's website shown above is a fixed grid website.

Mobile phones screens being significantly smaller than a computer monitor, limit the amount of content, which can be displayed. This limitation presents various issues around content delivery and the effective communication of an organisation with its intended users (McGrane, 2012b). The default behaviour of a mobile phone's web browser is to scale a website to fit within its small screen size (Google Developers, 2015). This means any website with a vast amount of information, such an academic institute's website, created for desktop viewing, becomes difficult to operate when presented on a mobile phone because of the drastic scaling down (Marcotte, 2010). Figure 13 compares a full-scale desktop version of UCOL's website along with a mobile phone's screen and also a scaled down version to fit the mobile phone's screen. The scaling makes it difficult to comprehend the visual elements such as text, imagery and hyperlinks* presented on the site.

* See glossary

Figure 13. Viewing a scaled down version of an academic institute's website on a mobile phone (UCOL, 2015)

If a potential student who is a *mobile only* user accesses a scaled down website as shown above, they would require continuous pinching and zooming to access various sections. Google (2015) states that the pinching and zooming could make the user experience challenging and difficult to locate information especially when the website is content heavy. If a visitor cannot find the desired information in a reasonable time frame, this will often lead to lack of interest and abandonment of the website (Google Developers, 2015; Ho et al., 2010). For this reason, Google (2015) recommends that organisations should provide mobile-friendly versions of their websites, whose interface and content are either specifically created or repurposed for viewing on mobile phones (Google Developers, 2015). This will ensure ease of readability and navigation of the provided content.

In 2016 UCOL invested in the creation of a mobile-friendly website stemming from the fact that about 80% of the online course related enquiries originated from mobile phones

* See glossary

(Archer, 2016b). Figure 14 showcases the desktop version of UCOL's new website viewed on a desktop monitor and also the mobile-friendly version viewed on a mobile phone. The mobile-friendly version shows less content in comparison to the desktop layout, but users can scroll down to access the remaining content. This readjustment aids legibility, accessibility of content and navigation on a mobile phone's screen. In comparison to zooming and pinching, scrolling provides a more natural and comfortable way of navigating around content on mobile-friendly websites (Cao, Cousins, & Zieba, 2015).

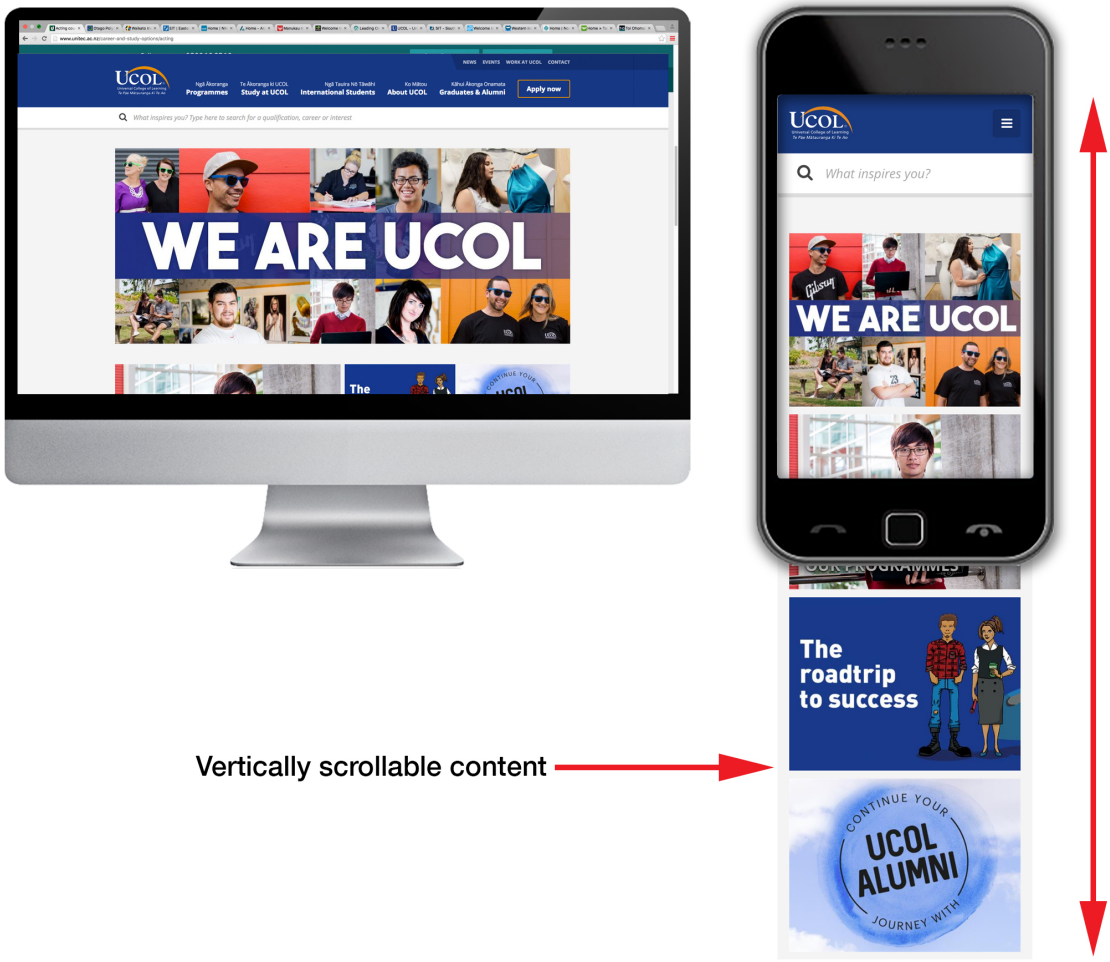

Figure 14. UCOL's new mobile-friendly website (UCOL, 2016b)

Creating mobile-friendly websites requires the selection of an appropriate technical method (McGrane, 2012a). As noted previously, apart from their technical differences, the different methods also contrast in the quantity of content and the way it is delivered. Web developers, business owners and different departments within an organisation may often have different opinions on the most important and right amount of content to meet the

* See glossary

needs of their mobile-user target audience (Halvorson & Rach, 2012). Some web developers suggest that mobile phone users may be content with limited amounts of information on mobile-friendly websites, since the viewing area is small; with the full information provided by desktop websites (McGrane, 2012a). On the contrary, other web developers contend that end users who primarily or solely use mobile phones to access websites still expect full access to information. The standpoint is that providing limited content could be handicapping the users of mobile phones and any other small screen devices.

Irrespective of platforms, including of desktop and mobile, it is vital that the content being delivered is of good quality and sufficient quantity. This ensures that the end users remain engaged; because content is what the users are looking for and is what supports the business goals (Halvorson & Rach, 2012). It is important to note that other factors contribute to the success of a website including, but not limited to, a suitable layout, performance speed, ease of navigation, accuracy of content, currency of information and appearance (Ho et al., 2010; Jabar et al., 2013). Before an academic institute delves into the implementation of a mobile-friendly website, it is important that strengths and weaknesses of different technical methods are understood thoroughly (Marcotte, 2011; McGrane, 2012a). This will ensure that the chosen solution suits an organisation's purpose, their financial constraints, timelines, human resources and meets the exclusive needs of its target audience (Google, 2013).

Section 3.2 compares and evaluates the suitability of the three technical methods available for the creation of mobile-friendly websites for academic institutes.

* See glossary

3.2 Technological approaches for the creation of mobile-friendly websites

Currently there are three technological methods of creating mobile-friendly websites, which complement the small screens of mobile phones (Google Developers, 2016). The first option is to create a dedicated mobile website, the second, is to create a responsive website, and the third, is creating adaptive templates of a website. The adaptive method has similarities to both dedicated and responsive methods (McGrane, 2015). While the dedicated method is purely applicable to mobile phones, the other two, by their default nature, serve a variety of devices used by the modern day consumer (Google Developers, 2015). Examples include but are not limited to desktops, laptops, tablets, mobile phones, Internet enabled televisions and eBook readers.

While the focus of this research is the creation of mobile-friendly websites, it acknowledges that prospective students of an academic institute may rely on more than just mobile phones (Research New Zealand, 2015). Google (2013) suggests in its report "*Building websites for the multi-screen consumer*", that mobile phones have become the key device for many organisations to connect with their target audiences. However, today's multi-screen consumers increasingly expect to connect with an organisation's website via a range of devices (Google, 2013; McGrane, 2015). It is therefore vital for organisations to create websites that can be accessed via a range of digital devices.

Research restricted to the use of mobile phones will limit the scope of information gathering and comprehensive knowledge required for an academic institute to choose one method over the other. To ensure that any interested parties of this research gain a thorough understanding and are aware of the surrounding implications of choosing between the three methods, all three have been compared and contrasted with a range of criteria in this section. These include but are not limited to, construction methods, individual functionalities, performance on mobile phones, success stories, search engine optimisation (SEO), cost of construction and maintenance, content delivery approaches and user experience parity and issues surrounding other devices. From a user-experience point of view, out of all mentioned above, Google (2013) identifies layout, content and speed as the three main criteria, which, if optimal, make the user experience highly engaging. This increases the chances of interested users converting into actual clientele.

Following are the explanations, differences and pros and cons of three methods.

* See glossary

3.2.1 Dedicated Mobile Websites

A dedicated mobile website is created as a separate website, as opposed to the desktop version (Williams, 2013). Usually these websites are created with a “dotMobi” domain name* such as “sitename.mobi” or an “M-dot” sub-domain* of the desktop website such as “m.sitename.com” (Google Developers, 2015). When a user tries to access a website through their mobile phone, the web servers perform a check, called device-detection, to find out what type of device is trying to access the website. This is known as the server-side detection (SQA, 2007). Once it is established by the server that the device is a mobile phone, it redirects the mobile phone’s web browser to the separately created mobile-friendly website. In the setup of separate mobile and desktop websites, users of other devices such as tablets and web enabled TVs are served the desktop version (Google, 2013).

Figure 15. Redirection to a mobile website (Google Developers, 2015, para.3)

Out of the three methods of creating mobile-friendly websites, dedicated mobile websites are the least expensive and quickest to build (Budiu, 2016). These are created with a device specific layout, less content and fewer features than the desktop version; with the aim of creating a device-optimised and lighter version (Nielsen, 2012). The lighter version facilitates the mobile phone users with quicker access to web content on a small screen and faster website performance – one of the key advantages of building dedicated mobile websites (McGrane, 2015). A link to a full desktop version or a native application (native app) is usually offered on the dedicated mobile website. This will redirect the users who may be interested in finding more information on the desktop or to perform specific tasks for which the app has been designed (Williams, 2013). A native app is a software program

* See glossary

that has been created for use on a specific operating system or digital device such as a mobile phone (Harb, Kapellari, Luong, & Spot, 2011; Rouse, 2016). Since these apps are downloaded and installed on the device itself and are developed exclusively for a specific platform they can offer fast performance.

Figure 16 presents United Airlines' dedicated mobile website. At the bottom left of the screen, a link to a full desktop site and a native app has been provided. Figure 17 presents Facebook's dedicated mobile website. When the site is opened on a mobile phone, using device detection, the website informs the user about a native app the user can download and install on their phone (an iPhone, in this example).

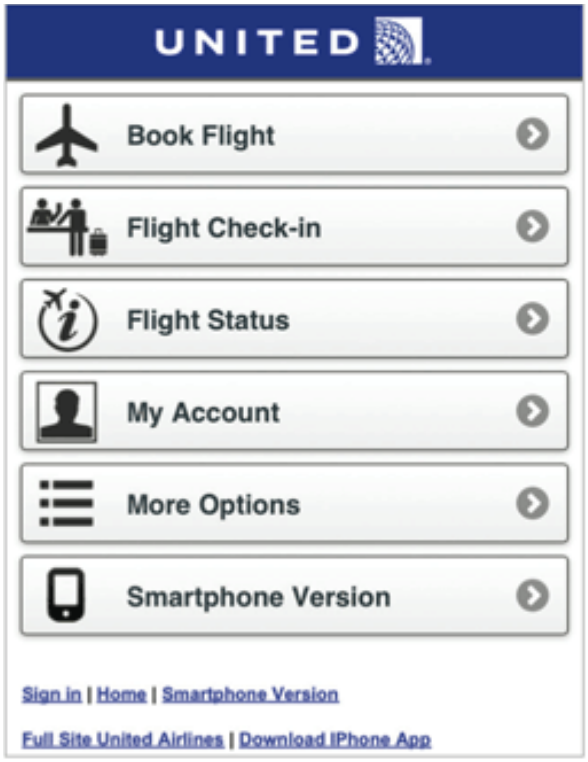

Figure 16. Redirection to a desktop site (McGrane, 2012b, para.15)

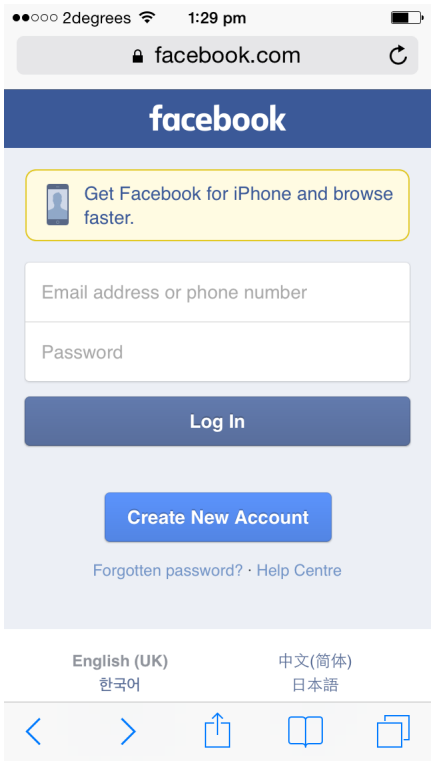

Figure 17. Redirection to a native app (Facebook, 2016)

A number of interlocutors have presented cases for limiting information for mobile users. The Nielsen Norman Group is a leading research organisation specialising in user experience for websites, applications and other digital products. Their clientele include some of the reputed names in the e-Business, Internet services and computer industries such as Google, Adobe and Microsoft (Nielsen Norman Group, 1998). A pioneer in the field of user experience and co-founder of The Nielsen Norman group, Jakob Nielsen presents a scenario of online shopping in his article "*Mobile Site vs. Full Site*". Nielsen, in

* See glossary

this article explains why dedicated mobile websites should offer limited content and features. Nielsen's (2012) main argument is that, if mobile websites have as much content as desktop websites, finding information can be difficult. He suggests if the mobile users cannot find a product on the mobile site, they may assume the product is not offered by the vendor, potentially leading to the loss of a business opportunity. Google (2015) recognises that mobile phones are a key tool for an organisation to engage with its target audience. Therefore, it is vital for a mobile-friendly website to offer a user-friendly experience and make the task of information seeking easier. Consequently, Nielsen (2012) proposes if the mobile phone users are shown a full range of products but with limited information about them, it will ensure that the users will find the products they are after. If they need more information, they can opt to use the full desktop version.

Luke Wroblewski is an entrepreneur and internationally recognized digital product leader (LinkedIn Corporation, 2016b). Currently a product director at Google, he has worked in lead positions at organisations like Yahoo, eBay and NCSA. Google and Twitter have acquired two of Luke's start-up companies. Luke is a renowned speaker and author of web design books. In his book "*Mobile First*" Wroblewski (2011a) agrees with providing only the most important features and content on a mobile-friendly website compared it to its desktop version. While Nielsen's (2012) proposal is based on providing a reduced form of the same content, Wroblewski takes a different approach. Wroblewski suggests since a mobile phone has a smaller screen size therefore it is of utmost importance that content and features are selectively chosen to offer only the most used functionalities. To illustrate this point, Wroblewski presents a comparison of Southwest Airlines' desktop site and its mobile app. Figure 18 shows the desktop version of the website which hosts a large range of content, features, advertisements and navigation options. Figure 19 shows the mobile app, which, on the other hand, provides specific functions around flight bookings and check in details. Wroblewski suggests that the limited set of functionality provided in the app has a more customer focussed approach, providing them with the most commonly used functionality on the airlines' website.

Similar agreements have been noted in the literature published by other authors. Jeff Croft is a noted user interface and digital product designer, an author of web design books and writer of web related technical topics (A List Apart, 2007). Croft's (2010) article "*On responsive web design and the mobile context*" also suggests that the needs of mobile phone users are different to those using desktops. For a better experience on mobile

* See glossary

phones, he suggests users want limited and selective information compared to the desktop users. Using an example of mobile usage for information seeking on restaurant sites, Croft suggests that customers using mobile phones tend to want specific information compared to those using a desktop. The address and opening hours may be enough for a mobile user, while desktop users may prefer detailed information such as images of the premises and more information about its cuisine or history.

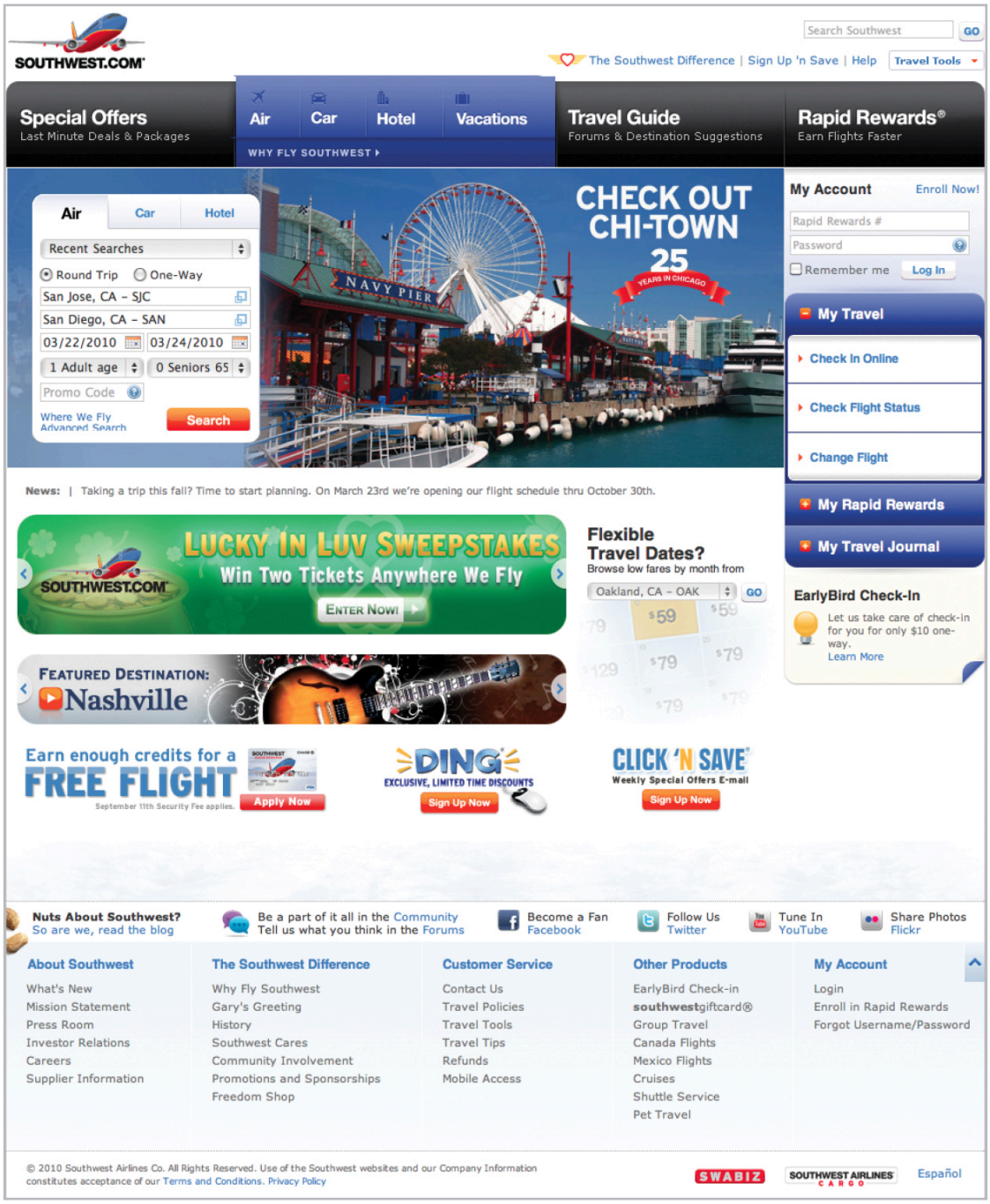

Figure 18. Several features on Southwest Airlines desktop website (Wroblewski, 2011a, p.20)

* See glossary

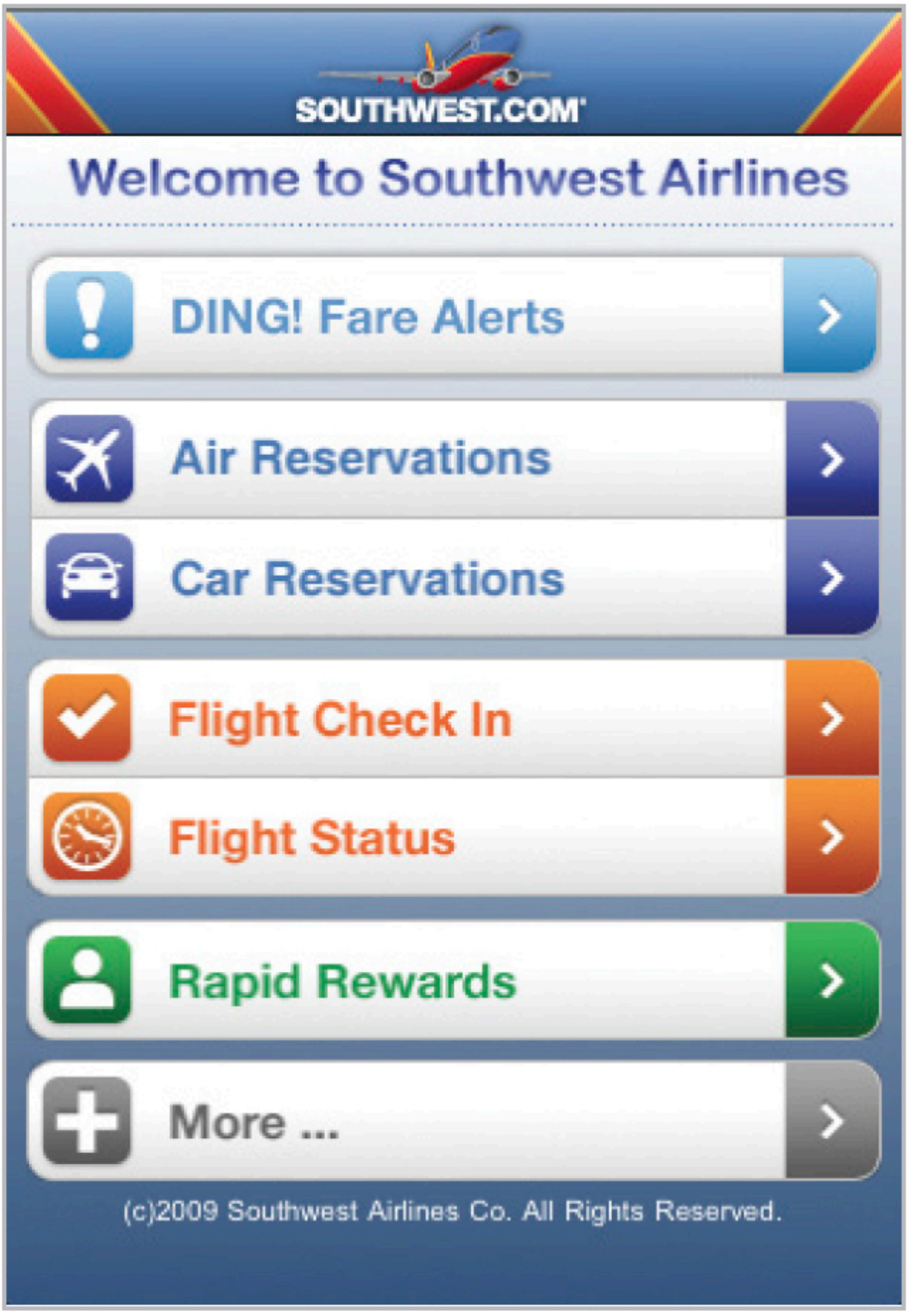

Figure 19. Southwest Airlines iPhone app with most used functions (Wroblewski, 2011a, p.21)

Google (2013) suggests that dedicated mobile websites are most suitable to organisations that need to offer a separate experience to the mobile phone users due to performance, technical or strategic reasons. For instance if an organization requires a mobile-friendly solution, but already has an existing desktop website which is quite heavy in content, building a separate dedicated mobile website will offer the fastest and most cost-effective solution (Erich, 2016). Being a separate entity to the desktop website, dedicated mobile websites allow the flexibility of taking a fresh approach to create a mobile-friendly solution (Nielsen, 2012). The resulting solution can be optimised for every aspect of the website including layout, navigation and performance speed on mobile phones.

The predominance of mobile phone based access to the Internet also stems from the affordability factor (Hill, 2010). Notably, individuals hailing from lower socio-economic groups and students are the most common users of mobile phones over desktop computers globally due to monetary constraints (Bhavnani et al., 2008; Hill, 2010). Creating a lighter and concise dedicated mobile website can offer wider user engagement to academic institutes for students who are entirely reliant on their mobile phones for finding course information. This may be due to the unavailability of desktop computers, broadband connections, or those living in remote areas where the Internet speeds might be slow. To further aid the reduction of content on the lighter mobile version, native apps can be employed to segregate the broader information seeking tasks from daily tasks, such as campus shuttle schedules, logging an IT issue or updating print credits usually only performed by the existing students (McGrane, 2012a).

Some of the reputable names of large-scale organisations that use a dedicated mobile website include Twitter, YouTube, IKEA and Turkish Airlines. Figure 20 shows IKEA and Turkish Airlines' dedicated mobile websites with an m-dot subdomain and links to full desktop sites or native apps.

* See glossary

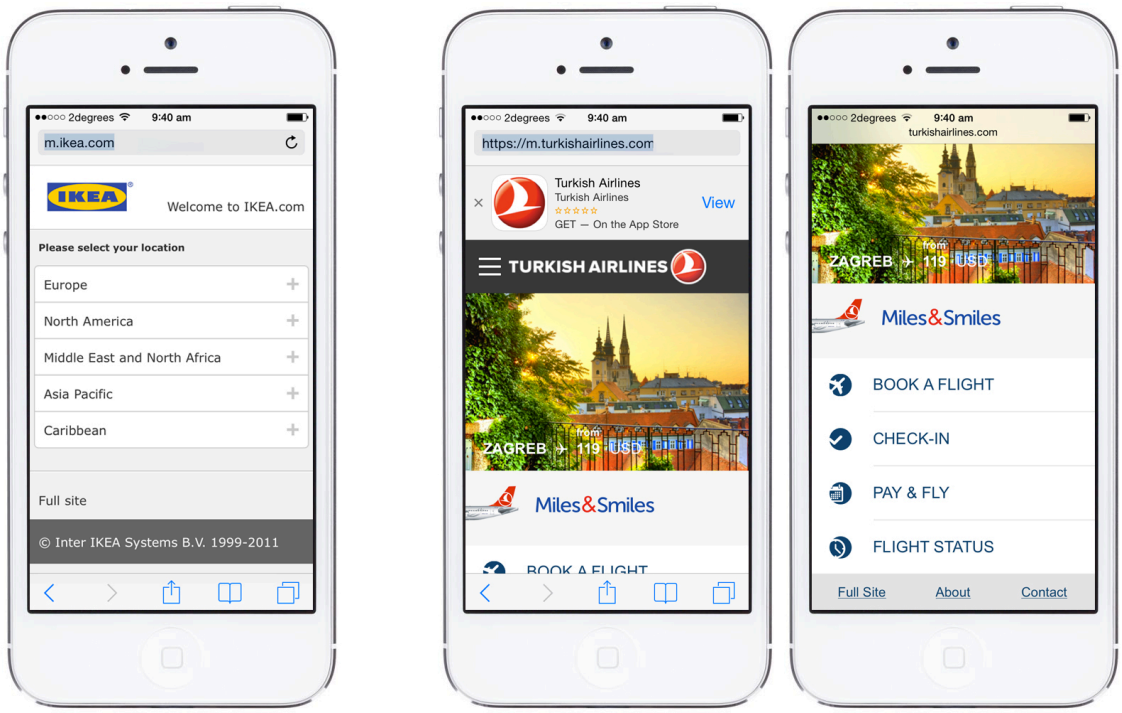

Figure 20. Dedicated mobile websites in the corporate sector (IKEA, 2016; Turkish Airlines, 2016)

Creating multiple versions of a website with different content is known as content forking (Google, 2013). Karen McGrane is an entrepreneur, author and tutor in the field of content strategy, information architecture and interaction design. Her clientele include prestigious names such as the New York Times and Condé Nast (A List Apart, 2016). McGrane (2012a) disputes Nielsen's (2012) proposal of content forking by creation of separate desktop and mobile websites with the possible companionship of native apps, and states that the duplication of content leads to several content strategy risks. McGrane suggests that this approach will require additional resources and strategies for on-going maintenance and ensuring consistency of content across both platforms. Every time new content needs to be added, removed or archived, it will require repeating the same processes twice or more if native apps were utilised as well (Williams, 2013). This is not cost effective, and even with the best of efforts, there is always a chance of human error in delivering consistent end results (McGrane, 2012a). In her book "*Content Strategy for Mobile*", McGrane presents a case study of content inconsistency between the desktop website and the mobile website of GAP Incorporate, a leading American clothing manufacturer. During one of the spring seasons the home page of GAP's desktop website was updated with promotional images of spring clothing, while the mobile

* See glossary

website was overlooked and still displayed promotional images of winter clothing (see Figure 21).

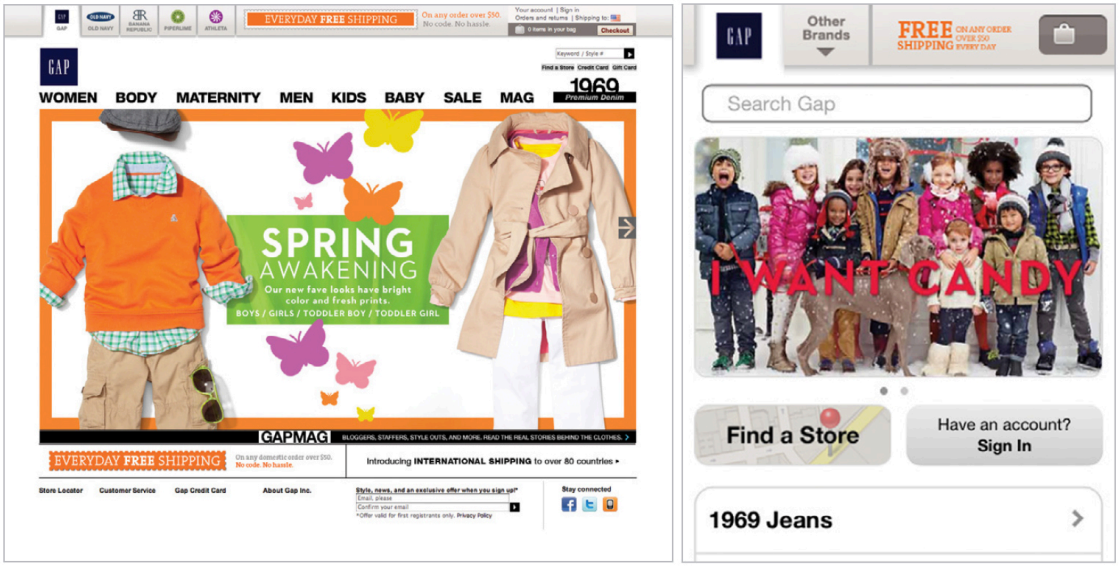

Figure 21. GAP Inc.'s inconsistency of content between desktop and mobile website (McGrane, 2012a, p.41)

Accuracy of content on an academic institute's website is not only an important factor for building and / or maintaining its reputation (Ho et al., 2010), but can also have legal implications for the institution. Any errors occurring as a result of inaccuracies in content may be counterproductive for academic institutes and off-putting for its potential students (Halvorson & Rach, 2012).

Both Marcotte (2011) and McGrane (2012a) disagree with presenting limited content to mobile phone users based on an assumption that mobile users are happy with specific or limited information. Marcotte (2011) responds to Croft's (2010) article in his book titled "*Responsive Web Design*", expressing that the context of a website should definitely be a top priority but it is wrong to assume that mobile users do not want access to all of the information provided on a desktop site. Marcotte suggests that only by establishing the requirements of an organisation, identifying the needs of their target audience and considering the reason a site is being made, that is, its context, one can ascertain the content suitable for a mobile-friendly website.

McGrane (2012a) contradicts Wroblewski's (2011a) example of Southwest Airlines' in her book "*Content Strategy for Mobile*". McGrane responds that it is not up to the web developers to decide what is really required by an end user. McGrane contends that the

* See glossary

mobile app of the Southwest Airlines lacks in providing many useful functionalities and information related to baggage, carry-ons, accompanied pets, delays, lost and found, parents looking to book travel for unaccompanied minors and helping disabled and elderly flyers. The app may provide an optimised selection of most important tasks but fails to offer a range of features that might be important the user. She argues that users tend to use any device that is in close proximity and provides them the convenience to carry out miscellaneous online tasks (Deloitte, 2015). In this example, a mobile phone user may require full access to a website's content and functionalities while they are travelling and may not have access to a desktop computer. While *mobile only* has become a known phenomenon (Hill, 2010), there could be some who rely on other devices for Internet access. Therefore web content being delivered to *any* device category—not only mobile phones—should not be diluted or trimmed down (McGrane, 2015).

In the context of this study, it should be noted that the websites for tertiary level educational institutes act as information resources for a range of site visitors including students, teachers and researchers (Bernier et al., 2002). This results in an enormous amount of information that these websites need to provide. Figure 22 showcases University of Auckland's website which hosts dozens of links to various subsets of information relevant to different stakeholders. Offering the same as a separate mobile website would require a great deal of human, financial and technical resources to be put in place (Cao, Ellis, & Gremillion, 2015). The resulting quantity of content that needs to be managed separately will increase the potential of inconsistent delivery of information to desktop and mobile platforms. The creation of a lighter and concise dedicated mobile website may offer tertiary academic institutes wider user engagement with the *mobile only* users. However content disparity between the desktop website and the dedicated mobile website may result in two different user experiences (Budiu, 2016). Google (2013) states that the different versions of an organisation's website should offer a coherent user experience. Otherwise, it may result in confusion and negative overall user experience for the organisation's website users.

* See glossary

Figure 22. High level of content on a university's website (The University of Auckland, 2016)

In assessing the option of a dedicated mobile site, it should also be noted that, apart from potential content or experience disparity, the usage of a separate m-dot sub-domain* and server side device detection mechanisms can cause technical issues (McGrane, 2015). When a website user tries to access a website URL* such as "sitename.com" through their mobile phone, the server redirects this request to the m-dot sub-domain* such as "m.sitename.com". This redirection requires server side calculations and can cause a delay in the loading of the dedicated mobile website on a mobile phone (Google, 2013). Thus, the key advantage of faster loading that dedicated mobile websites offer as lighter versions can be negated to some degree by the redirection process (Fox, 2013).

Furthermore the server-side detection of the type of device and associated browser can be prone to errors (Radware, 2014). Radware Limited is a leading international information technology consultancy and cyber security provider (Radware Ltd, 2016). In 2014 Radware conducted a study on one hundred leading retail websites. This study included the scrutinising of various performance aspects of the m-dot websites offered by these

* See glossary

companies. Radware discovered that many of the tablets were served an m-dot website as a result of faulty server-side redirection in comparison to the intended desktop version of the website (McGrane, 2015). Since the screen of a tablet is bigger than that of a mobile phone, therefore the flawed redirections lead to the rendering of unsuitable layouts on the tablet screens. Sharing the URL* links of a dedicated mobile website can be another potential issue leading to incorrect rendering of webpages (Google, 2013). If the user of a dedicated mobile website wants to share a particular webpage of a dedicated mobile website with a desktop user they will have to share the webpage URL* which could have a “dotMobi” domain name* such as “sitename.mobi” or an m-dot sub-domain* such as “m.sitename.com”. When the desktop user clicks on this link to access it, usually the server redirects the desktop user to the desktop version of the shared webpage (McGrane, 2015). Occasionally, due to erroneous redirection processes, the desktop user may be served the layout of a mobile website instead of its desktop equivalent (Frost, 2013). This problem has been experienced by even well funded websites including Volkswagen, YouTube, CBS News and Wikipedia. As an example, see Figure 23, which demonstrates the flawed rendering of CBS news’ mobile website on a desktop web browser.

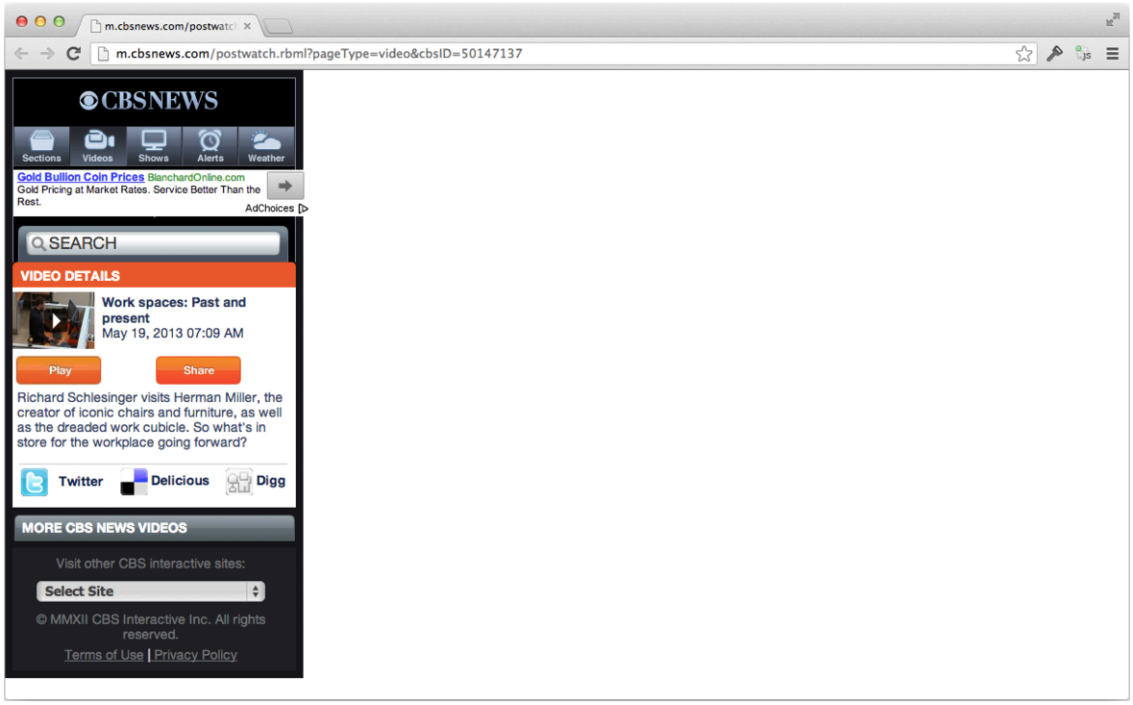

Figure 23. Erroneous rendering of a mobile website on a desktop (Frost, 2013, para. 18)

The following section discusses the second method for creating mobile-friendly websites: Responsive Web Design (RWD).

* See glossary

3.2.2 Responsive Web Design

The year 2010 witnessed the introduction of Responsive Web Design (RWD), a breakthrough in web development. RWD is a web development system, which aims to create websites that can automatically adjust their layout and seamlessly deliver the same content to end users with different sized devices (Marcotte, 2010). Figure 24 illustrates the rendering of a responsive website on different devices in different orientations.

Figure 24. A responsive web site (Local SEO Admin, 2014, para.3)

Ethan Marcotte is a distinguished web designer and developer, who has contributed significantly to the body of knowledge in this discipline as an author and technical editor. Marcotte (2010) coined the term 'Responsive Web Design' in formulating a system utilising the existing adaptable features of web technologies such as fluid grids, flexible images, and media queries. In his book "*Responsive Web Design*", Marcotte (2011) agrees that building a dedicated mobile website does have valid applications for the needs of an organisation, but suggests, however, that forking of content to optimise a website for viewing on a specific device is unsustainable in the future. Due to the technological advancements, various electronic gadgets are becoming capable of web access and newer devices are frequently being introduced (McGrane, 2012a). Using the dedicated method of building mobile-friendly websites, an organisation may respond to the needs of its mobile phone users, however, this practice does not take into account the users of other devices including laptops, tablets, personal digital assistants, gaming consoles, televisions and eBook readers. Furthermore, within the category of mobile

* See glossary

phones there are varying screen sizes and resolutions (Cao, Cousins, et al., 2015). Suboptimal layouts maybe rendered on mobile phones where the screen size is significantly different to the dimensions at which the website was originally created. This makes it almost impossible to dedicate a separate version of a website for every device.

Prior to the creation of responsive web techniques, web page layouts were created with fixed grids and pixel based dimensions (Gardner, 2011). Figure 25 displays two snapshots of a fixed grid layout. The snapshot on the left shows how a page looks when it is displayed in full size on a bigger screen. The snapshot on the right is the end result of horizontal down scaling of the browser. The browser window cuts off and hides a considerable amount of page content. The unchanging nature of a fixed grid layout, not only introduces a range of visual and navigation issues for viewing on a mobile phone, but a desktop user could also miss out on important information when the browser window is scaled down by the user, leading to cropping of content.

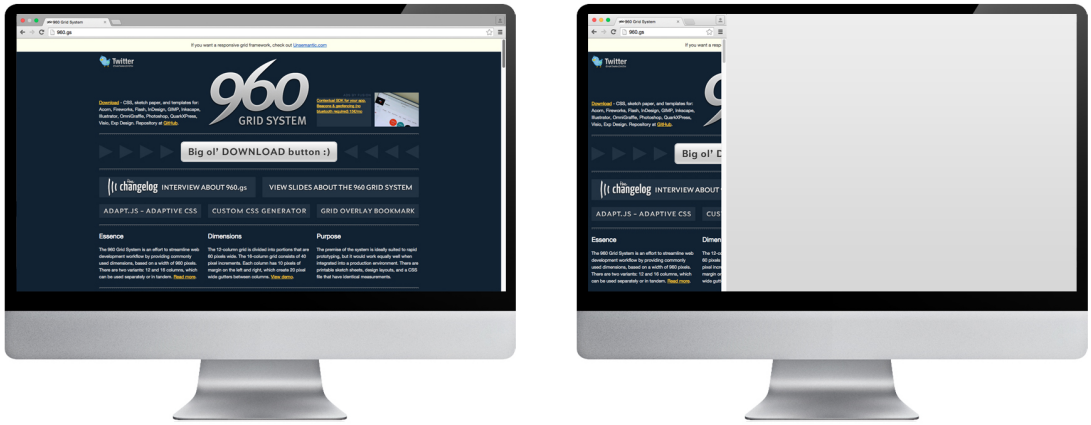

Figure 25. Cropping of contents by horizontal downscaling of a fixed grid layout (N. Smith, 2008)

Before delving into the suitability of RWD for the creation of mobile-friendly websites for academic institutes it is important to understand the functionality of the fundamental principles of RWD. Following is a brief explanation of the three key techniques which collectively make a website responsive:

* See glossary

Fluid Grids

Compared to fixed grids, a flexible or fluid grid works on percentage-based grids and percentage-based layouts within those grids (Marcotte, 2011). When a responsive site is viewed on a small screen such as a mobile phone or when the browser size is reduced on a desktop screen, all the visual elements of a fluid grid scale down proportionately as a result of percentage-based sizing. The result is that the information is not cropped or lost when using a small screen device. Figure 26 demonstrates two snapshots of a fluid grid. Similarly to Figure 25, the snapshot on the left is the full sized view of a website and the snapshot on the right is the browser's horizontally scaled down view. As can be seen, on the right, the visual elements such as the banner, navigation items and textual columns scale down proportionately when the browser size is reduced.

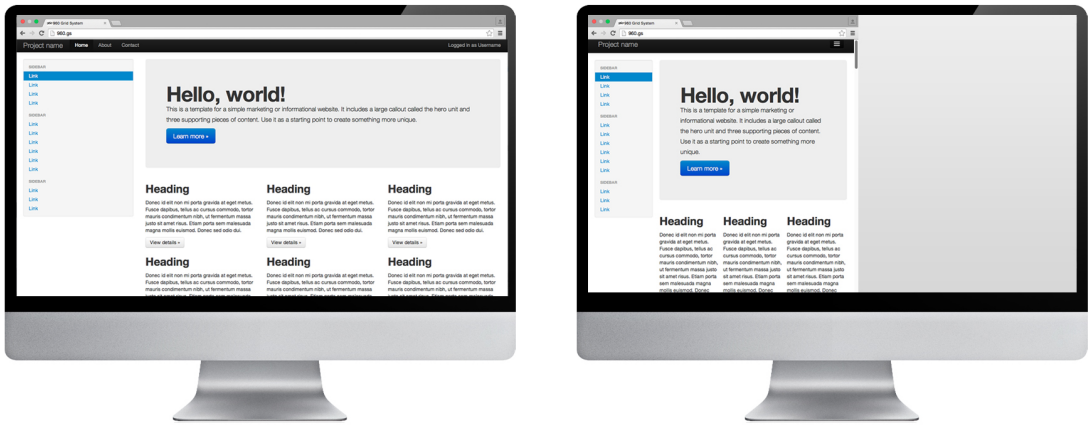

Figure 26. Scaling of a fluid grid layout (Bootstrap, 2014)

Fluid Media

Internet service providers (ISP's) provide increasingly faster Internet speeds via broadband and optical fibres. As a result, rich media content such as images and videos have become an inherent part of contemporary websites. To make these static and moving images more accessible to users they are made fluid (Marcotte, 2011). Like the flexible grid, fluid media also works on percentage based scaling and scales along with its enclosing container (Gardner, 2011). Figure 27 shows an example of a fluid banner image, which changes its dimensions proportionately to suit the size of its container webpage when the web browser is scaled horizontally.

* See glossary

Figure 27. Scaling of fluid media to fit within its container (Fluid media inc., 2015)

Media Queries

The scaling of a web page using fluid grids and fluid media are only one aspect of a webpage's responsive capabilities. The scaling itself is not sufficient for making a website fully responsive, since the dramatic scaling of a site beyond its original size introduces legibility and aesthetic issues. If a page is scaled down drastically, say from the size of a desktop to mobile phone, the visual components will scale down beyond comprehension (Marcotte, 2011). To make a website fully responsive and suitable for viewing on various devices, media queries are used to code device-specific styling rules which instruct the web browsers to dynamically readjust a website's layout in accordance to the display device being used (Natda, 2013). One of the factors that media queries utilise is resolution breakpoints – that is, established dimensions for a variety of commonly used display devices including mobile phones, tablets and desktop screens. Furthermore, media queries instruct the browsers to also consider the unique characteristics of the device being used – such as orientation, aspect ratio, resolution, current browser, browser size and a few other technicalities – to precisely serve an appropriate end result for a screen as if it were custom made for the viewing device (World Wide Web Consortium, 1994).

Figure 28 provides two screen captures of the same responsive website readjusted for viewing on two different devices. The snapshot on the left displays the rendered version of the website for a 1200 pixels wide computer monitor and the snapshot on the right is 320 pixels wide rendering for a mobile phone. The layout of both the renderings uses same content including the banner, logo, navigation buttons and informative text. However, due to the device specific styling rules the visual elements are arranged and scaled differently

to better suit the device in use. The content is being displayed in a two-column format on the desktop screen and a one-column format on the mobile phone's screen. Users of both the devices can easily view the content and utilise vertical scrolling to navigate around the content.

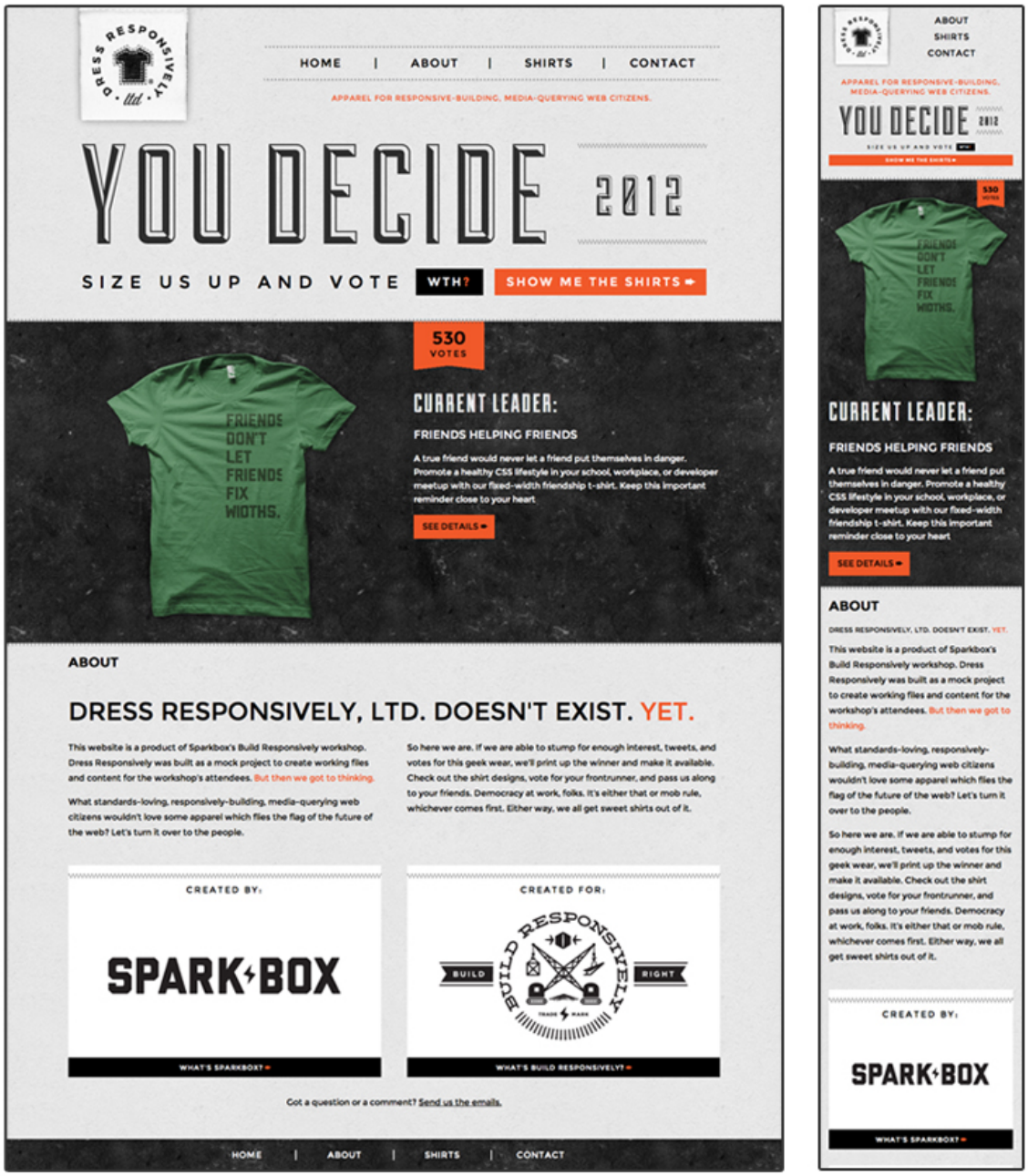

Figure 28. Responsive layouts rendering comparison (Sparkbox, 2012)

Considering the success of mobile phones as Internet access devices (Hill, 2010; Morgan Stanley, 2009), Luke Wroblewski (2009) proposed an approach for building mobile-friendly websites and coined a name for this method 'Mobile First'. *Mobile first* is both a design as well as a content strategy and complements the creation of mobile-friendly websites via RWD (Gardner, 2011; Marcotte, 2011). Wroblewski (2011a) suggests that a mobile experience of a website should be built first, before the tablet or computer version. This is to address the issues of smaller viewing areas offered by mobile phones and also the fact that mobile phone browsers are not as capable as desktop computer browsers (Korpi, 2012). This is seen particularly in their lack of support for JavaScript or CSS based media queries (Marcotte, 2011). Concentrating on creating the mobile experience first allows a greater focus for the web developers to identify and create only the core content and functionality (Keith, 2011) of a website and present it via layouts that are optimised to suit mobile phone screens (Buckler, 2015). Thereafter, animated effects, flash based content, design embellishments, layouts and other features can be progressively added to the site for screens with more real estate for display (Marcotte, 2011). Korpi (2012) states that the *mobile first* approach not only complements the creation of mobile-friendly websites, but also benefits the user experiences for the other devices. As a result, a cruft*-free experience for mobile phones can lead to a cruft*-free experience for other devices. (Cruft in technical terms means undesirable elements in a digital product such as unwanted or unnecessarily complicated code.) The combination of RWD as a technical method and *mobile first* as a content strategy has gained a great deal of popularity amongst web developers worldwide (Keith, 2011; ZURB, 2016).

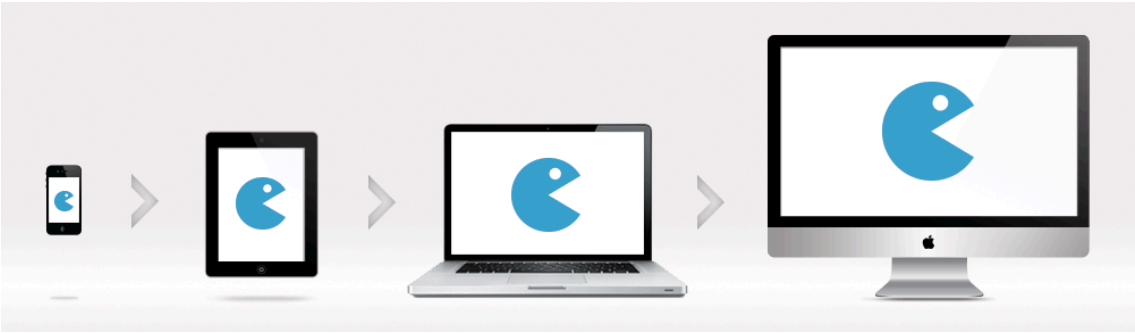

Figure 29. Mobile first (ZURB, 2016, para.15)

RWD has become Google's recommended method for the creation of mobile-friendly websites for a range of reasons including the usage of a single URL*, single set of code, client side detection, search engine optimisation and user experience parity (Google,

* See glossary

2013; Google Developers, 2015; McGrane, 2015) which are explained as follows. Google Developers (2015) explain that irrespective of the device being used, RWD uses only one URL* (Uniform Resource Locator) such as “sitename.com” and one set of code. When a website user tries to access a responsive website through their mobile phone, the mobile phone is served the entire website code comprising of the structural and device specific styling instructions. The browser of the device in use is responsible for the suitable rendering and layout of the responsive website (Charlton, 2014a). This process is known as client-side detection (SQA, 2007). Unlike dedicated mobile websites, responsive websites do not require going through the process of server-side detection of the devise in use. This reduces the load times of responsive websites (Google Developers, 2015). Due to client side detection and device based rendering, responsive websites are less prone to erroneous rendering, compared to dedicated mobile websites (Budiu, 2016).

Search engine optimisation (SEO) is a set of processes which aim at improving the ranking of a website on a search engine such as Google, Bing and Yahoo, thus making the website more visible in search results (Parikh & Deshmukh, 2013). The more a website and its URL are used by end users, the higher it goes in a search engine’s rankings (Francis, 2014). As mentioned in Section 3.2.1, dedicated mobile websites are created with a separate URL than the desktop website (Google Developers, 2015). While the URL for the desktop site may be “www.sitename.com” the dedicated mobile website, on the other hand, may utilise a URL such as “sitename.mobi” or “m.sitename.com”. (McGrane, 2015). Since the dedicated mobile website is a separate entity with a different URL than its desktop counterpart, it requires its equity being built from scratch for the search engines (Francis, 2014). As a result of separate URLs, dedicated mobile websites do not automatically inherit a high search ranking from their desktop counterparts and may appear lower on search-engine page results (Budiu, 2016). Using a range of technical solutions the separate desktop and mobile URLs can be clustered together for Google’s understanding. However, if not executed properly, the technical fixes may result in further issues such as slowing down of search results. Responsive websites, on the other hand, work on a single URL across all devices. This means the URL for a responsive site gains equity amongst search engine rankings due to a combined contribution from a range of devices using it (Francis, 2014). This enables the website to be spotted quickly by a search engine and thus increasing the number of visitors to a website, leading to its stronger online presence and increased revenue and exposure for an organisation. The usage of a single URL thus makes it easier and faster for search

* See glossary

engines such as Google to easily discover a site and its associated content, as opposed to two different URLs and separate desktop and mobile webpages for the same content (Google, 2013). This is due to the fact that Google has to scan through the website only once, rather than going through multiple versions of it.

In 2015 Google initiated new search engine advancements aimed at making the search of mobile-friendly websites faster (Google, 2016b). Google recommends that a mobile-friendly website with a strong user experience is crucial for increasing the user engagement for an organisation's web content. Dedicated mobile websites, which are not planned properly and drastically lacking in content, feature and user experience parity with their desktop counterparts can suffer from the high bounce rates (Francis, 2014). A bounce rate is the abandonment of a website by a user after only visiting the entrance page (Google, 2016a). Google interprets high bounce rates as a sign that a website is not offering relevant content to users and this further cause a drop in a website's rankings. Google (2013) suggests that responsive websites provide a streamlined experience to its users with varying devices and are therefore less prone to bounce rates.

Another advantage of a single URL and device based rendering, is the ability to share a responsive website's URL link error free. The website owners and its users can distribute the same URL for sharing and promoting the website with confidence that the devices being used will be served a suitable end result (Google Developers, 2015). The greater compliance RWD offers for the search engine optimisation can offer a competitive edge to an academic institute's mobile-friendly website. Showing up higher in the search engine results will not only serve the domestic students but will also help connect with International students who may only rely on finding an academic institute's information online and may not have any existing knowledge of an institute's reputation, being geographically apart (Jabar et al., 2013).

Responsive websites can initially cost more to build than dedicated mobile websites since the website is built for serving more than one device (Budiu, 2016; Google, 2013). However, unlike dedicated mobile websites, which rely on content forking, responsive websites rely on a single set of content. A single site and a single set of content are thus easier to maintain and are less demanding in terms of resources and budget required to make any content updates (Charlton, 2014a). Responsive websites can therefore offer a more cost effective solution for academic institutes for on-going site maintenance and the

* See glossary

resources required in the longer run (Cao, Cousins, et al., 2015). Also, updating only a single set of content when required, eliminates errors caused by content segregation and duplication (McGrane, 2013). As a result responsive websites offer content, feature and user experience parity to a multitude of users and devices. It can be assured that irrespective of the screen size, whether it be that of a cheap smartphone with 320 x 480 pixel dimensions or a lavishly priced high definition screen with 1920 x 1080 pixels or any other commonly used gadgets for Internet access such as tablets, consistent delivery of information will be enjoyed across all devices. Effectively, educational institute websites can reach out to prospective students and other target audiences without few technical deterrents. Students with access to non-desktop devices, especially those reliant on mobile phones due to preference, geographical reasons or financial constraints, can still gain full access to the required information on an educational institute's website, which may not be the case with dedicated mobile websites.

The World Wide Web Consortium (W3C) is an international community responsible for the development of web standards (World Wide Web Consortium, 2015). One of the W3C's missions is to ensure that the information available on the web be easily accessible to users with varying hardware devices, software and network capabilities. This mission falls under a concept called 'One Web'. They developed web standards like HTML5* and CSS3* to enable detection and response, to the capabilities of various digital devices.

Gardner (2011) states that due to its device agnostic nature, combined with the benefits of HTML5 and CSS3, RWD has introduced a new thought process of creating websites, which has helped web developers realise the *one web* vision. McGrane (2015) states that RWD offers more than a mobile-friendly solution for an organisation and long term financial and strategic benefits. This has led to a major transition and acceptance of RWD across large corporations, including Microsoft, Sony, Nokia, Google, Starbucks and Expedia (McGrane, 2015; Strelchenko, 2014). Figure 30 showcases Microsoft's responsive website rendered on a desktop, tablet and a mobile phone.

* See glossary

Figure 30. Microsoft's responsive website (Lowell, 2014, para. 10)

RWD has been a widely accepted and highly successful web development system that aims to offer content, feature and user experience parity to a multitude of users and devices. However, its one-size-fits-all approach and usefulness for the creation of mobile-friendly websites has been challenged by web developers and content strategy specialists (McGrane, 2013). James Pearce, head of Open Source development at Facebook, and a renowned mobile web developer and entrepreneur (LinkedIn Corporation, 2016b), presents a key reason for this in his article "*Not a mobile web, merely a 320px – wide one*". Pearce (2010) states when a website user tries to access a responsive website through their mobile phone, the mobile phone is served the entire website code comprising of the structural and device specific styling instructions and content including full text, heavy imagery and plugins (Kim, 2013). The browser of the mobile phone thereafter reads the device specific styling instructions, hides some of the website's content and suitably renders a layout (Charlton, 2014a). Pearce (2010) suggests that using the fundamental principles of responsive web design, a website can be made to aesthetically render on a mobile phone and it does a good job at repositioning a responsive site's content to suit the size of a display device, but this repositioning is only a cosmetic solution and does not take into account the actual performance of a site on a

* See glossary

mobile phone (Buckler, 2015). Considering that a higher level academic institute's website hosts a great amount of content, downloading the entire content of a website to an existing or prospective student's mobile phone can be unnecessarily taxing to their data plans (McGrane, 2012a). This can be off-putting for the students who may have a limited amount of Internet data available to them on their mobile phones due to financial constraints.

In his article "*Improving Responsive Web Design With RESS*", Buckler (2015) agrees with the issues of RWD not taking into account a device's performance capabilities and provides further clarification. Buckler suggests when using RWD, although a diverse range of screen sizes can be accommodated, however the advanced state of a device's screen is not proportional to the device's processing power. Additionally, responsive sites also do not take into account network speeds. For instance, a website user may have a state-of-the-art desktop monitor, however their computer could be very old and the machine may only be connected to a dial-up connection. Due to complex coding and heavier sizes in comparison to dedicated mobile websites, speed and site performance are one of the most criticised aspects of responsive websites (McGrane, 2015). Poorly planned responsive websites can suffer from this 'data bloat' (Google, 2013). Google's Senior Vice President of infrastructure, Urs Hoelzle, asserts even a fraction of delay, calculated in milliseconds, in the searching and accessing of a website can turn users away (Hoelzle, 2012). Google's research shows that a higher speed for web searches and accessing websites has a direct impact on increasing the user engagement and business revenue. The large content of a higher-level academic institute's website increases this risk.

In attempting to offer content parity to users, responsive sites can face technical hurdles while trying to consistently deliver visually complex information across various devices, especially mobile phones (McGrane, 2012a). One of the challenges for catering content to smaller screens of mobile phones is their limited ability to view complex user interface elements, data forms and imagery (Sandelin, 2015). Some examples include spread sheets, tables, info graphics, data visualizations, dashboards and multi-step forms that contain a lot of information and do not translate well when truncated or scaled down to smaller screen sizes (Budiu, 2016). The following two scenarios related to the rendering of tables on mobile phones illustrate the limitation of responsive websites when trying to present complex information in the same manner to mobile phones as to other devices.

* See glossary

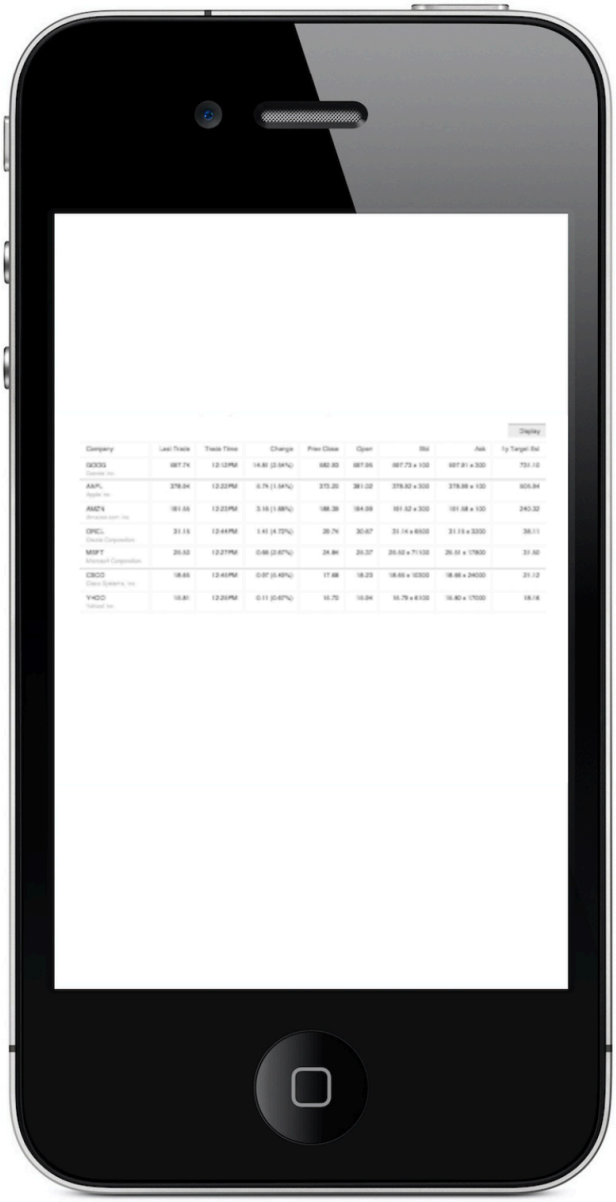

Figure 31 presents the first scenario where a responsive table has been scaled down fluidly along with its enclosing fluid grid to fit on a mobile phone's screen. The data in the table has scaled down beyond comprehension. For a user to be able to read the table's content they will have to pinch and zoom around the table. However this will result in a lack of clear overview of the table (Sandelin, 2015). Google (2015) discourages the use of pinching and zooming as a method of navigating around a webpage.

Figure 31. A scaled down table on a mobile phone screen (Sandelin, 2015, p.10)

Figure 32 presents the second scenario with the help of two snapshots of UCOL's responsive website rendered on a desktop and a mobile phone. The webpage in the snapshots lists the scholarships available at UCOL for existing and prospective students in a non-responsive tabular format. As one of the solutions to overcome the issue of drastic scaling-down of table which makes it incomprehensible, a table is made non-responsive so that it does not scale down along its enclosing grid (Sandelin, 2015). This is done in an attempt to provide the table a higher chance of being able to be read. The snapshot on the left demonstrates that the table can be comfortably viewed on a desktop screen and the user can easily scroll up and down. The snapshot on the right shows that

* See glossary

the non-responsive table gets truncated on a mobile phone's screen when displayed at its full size. Due to the truncation, the user will have to scroll both horizontally and vertically to understand the table's content and as a result will loose the ability to get an overview the table's content.

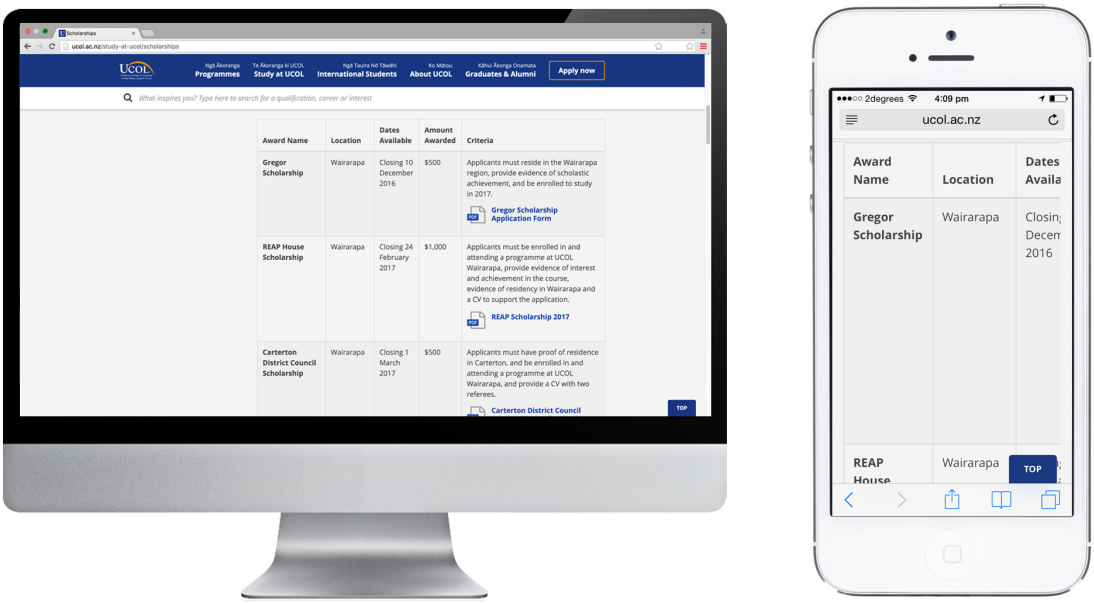

Figure 32. A table on UCOL's website rendered on a desktop and mobile (UCOL, 2016a)

As articulated by Karen McGrane (2012a) in her book "*Content strategy for mobile*", and echoed by Boulton (2012), many web developers who endorse RWD suggest that responsive sites, providing the same content to different devices by reformatting their layout, are favourable for offering experience parity. McGrane (2012a) suggests that simply making a website responsive and its content respond to a variety of screens, does not entirely take into account how the content is best viewed and presented on a device. McGrane (2015) notes in her book "*Going Responsive*" that RWD's technical mechanisms aim to support the World Wide Web Consortium's (W3C) philosophy of *one web* (World Wide Web Consortium, 2015). However, she sees a disparity between RWD's core functionality and the essence of *one web*. Following is the actual definition of *one web* in the words of W3C:

* See glossary

> One Web means making, as far as is reasonable, the same information and services available to users irrespective of the device they are using. However, it does not mean that exactly the same information is available in exactly the same representation across all devices. The context of mobile use, device capability variations, bandwidth issues and mobile network capabilities all affect the representation. (World Wide Web Consortium, 2008)

Comparing RWD to the other two methods of creating mobile-friendly websites McGrane (2015) explains that, to overcome the suitability issues of complex data forms for smaller screens both dedicated mobile websites and adaptive websites (discussed in the following section) tend to either eliminate the problematic content in the mobile version or deliver it in an alternative data form compared to the desktop version (Budiu, 2016; Sandelin, 2015). Some examples of alternative data forms which get served based on device suitability include, different versions of the same image with different resolutions, simplified charts for detailed tables, brief summary and detailed paragraphs for the same textual content and a textual summary as an alternative for audio and video media forms (McGrane, 2012a). To provide a specific example of alternative content relevant to the issue of rendering of tables on a mobile phone's screen, Figure 33 presents a table rendered in its original form for the desktop screen and in a pie chart form for a narrowed down browser to simulate a mobile phone's screen.

* See glossary

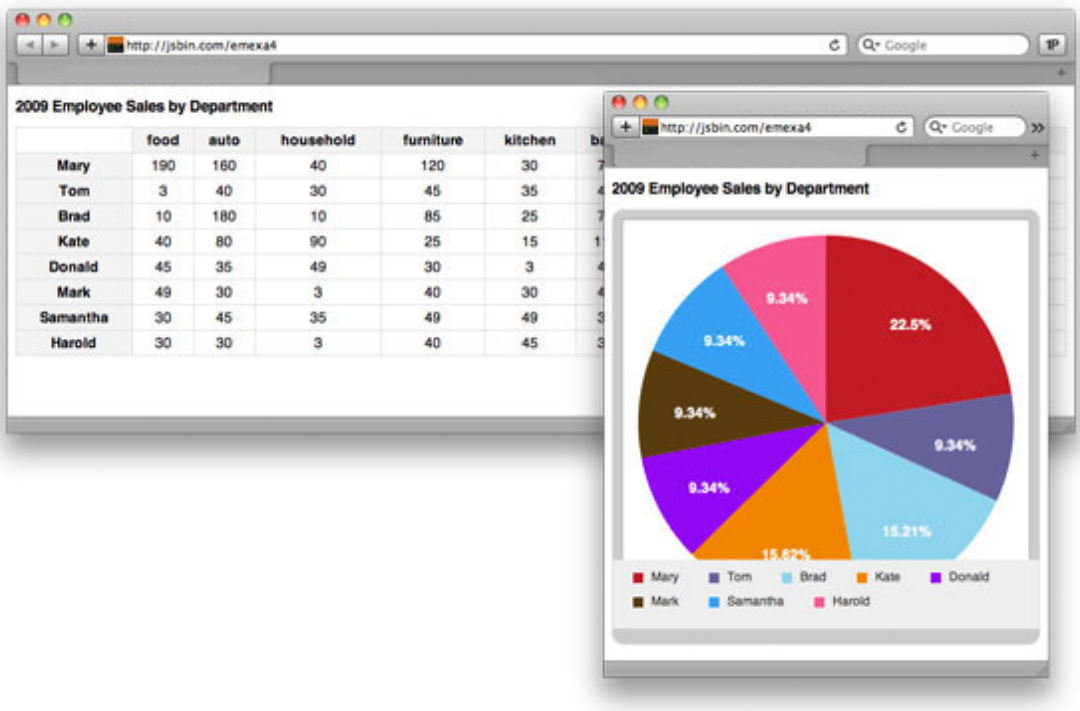

Figure 33. Chart of percentage values converted to a pie chart for a smaller screen (Fern, Koroma, & Martin, 2014, para.12)

The alternative representation of content in dedicated mobile websites and adaptive websites not only aids in offering experience parity to devices with different screen sizes and capabilities but also contributes in offering a device-optimised solution (McGrane, 2012b). McGrane recommends that for responsive websites to go beyond its default mechanisms and offer a device-optimised experience to its users, they need to make use of adaptive content (discussed in the section 3.2.3). Offering alternative representation of the same data to deliver the same information but in a different form to different devices is one of the attributes of adaptive content.

Using effective coding practices, responsive sites can be made as fast as, or faster, than dedicated mobile websites and adaptive websites (McGrane, 2015). However, the creation of an effective responsive website that provides an optimal performance to different devices requires careful planning (Google, 2013), longer development periods, advanced level coding, testing and development skills (Budiu, 2016; Strelchenko, 2014). Thus the implementation of RWD as a mobile-friendly solution for an organisation with a content-heavy website, is slower compared to the implementation of dedicated mobile websites. The conversion of an existing non-responsive website with a large amount of content into a responsive and mobile-friendly solution is a technically challenging and time

* See glossary

consuming process (Kim, 2013). To offer a mobile-friendly solution via RWD, a non-responsive website has to go through the process of converting all of its fixed structure and content into a responsive structure and this conversion may require a major makeover. It may therefore be more prudent to employ RWD when an organisation requires a brand new website or a complete overhaul of its existing website (Erich, 2016).

The following section discusses the third method for creating mobile-friendly websites: Adaptive Web Design (AWD).

* See glossary

3.2.3 Adaptive Web Design

Aaron Gustafson introduced the web development method and coined the term Adaptive Web Design (AWD) in 2011 (Gustafson, 2011). Gustafson is a leading web design author and developer who has contributed significantly to the W3C for the development of web standards (LinkedIn Corporation, 2016b). AWD's functionality has similarities to both dedicated and responsive methods of creating mobile websites (McGrane, 2015). Both dedicated mobile websites and adaptive websites provide a device-optimised solution in terms of a website's design, layout, code and content. Where dedicated mobile websites are created for mobile phones, as a separate version of the desktop site, adaptive websites on the other hand are a collection of separately created websites for a range of devices, including mobiles, tablets, laptops, desktops and televisions (Korpi, 2012). Using resolution breakpoints, both RWD and AWD offer layouts which are specifically designed for a range of display devices, under the same URL* (McGrane, 2015). Like dedicated mobile websites, AWD also works on server-side detection. However, in the case of AWD, when a specific device such as a mobile phone tries to access an adaptive website, the web servers, upon device-detection, deliver the mobile specific version of that website under the same URL (Google Developers, 2016). Google refers to this process as "dynamic serving" of the URL. Due to the usage of a single URL*across all devices, adaptive websites can also offer the same SEO benefits to an academic institute's website as responsive sites (Cao, Cousins, et al., 2015; Evolve Design, 2016).

Figure 34. Separate websites under same URL (Google Developers, 2016, para.3)

* See glossary

AWD works on 'progressive enhancement', a content strategy for delivering online content to a multitude of devices (Gustafson, 2011). Progressive enhancement challenged and reversed the planning order of 'graceful degradation', a traditional multi platform content strategy (Florins & Vanderdonckt, 2004). Extensively practiced from 1994 to early 2000s, *graceful degradation* methodology recommended building a website for the most advanced / capable browsers first, which were usually desktop based (Gustafson, 2008). Thereafter less rich versions of the website with basic information and functionality were created for older or less capable browsers and devices, including mobile phones. Many developers began to question this practice; due to the rising popularity and capability of mobile phones as Internet access devices and the fact that mobile phone users were quite limited to the user experience and content that this system provided. The method and the term *progressive enhancement* were introduced in 2003 (Champeon, 2003). As opposed to *graceful degradation*, this strategy suggests starting from the lowest common denominator by considering the content delivery for the most basic browsers and devices first and then moving on to the more state-of-the-art ones (Florins & Vanderdonckt, 2004).

A website is created as a combination of markup* coding for content plus styling rules for presentation (Gustafson, 2008), and *progressive enhancement* benefits from this segregation. It proposes stripping down or keeping the styling to a bare minimum for older or basic browsers and devices. This allows the most important item, that is, the content of a website to be delivered to the devices with limited functionality. Thereafter, using different versions of style sheets, more dynamic user experiences with graphics-rich content can be created for the more elite devices and web browsers (Champeon, 2003). Similar to RWD, adaptive websites also benefit from a *mobile first* strategy (Korpi, 2012; McGrane, 2012a), which is analogous to progressive enhancement. AWD's usage of *progressive enhancement* ensures that the various versions of a website are cruft*-free and highly optimised for the devices they are created for, including mobile phones. This results in faster load times of a website for a range of devices (Google, 2013).

McGrane (2015) states that RWD works on its clearly defined set of fundamental techniques, which are fluid grids, fluid media and media queries. AWD on the other hand utilises a variable combination of three techniques to make adaptive websites. These are adaptive grids, adaptive designs, and adaptive content. McGrane suggests that different web developers interpret the meaning of adaptive solutions differently. Following are brief

* See glossary

explanations of the three key underlying techniques which form the general understanding of adaptive websites and collectively make a website adaptive:

Adaptive Grids

Adaptive websites are created with adaptive grids, which are a series of fixed and static layouts created at different resolutions for different devices (McGrane, 2015). Due to their static nature, these grids do not do not fluidly scale along the browser's window as fluid grids in responsive websites do. Adaptive grids by default snap into place for the device specific sizes or resolution breakpoints when scaling a browser window up or down, (Cao, Cousins, et al., 2015). However, due to the varying interpretations of AWD and depending on how an adaptive website is coded, the grid simply may work as a fixed grid and may not scale and snap into place at all (Charlton, 2014b). Figure 35 demonstrates the effect of adaptive grids snapping into place by presenting four states of horizontal downscaling of a browser window. State 1 presents the fully maximised view of the browser window and the desktop version of the website. In State 2 the browser window is horizontally scaled down to the edge of the website's layout just before the website scales down to the next resolution breakpoint of a tablet. In State 3 the browser window only fractionally scales down and the website snaps into the next resolution breakpoint. Due to a lack of fluidity in the adaptive grid there is a gap between the outer edge of the website's current layout for tablets and the browser window. State 4 repeats the effect from State 2 where the browser window is horizontally scaled down to the edge of the website's layout just before the website scales down to the next resolution breakpoint.

* See glossary

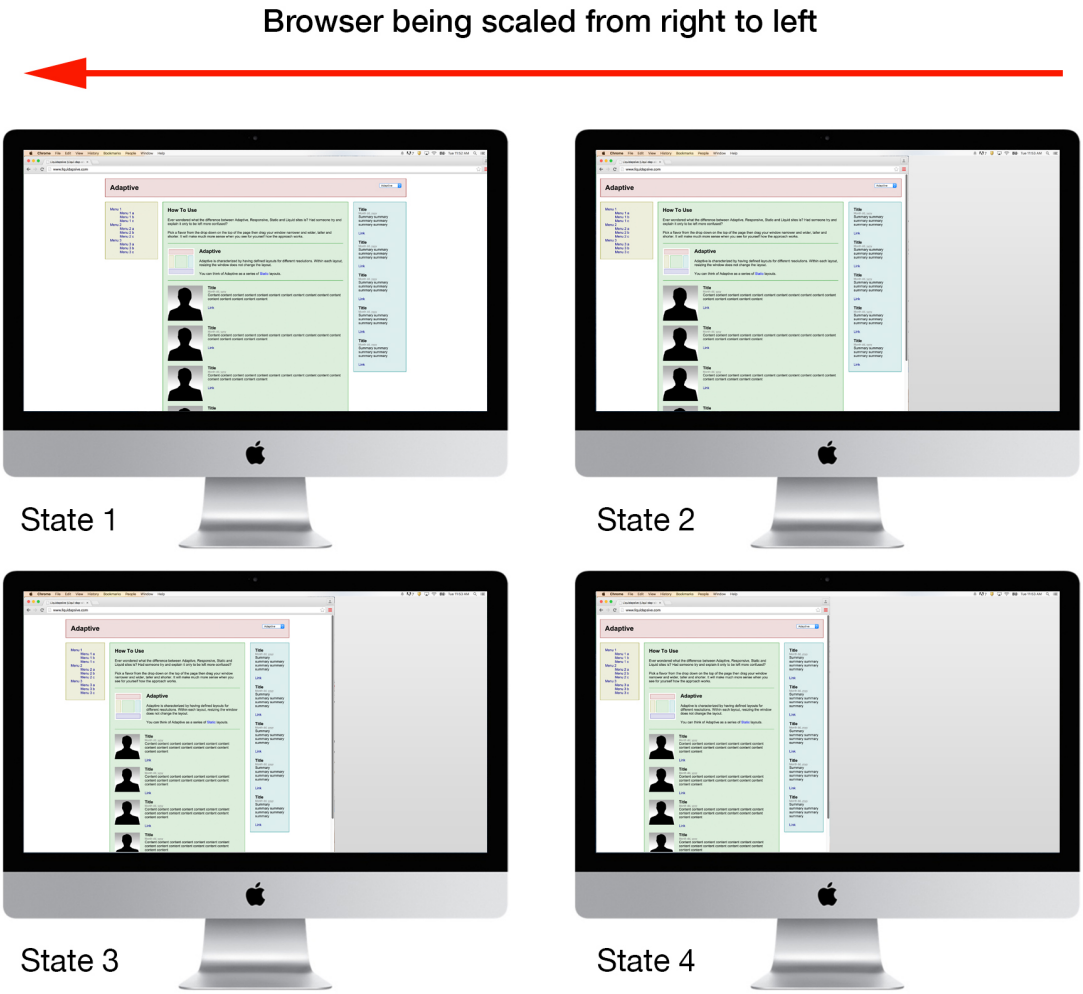

Figure 35. An adaptive grid's snapping into resolution breakpoints (Davison, 2016)

Adaptive Designs

In order to respond to a variety of devices, layout and presentation related compromises are occasionally made for responsive websites (Kim, 2013; McGrane, 2015). To ensure that a responsive site's design remains consistent across all the devices, it may need to be simplified and restricted to the amount of designer elements. As a responsive site expands in size and content, it can become difficult to change any complex design elements across all devices. Adaptive websites on the other hand enjoy a creative freedom where the layouts are independently designed as device specific templates (Google, 2013). Figure 36 presents three different layouts of CNN's website for desktops, tablets and mobile phones.

* See glossary

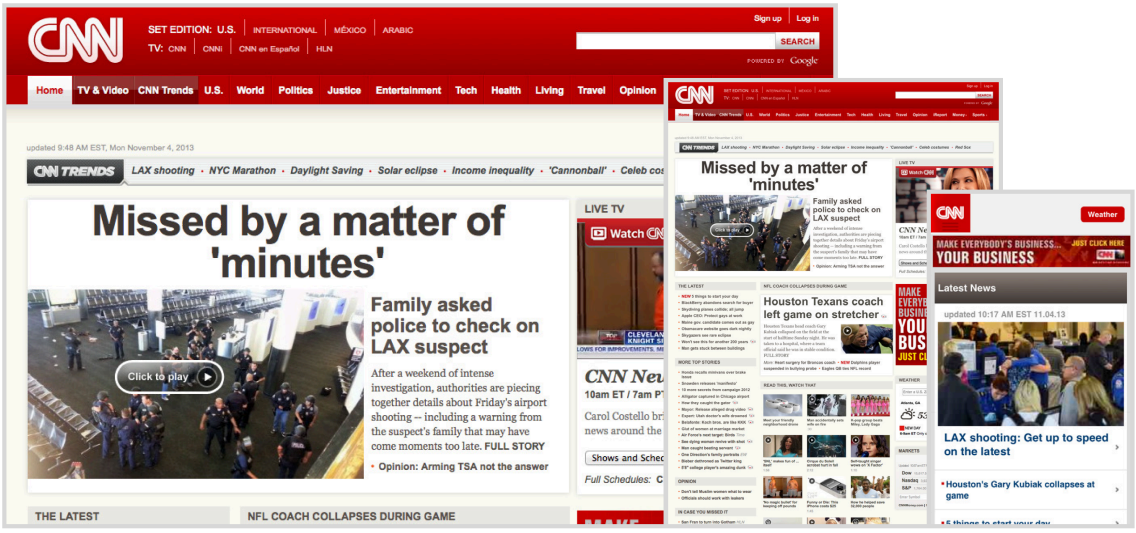

Figure 36. Device optimised layouts of CNN's website (Google, 2013, p.8)

Adaptive Content

Adaptive content is a set of content, which aims to present the same information either in different formats to different devices or provides customised or personalised information to different users based on a range of contextual criteria determined by an organisation (McGrane, 2015). Although content can be customised based on a range of factors, however, the three main variables used in the creation of targeted content are device type, context and personalisation. Presenting an alternative representation of the same information to make it suitable for viewing on a particular device is one of the most common uses of adaptive content (Urbina, 2014). Some basic examples of alternative data forms have been discussed in Section 3.2.3 which include, different versions of the same image with different resolutions, simplified charts for detailed tables, brief summary and detailed paragraphs for the same textual content and a textual summary as an alternative for audio and video media forms (McGrane, 2012a). At a more advanced level, serving customised content to different devices may even include the consideration of the mode of interaction a device can provide to its users, including typing on keyboards, touching on mobile phones or audio input to a GPS (Johnston, 2016). Serving different information based on context and personal requirements of a user also form the more advanced implementations of adaptive content (Johnston, 2016; McGrane, 2015). A detailed discussion on advanced criteria of adaptive content is beyond the scope of this research, however some basic examples are being discussed to indicate the possibilities that adaptive content can offer to academic institutes for offering targeted information to prospective students in the future. While the contextual criteria may include geographical

* See glossary

location and time of day, personal criteria may include age, gender, language and ethnic group of the user. Some examples of serving different information to suit the contextual or personal criteria of a user are listed as follows: online search results for restaurants may first present restaurants nearby using a user's location; targeted in-store promotions may be served to mobile phone users dependent on their age and gender; an academic institute may present different information on enrolment criteria to prospective students from different countries.

As noted in the previous section, McGrane (McGrane, 2012b) proposes, that a hybrid approach of creating responsive websites that use adaptive content, can provide device-optimised experiences of a website, to its users. A detailed discussion on this concept is outside the scope of this research, but introduces a fertile area for investigation. In fact, another variant of this concept has been proposed by Wroblewski (2011b). It is called 'RESS: Responsive Design + Server Side Components'. This technique proposes the amalgamation of client-side rendering of a website's responsive layout and device optimised content served to a device by server-side device detection. As a result, the layout can be rendered potentially error free and the device in use does not need to download the entire website content. Consequently the device can enjoy a device specific layout and fast website performance. Similar to adaptive content, *RESS* also utilises additional measures to ensure the content being served is optimal for device usage (Buckler, 2015). These include: taking into account the network speed, and serving lighter alternative versions of content, such as lower resolution images where bandwidth* is limited; not serving incompatible content to devices, such as flash based content not supported by Apple devices; and providing additional or different information depending on a user's geographical location. Although this method has a lot of merit, at the time of writing, it has not been developed further (Buckler, 2015; Wroblewski, 2011b).

Both responsive websites and adaptive websites aim to serve layouts which are devoted to the specifics of display devices, and serve these layouts under the same URL* (McGrane, 2015). Responsive sites essentially deliver the same code and content across a diverse range of digital devices. Adaptive websites utilise different versions of code and adaptive content, which are optimised for different devices. In the case of adaptive websites, if a device with higher specifications such as a high-density retina display is detected, the server will deliver high-resolution images to the device and contrarily a device with lesser capabilities will be delivered medium to low-resolution images.

* See glossary

Therefore adaptive websites can offer faster loading times and expeditious performance overall in comparison to responsive websites (Cao, Ellis, et al., 2015; Google, 2013).

Within the category of mobile phones there is a great disparity between device capabilities (Rieger & Rieger, 2011). The latest generation of smartphones* may have fast processors and can perform swiftly when accessing heavier responsive websites and rich media content (Google Developers, 2016). However, low-end mobile phones known as feature phones, may suffer significantly due to their lack of support for media queries and lesser performance capabilities. Where dedicated mobile websites for an academic institute can offer a better user engagement and fast site performance for mobile phone users, adaptive websites on the other hand can offer wider user engagement and site performance (McGrane, 2012a). This is the case not only for the students who fall into the *mobile only* category, but other students as well who may only be reliant on other digital devices with lower capabilities such as entry level tablets; without the need for creating device dedicated subdomains* such as “tablet.sitename.com”. Additionally, complementary to any device and not only mobile phones, students with limited access or access to slow speed Internet connections can enjoy faster access to course related information on an academic institute’s website.

The conversion process of an existing website with a large amount of content into a responsive website may require a major overhaul of the website and longer development periods (Budiu, 2016; Strelchenko, 2014). However, just like dedicated mobile websites, the device dedicated versions of a website created with AWD are also separate entities to the existing desktop website. Therefore adaptive websites also allow independent creation of different versions without the need to make any major alterations to the existing website (Charlton, 2014a). Depending on the number of adaptive versions of a website that need to be created, adaptive websites may be faster to develop than responsive websites. Additionally AWD makes it easier for web developers to make any alterations to one version of the website without having to interfere with other versions (Google, 2013).

Using a combination of progressive enhancement and adaptive content, AWD aims to offer the same information to different users in different representations by considering: “…mobile content, device capability variations, bandwidth issues and mobile network capabilities…” (World Wide Web Consortium, 2008). Consequently it appears that AWD

* See glossary

as a technical method of website development has a greater inclination towards the W3C's *one web* philosophy.

Graham Charlton is a content strategy specialist and has several years of experience in ecommerce, mobile web and content marketing (LinkedIn Corporation, 2016a). Charlton has authored several best practice reports on mobile commerce, multichannel retail and ecommerce user experience and written various articles on AWD. Charlton (2014a) suggests that AWD is most suitable to organisations which have an extensive target audience with access to varying digital devices. Some of the reputable names that utilise AWD include Apple, About.com, Lufthansa and Amazon (Evolve Design, 2016; YOTTAA, 2014). Figure 37 showcases two snapshots of Amazon's adaptive website. The snapshot on the left is the mobile version of the website and the snapshot on the right is the desktop version and they both utilise the same URL* which is www.amazon.com.

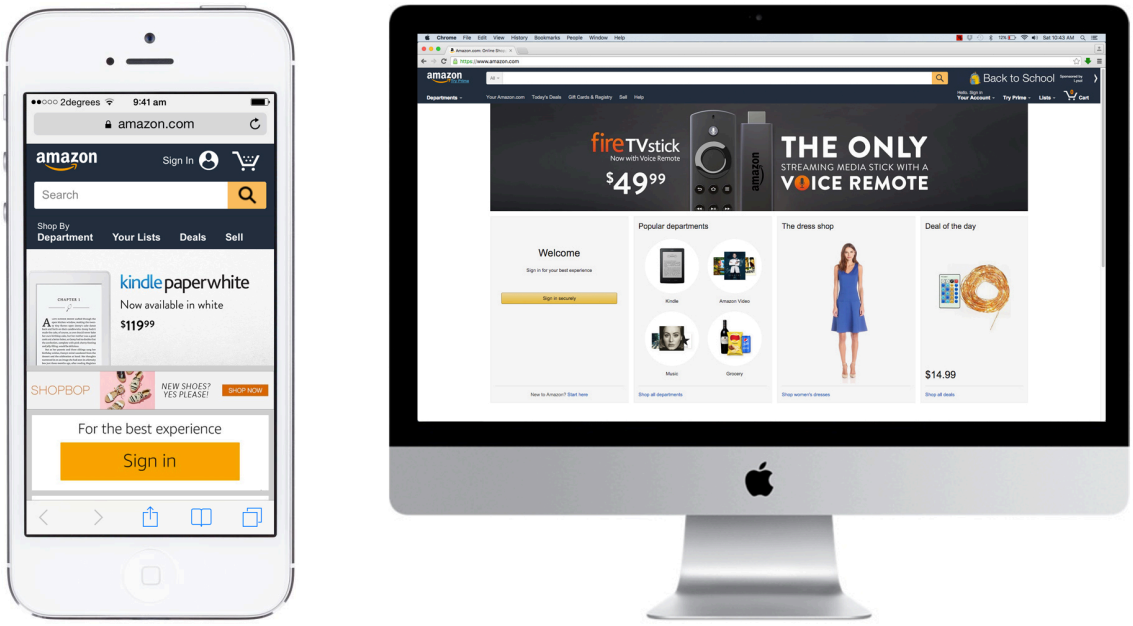

Figure 37. Amazon's adaptive website (Amazon.com, 2016)

Although adaptive grids in conjunction with adaptive designs offer layouts that are suitable for specific devices (McGrane, 2015), within the device categories however, there is a variation in screen size and resolutions. For instance the screen size of an Apple iPhone 6 plus is 5.5 inches and iPhone 5 is 4 inches (Apple Inc., 2016). Adaptive templates of a website are usually created with a finite number of anticipated screen sizes (Cao, Ellis, et al., 2015). The fixed nature of adaptive grids can thus result in incorrect rendering and

* See glossary

suboptimal layouts for devices in similar categories, but of a different size. This becomes a problem every time a new device gets introduced to the market with a different screen size, resulting in the web development needing to create a new version of the website (McGrane, 2015). This will be especially true for unconventional gadgets for Internet access such as the Apple Watch. Responsive websites on the other hand fluidly adjust amongst the varying screen sizes in the same device category. To suit a new device category, additional styling rules can be quickly incorporated for responsive websites rather than having to build a new version.

As discussed, adaptive grids may not scale and snap into different resolution breakpoints (Charlton, 2014b). As a result, similar to traditional fixed width websites (Gardner, 2011) adaptive websites may also experience cropping issues due to the horizontal downscaling of the browser on a desktop screen. Due to this limitation, placement of critical links or other elements of a web page can be clipped, leading to loss of important information for the end users and business opportunities for the website owners (Marcotte, 2011). Figure 38 shows a close-up of the top menu on MSN New Zealand's website. It demonstrates the clipping of the Health and Fitness link caused by the horizontal scaling of the browser.

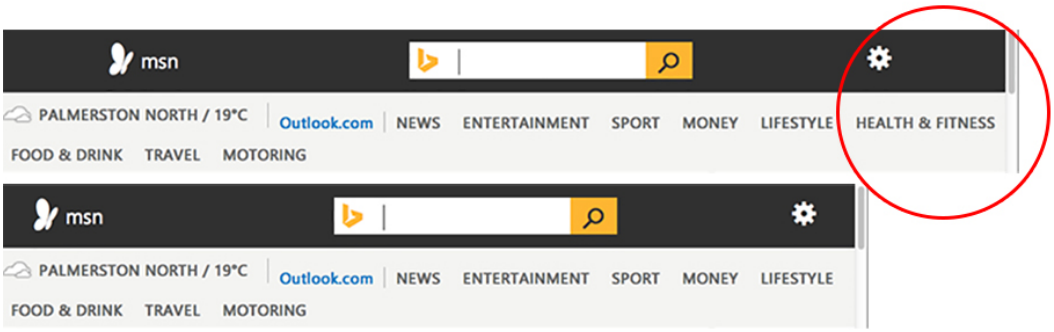

Figure 38. Clipped content (Microsoft, 2014)

As another example of cropping issues, Figure 39 shows two snapshots of Amazon's adaptive website rendered on a desktop computer. The snapshot on the left shows the full sized desktop version and on the right shows that a considerable amount of the website cropped upon the horizontal scaling of the web browser. Once again the fluid scaling of responsive websites can ensure that the content of a website does not get clipped. In an educational institute's site, this could be critical in a student's decision for choosing one institute over another.

* See glossary

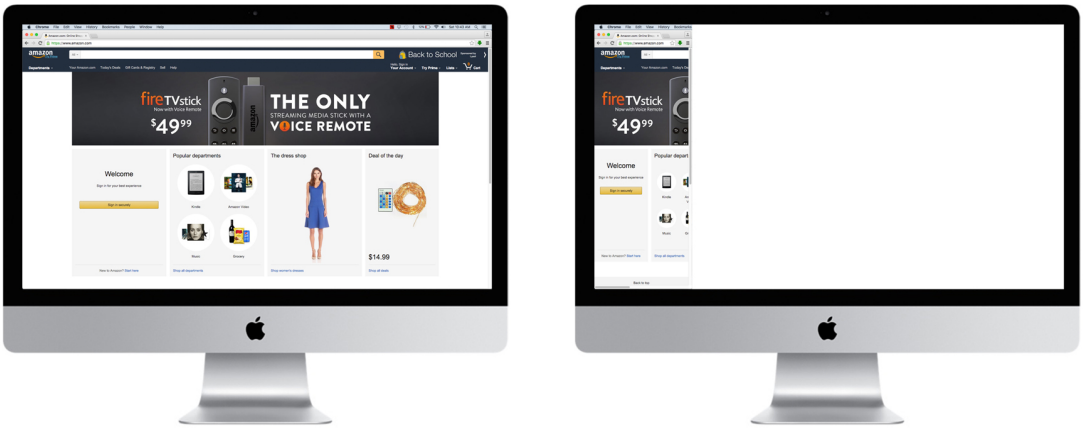

Figure 39. Horizontal downscaling of Amazon's adaptive website (Amazon.com, 2016)

Similar to dedicated mobile websites, adaptive websites also suffer from the issues of error prone device detection and content forking (McGrane, 2015). They can also be resource intensive for post-deployment maintenance. For the correct detection of a multitude of devices, adaptive websites rely on server-side device detection libraries (Google Developers, 2015). These libraries need to be continuously updated, which is a technically challenging task and usually susceptible to errors (Buckler, 2015). Alternatively, organisations may invest in expensive libraries created by companies like 'Netbiscuits' who specialise in the creation and regular maintenance of these libraries, which is another added cost of implementing AWD (McGrane, 2015). Responsive websites on the other hand do not require any device detection libraries due to their client-side implementation of a website's layout.

In the setup of a separate dedicated mobile website and a desktop version, content forking issues will be applicable to two versions of a website. However, at a minimum adaptive websites are built with at least three versions of a website for mobile phones, tablets and desktop computers (Cao, Ellis, et al., 2015). Therefore every time new content needs to be added, removed or archived, adaptive websites will require repeating the same processes a number of times (Williams, 2013). Managing multiple sets of content and keeping them up-to-date is highly tedious (Google, 2013). To overcome the issues around content forking for a multi platform environment, an organisation may need to need to further invest in high-level and expensive content management system (CMS) (McGrane, 2015). On top of this, Google (2013) suggests, if the multiple versions of an adaptive site are radically different to each other, it may lead to changing user

* See glossary

experiences and confusion amongst users. As has been noted, an incoherent user experience across devices is counterproductive for a brand's equity.

Several sources including McGrane (2015), Google (2013) and Charlton (2014a) suggest that AWD is a time consuming, resource-intensive and budget heavy solution. It is most suitable for organisations who have an extensive target audience and need to make regular changes to their website or frequently need to make isolated adjustments to the device dedicated versions for targeted users. Due to the complexity involved in on-going maintenance of several versions, skilled in-house web developers or vendors are essential for the purpose. Considering these aspects, adaptive websites may not be a feasible and sustainable solution for academic institutes, which have to deal with both large sites and financial constraints.

* See glossary

3.3 Technology usage by top twelve academic institutes worldwide

To obtain an international perspective, a brief observational test was conducted on the websites of top twelve academic institutions globally. The aim was to ascertain, if the top ranking institutes, implemented mobile-friendly websites, and what technical method of creation was appointed. The rankings for 2016-2017 were obtained from the website of Times Higher Education (2017).

To conduct this test the landing pages of these websites were visited on a desktop computer, tablet and a mobile phone. The URLs of these websites were checked to find out if the same URL was being used for all the devices. Fluidity of all the web pages was tested on the desktop computer by horizontal and vertical scaling of the browser window to find out if the layouts were responsive or adaptive. Layouts were observed across devices to spot any differences and discover if they utilised any adaptive templates. Admission and enrolment related webpages were visited along with other pages at random to find out if the content was being served adaptively to devices in alternative representations.

It was discovered that all twelve institutes had implemented mobile-friendly websites. However, one of the twelve was only partly mobile-friendly and relied on a combination of dedicated mobile pages with an “M-dot” sub-domain and desktop pages of the website. Out of the remaining eleven, ten employed RWD and one used a hybrid of responsive and dedicated methods where some pages utilised an “M-dot” sub-domain and some had the same URL as the desktop website. None of the institutes seemed to have implemented any adaptive mechanisms or adaptive content. However, due to the brief scope of this observation, not every webpage and associated content sections were inspected. Table 2 reveals the findings of this test. The abbreviated heading MFW used in the third column of the table stands for mobile-friendly website.

* See glossary

Table 2. Website observational test of top twelve institutes globally

Institute's name, country and URL	Rank	MFW	Method
University of Oxford (UK) http://www.ox.ac.uk/	1	Yes	RWD
California Institute of Technology (USA) https://www.caltech.edu/	2	Yes	Hybrid of RWD + Dedicated
Stanford University (USA) https://www.stanford.edu/	3	Yes	RWD
University of Cambridge (UK) https://www.cam.ac.uk/	4	Yes	RWD
Massachusetts Institute of Technology (USA) http://web.mit.edu/	5	Yes	RWD
Harvard University (USA) http://www.harvard.edu/	6	Yes	RWD
Princeton University (USA) https://www.princeton.edu/main/	7	Yes	RWD
Imperial College London (UK) https://www.imperial.ac.uk/	8	Yes	RWD
ETH Zurich – Swiss Federal Institute of Technology Zurich (Switzerland) Desktop URL - https://www.ethz.ch/en.html Mobile + Tablet URL - https://m.ethz.ch/en/	9	Partly	Hybrid of Dedicated + Desktop site
University of California, Berkeley (USA) http://www.berkeley.edu/	=10	Yes	RWD
University of Chicago (USA) http://www.uchicago.edu/	=10	Yes	RWD
Yale University (USA) http://www.yale.edu/	12	Yes	RWD

* See glossary

This brief investigation was instrumental in validating some of the findings from the literature review since the websites observed exhibited some of the pros and cons of technical methods, listed under the Section 3.2. Some of the well-planned and implemented responsive websites provided a coherent user experience across the three devices. These websites were from University of Oxford, Stanford University, University of Cambridge, Harvard University and University of California Berkley.

Some of the responsive websites demonstrated various flaws at varying levels when used on a mobile phone. It would appear these websites had been implemented or maintained without thorough planning. Collectively, some of the issues that have been discovered were: slow loading times; unsuitable content did not load on mobile phone; non-responsive tabular data and page sections were difficult to operate; missing content; and suboptimal layouts. These websites were from Massachusetts Institute of Technology, Princeton University, Imperial College London, University of Chicago and Yale University. As can be seen from Table 2, the website of ETH Zurich – Swiss Federal Institute of Technology Zurich was partly mobile friendly and used a dedicated method. California Institute of Technology relied on a hybrid of responsive + dedicated methods. Apart from some of the above-mentioned flaws, collectively, these websites also demonstrated content forking issues, user experience disparity and erroneous server side detection. Interesting visual examples of some of these issues have been presented in "*Appendix 01 Issues discovered post hoc analysis of websites for top twelve global institutes*".

It is worth noting that some of these websites have provided a web app* with an "M-dot" sub-domain* of the desktop website. Compared to a native app, a web app is not installed on a mobile phone but accessed via a mobile phone's Internet browser (Godwin-Jones, 2011). This is being specified to eliminate any confusion for the readers of this research who may be interested in visiting these websites. These websites were from University of Oxford, Stanford University, Harvard University, Princeton University and the University of Chicago.

The next section concludes the discussion on the comparison of the three methods available for the creation of mobile-friendly websites.

* See glossary

3.4 Conclusion

This literature review set out to discover the contemporary technological methods available for the creation of mobile-friendly websites and compare their suitability in a tertiary academic setting. In order to do so, dedicated mobile websites, responsive web design and adaptive web design were compared and contrasted across a range of criteria. Some of the key criteria included construction methods, individual functionalities, performance on mobile phones, success stories, search engine optimisation (SEO), cost of construction and maintenance, content delivery approaches, user experience parity and suitability to a multiplatform environment Several merits and shortcomings were discovered and discussed. Following are key comparative conclusions of the individual methods.

Dedicated mobile websites

Dedicated mobile websites can have cheaper development costs, faster implementation periods, speedy performance on mobile phones and device-optimized user experience. Some of the disadvantages of dedicated mobile websites are error prone device detection and link sharing, error prone layouts within the device category, latency* due to server-side redirection, potential content and user experience disparity, resource intensive maintenance, and the lack of expansion capabilities to other devices, leading to a further need of building separate versions of the website for other commonly used devices such as tablets. This impacts on financial resources and may eventually outweigh the initial financial advantages of choosing dedicated mobile websites. This technology is less suited for organisations whose users utilise a wide range of devices for accessing the organisation websites.

Responsive Web Design (RWD)

Some of the advantages of RWD are optimal rendering of layouts across a range of devices, higher compatibility with search engine optimization, error free link sharing, low maintenance and associated costs, content and user experience parity across devices and expansion capabilities to new devices. Some of the disadvantages of RWD are higher initial development costs, need for being built from the ground up, need for detailed planning, slower speeds on mobile phones if not planned properly and not being a devised optimized solution by default. Choosing RWD, especially for large and complex

* See glossary

websites, requires that thorough strategic planning be implemented to ensure the considerable financial and human resources are available in the development stage; and that strong communication structures are developed between different stakeholders and providers of website content.

Adaptive Web Design (AWD)

AWD's advantages include, speedy performance on mobile phones and other devices, device optimised user experiences, easier independent creation and changes for different versions of the website. Some of the disadvantages of AWD are error prone device detection, potential content and user experience disparity across devices, complexity of implementation, higher development costs, varying interpretations, resource intensive maintenance and default lack of expansion capabilities to new devices.

As noted previously, from a user-experience point of view, Google (2013) identifies layout, content and speed as the three main criteria that lead to best mobile-friendly user experiences. Google suggests that if all three are optimal, it makes the user experience engaging and increases the chances of interested users converting into actual clientele. With sufficient planning, correct implementation and technical fixes all three technical methods discussed can be optimised for layout, content and speed along with other technical criteria for an academic institute's mobile-friendly website (Google Developers, 2015). Content forking issues for dedicated and adaptive websites can be resolved by employing additional processes, software and human resources. Using effective coding practices, responsive sites can be made as fast as or faster than dedicated mobile websites and adaptive websites (McGrane, 2015). A hybrid of responsive layouts and adaptive content can be developed so that the resulting website serves device-optimised layouts and alternative representations of the same content for both mobile phones and the range of other devices (Buckler, 2015; McGrane, 2012a; Wroblewski, 2011a). Using a range of technical solutions, the separate URL of a dedicated mobile website can be clustered together with its desktop counterparts so that both the URLs enjoy similar search ranks (Budiu, 2016).

The selection of one technical method over another for academic institutes will require the consideration of various factors including financial capabilities, timelines and human resources (Google, 2013). Also, different academic institutes will have a different range of

* See glossary

student markets and device usage trends amongst their potential student groups. Since all of these factors may vary for different institutes, any recommendations can only be made on a case-by-case basis. A detailed discussion on the correlation between available resources and suitable technical method is beyond the scope of this research, but could well form the basis of another research opportunity.

Although the targeted users of this research are the NCEA Level 3 students, the prospective students for universities and ITPs may also include students from other age groups and international origin (Ministry of Education, 2013). Consequently a great range of device diversity can be expected from the collective group of prospective students (Research New Zealand, 2015). Google (2013) suggests that mobile phones have become the key device for many organisations to connect with their target audiences. However, today's multi-screen consumers increasingly expect to connect with an organisation's website via a range of devices (Google, 2013; McGrane, 2015). It is therefore vital for academic organisations to create websites that can be accessed via a range of digital devices to suit potential users. This suggests the value of a thorough understanding of an institution's target audience and the devices they are using. Surveying a specific student market—namely UCOL's prospective student population—is given as an example of this, in the following Findings section.

In conclusion, dedicated mobile websites can offer an optimised mobile-friendly website but cannot fulfil an academic institution's needs for delivering content over other platforms (Marcotte, 2011; McGrane, 2012a). RWD and AWD, on the other hand, can offer an academic institute more than a mobile-friendly solution and suffice the multi-screen delivery requirements of an academic institute's content (Cao, Ellis, et al., 2015). However, both of these solutions will be more complex to implement than dedicated mobile websites. The brief observational test performed on the websites of top twelve academic institutions globally revealed general agreement with the findings in the literature review; particularly, the need for thorough planning for the implementation of responsive websites being stressed.

Adaptive websites can offer highly optimised versions of a website, however it will be resource-intensive for its on-going maintenance and, by default, lack expansion capabilities to devices other than those originally considered (Charlton, 2014b; McGrane, 2015). Implementation of responsive websites will be resource-intensive during the

* See glossary

development phase; however, once developed, these will require the least maintenance and offer evolutionary capabilities for emerging devices and screen sizes within the same device categories (Google, 2013; Google Developers, 2016).

The research here supports the conclusion that, for academic institutions in New Zealand, RWD and AWD are the more fitting solutions for the implementation of mobile-friendly websites. Furthermore, of the two solutions, RWD seems to offer longevity to the return on investment for an academic institute's website (McGrane, 2015). Interestingly, out of the top twelve academic institutes worldwide, a majority had implemented responsive websites. While investigating the content delivery approaches for the individual methods, the concept of a hybrid of responsive layouts and adaptive content, and another variant of it called 'RESS: Responsive Design + Server Side Components' was discovered. These concepts have been briefly discussed above, but deserve further research. Academic institutes may utilise this concept for the creation of websites that offer targeted information for different student groups, for example domestic and international.

As noted above, device usage trends amongst potential student groups may be unique for different academic institutes and these trends will have an effect on the selection of a suitable technical method of creating mobile-friendly websites. Section 4.1 of the primary research will present the statistical findings on the unique characteristics of NCEA L3 students in Whanganui, including device preferences for course related information seeking. Thereafter, Section 4.2 will reveal how effectively New Zealand tertiary academic institutes utilise the technology available, to implement mobile-friendly websites to aid information seeking for the prospective students.

A succinct list of some of the key points above is provided in Table 3, the form of which has been partially adapted from Google's (2013) report "*Building websites for the multi-screen consumer*".

* See glossary

Table 3. Quick comparisons of Dedicated, Responsive and Adaptive methods of creating mobile-friendly websites

Criteria	Methods		
	Dedicated	**Responsive**	**Adaptive**
Domain name	• Different URL for the mobile-friendly version of the website.	• Same URL for all the devices.	• Same URL for all the devices.
Detection mechanism	• Server-side. • Error prone device detection. • Website redirection can cause latency issues.	• Client-side. • Less prone to erroneous device detection. • Elimination of the server-side redirection reduces load times.	• Server-side. • Error prone device detection. • Server-side detection libraries required for the correct detection of devices.
Sharing	• Error prone redirections to the incorrect version of the website.	• Single URL and client-side device detection ensure error free link sharing.	• Error prone redirections to the incorrect version of the website.
Search Engine Optimisation (SEO)	• The mobile-friendly version of the website does not automatically inherit the search ranking of the desktop version. • Clustering of the separate URLs for SEO is technically challenging. • Drastic disparity between the mobile-friendly version and the desktop version of a website may lead to high bounce rates.	• Single URL for all the devices leads to higher search engine rankings. • Single set of code makes it faster for search engines to find content on a website. • Less prone to bounce rates. • Google's recommended method for SEO.	• Single URL offers similar SEO benefits as responsive websites. • Drastic disparity between the different versions of a website may lead to high bounce rates.

* See glossary

Development and maintenance	• Careful planning required to ensure that the mobile-friendly version and the desktop version of a website are not radically different to each other. • Least expensive solution for building mobile-friendly websites. • Quickest solution for building mobile-friendly websites. • Development and maintainenance of a separate mobile-friendly version can be done independently without interfering with the desktop version. • Separate website versions lead to a resource intensive maintenance.	• Conversion of a complex non-responsive website into a responsive and mobile-friendly website is technically challenging. • More suitable for brand new websites or complete website overhauls. • Higher development costs, being more than a mobile-friendly solution. • Longer development periods, being more than a mobile-friendly solution. • Once developed, the maintenance of a single set of code and content are easier and less resource intensive.	• Careful planning required to ensure that the multiple versions of a website are not radically different to each other. • Development techniques suffer from varying interpretaions. • Higher development costs, being more than a mobile-friendly solution. • Can be faster to develop than responsive websites, depending on the required number of independent versions of a website. • Develsopment and maintainenance of a separate device-specific version of a website can be done independently, without interfering with the other versions. • Separate website versions lead to a resource intensive maintenance.
User experience	• Optimised design, layouts, code, content, navigation and speed, only for mobile phones.	• Not a devised-optimised solution by default. • Fluidly adjust their layouts for different	• Optimised design, layouts, code, content, navigation and speed, for a range of devices.

* See glossary

	• Prone to incorrect rendering of layouts, on mobile phones, with significantly different screen sizes, to the original website dimensions. • Prone to content and user experience disparity issues between the mobile-friendly version and the desktop version of a website, due to content forking.	sized devices, and varying screen sizes in the same device category. • Less prone to erroneous rendering of layouts across a range of devices. • Same code and content offer user experience parity for a multitude of devices. • Default mechanism of delivering the same content across devices, becomes problematic, for serving visually complex information, to small screen devices.	• Prone to incorrect rendering of layouts, on devices, with significantly different screen sizes, to the originally specified dimensions, of a device-specific version. • Prone to content and user experience disparity issues between the range of devices, due to content forking.
Performance	• Device optimised code results in speedy performance on mobile phones. • Website redirection can cause latency issues.	• Heavier file sizes and the downloading of a website's full content can reduce site speed on mobile phones and other devices with lower capabilities.	• Device optimised code results in speedy performance on a range of devices.
Expansion capabilities	• Not expandable to other devices, being a website version only for mobile phones.	• Expansion to new devices can be quickly incorporated by additional styling rules, rather than building new versions of the website.	• Expandable to new platforms by creating separate versions of the website for new devices.

* See glossary

Chapter 4. Findings

4.1 Secondary schools student survey

Overview

This section investigates the second part of this research, which is, unique target audience needs for tertiary institutes, with a particular focus on prospective students for UCOL. Whilst these findings are specific to UCOL's prospective students, the methodology, questionnaires and some data can be adapted for other institutions engaged in their own target market research. Criteria included device usage, information seeking patterns, importance of mobile-friendly websites and how the performance of these websites impacted the student opinions about an institute. Device usage queried if the participating students demonstrated the *mobile only* trend for course related information seeking and decision-making. If the trend of relying solely or significantly on mobile phones was not prevalent, then the device preferences of these students would be ascertained. The information seeking patterns investigated the frequency of information seeking. In investigating the importance of mobile-friendly websites, the survey enquired how much these students rely on mobile friendly websites for information.

Students enrolled in the concluding year of education from six secondary schools in Whanganui (New Zealand Qualifications Authority, 2015b) were invited to participate in a survey. This is where the researcher is currently located and formerly employed at UCOL. The schools comprised a mix of state, state-integrated and private schools (New Zealand Qualifications Authority, 2015a). While the state and state-integrated schools are funded by the government, private schools on the other hand are mainly funded by student fees (Ministry of Education, 2016). Table 4 lists the six secondary schools and their associated types (Ministry of Education, 2015). With the exception of Whanganui Girls College, all the other schools are coeducational.

Table 4. List of secondary schools in Whanganui

School's name	School type
1. Whanganui City College	State
2. Whanganui Girls College	
3. Whanganui High School	
4. Whanganui Collegiate School	State-Integrated
5. Cullinane College	
6. St Dominic's College	Private

It is a common assumption that the students enrolled in these schools come from different socio-economic groups with varying household incomes. Student participation from schools with different funding models allowed gathering of representative statistics.

Two key factors limited the geographical scope of this survey to Whanganui: the first, a pragmatic consideration of dealing with a manageable cohort; and secondly, apart from the fact that UCOL's campuses are located in and around the Manawatu region, the region itself has witnessed a 20% increase in broadband connections between 2009 – 2012, making it the highest in New Zealand (Statistics New Zealand, 2013). The introduction and literature review presented statistics, which indicated high ownership of mobile phones and high Internet usage for information seeking amongst younger New Zealanders, aged 16 to 19 (Frost & Sullivan, 2013; Gibson et al., 2013). The overlaps suggested a high probability that mobile phones may have become an important vehicle for NCEA Level 3 students to find course related information and make decisions prior to enrolling into an area of study.

The surveys were conducted in the months of September and October in 2016. The full questionnaire is available under "*Appendix 02. Secondary schools student survey".* There were a total of four sections. Question types included demographic questions, dichotomous questions, multiple choice and rating scales. To ensure that the readers of this research who may be interested in a detailed understanding of the survey design including, interlinkages amongst, and rationale for the sections, thorough explanations are

* See glossary

listed under "*Appendix 03. Student survey explanation".* Following are some brief and important explanations of the individual sections:

- Section A focussed on establishing the demographic distinctions of the participants. This has been done only to determine the general constitution of the participants. The scope of this survey is aimed at collective findings rather than segregated results for individual social groups, such as gender or ethnicity. It is acknowledged that further investigations in succeeding sections for individual social groups may have presented distinctions in the findings.

- Section B aimed to discover the participants' diversity of device ownership, with a specific focus on mobile phones. Mobile phone brands were queried to ascertain the diversity of screen sizes and operating systems, which is an important consideration for an organisation when creating a mobile-friendly website (Marcotte, 2011; McGrane, 2012a; Wroblewski, 2011a).

- Section C aimed to discover the participants' device and Internet source preference for day-to-day online activities. The intention was to ascertain any contrasts in device preference for general Internet usage versus course related information seeking, which was examined in Section D. It was also aimed to discover if the prospective students were limited in their means of Internet access via mobile phones, which is another important consideration for building mobile-friendly websites (Hill, 2010). In order to generate cumulative statistics, Section C had a couple of exit points for participants who either did not use the Internet at all, or did not use mobile phones to access the Internet.

- Section D aimed to examine various aspects of participants' access to tertiary academic institute websites. This section was structured to offer the participants two different pathways within the section, starting from Question D1. The participants who had previously accessed the websites of tertiary academic institutes for the purpose of finding educational courses, had to attempt questions D2 to D11, under pathway one. These questions were structured with four themes. These included: device preferences; information seeking patterns; importance of mobile-friendly websites; and how certain performance aspects of

* See glossary

these websites on mobile phones affected the student's decision-making and opinion about an institute.

The participants who undertook pathway two had to attempt questions D6 to D13. Apart from the overlaps with the above-mentioned themes between questions D6 to D11, question D12 and D13 were structured to discover the device preferences in the hypothetical scenario of accessing academic institute websites for course related information seeking.

Out of the six, students from five schools participated in the surveys. The contributing schools were Whanganui City College, Whanganui Girls College, Whanganui High School, Whanganui Collegiate School and Cullinane College. There were a total of over 400 students enrolled in NCEA Level 3 at these schools in 2016 (Coe, 2016; Kaua, 2016; Mokha, 2016; Shore, 2016; Todd, 2016). Out of these, 217 students participated in the surveys. Out of the 217 filled out surveys, 201 were usable, while 16 were incomplete and were not taken into consideration.

Statistical findings have been presented in percentages, supported by bar graphs. Percentages with a decimal value were rounded off to the closest integer value. The findings from various sections have been presented as follows:

Findings

Section A

Out of the 201 participants, 196 belonged to the usual age group of 17 to 18 for the NCEA L3 students (New Zealand Qualifications Authority, 2014), with the exception of four 19 year old students and one 16 year old student. 46% of the participants were male and 54% were female. As shown in Chart 1, there was significant distinction between the enrolment types, where 93% of the students were domestic and 7% were international students originating from Europe, Asia and Middle Eastern, Latin American and African (MELAA) ethnic groups.

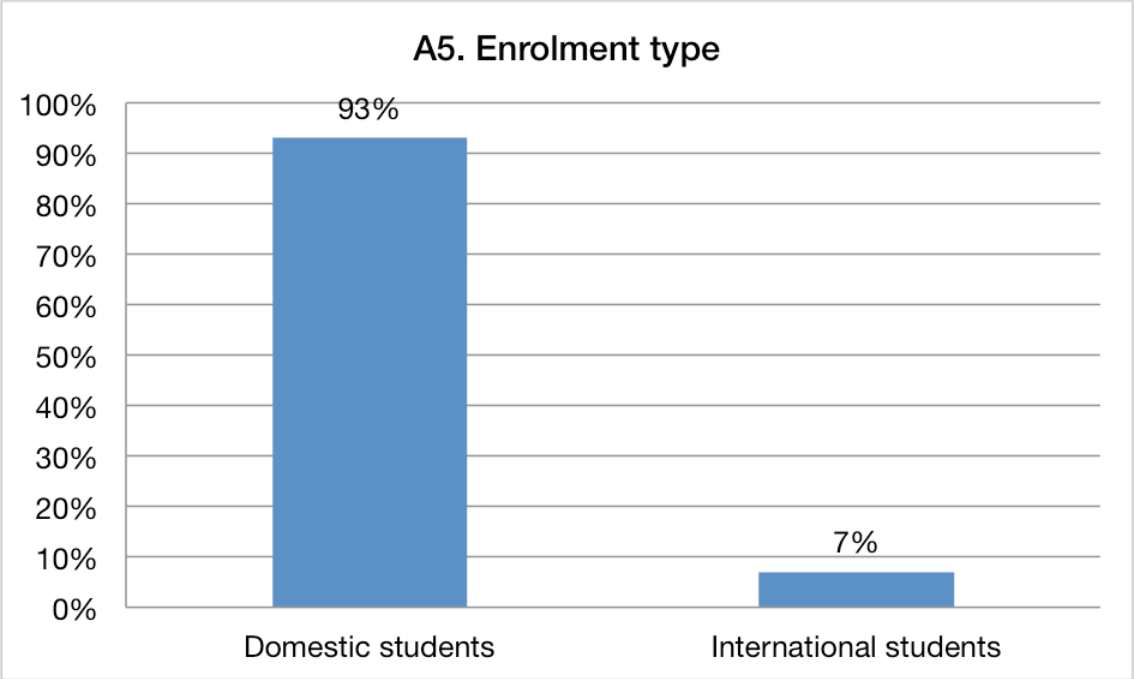

Chart 1. Percentage distinction between enrolment types

Chart 2 presents the constituency of the ethnic groups for this survey. As shown in the chart, students of European ethnicity dominated the respondent base with 66% participation. The remaining formation included 17% Maori, 9% Asian, 4% Pacific peoples, 2% MELAA and 2% other.

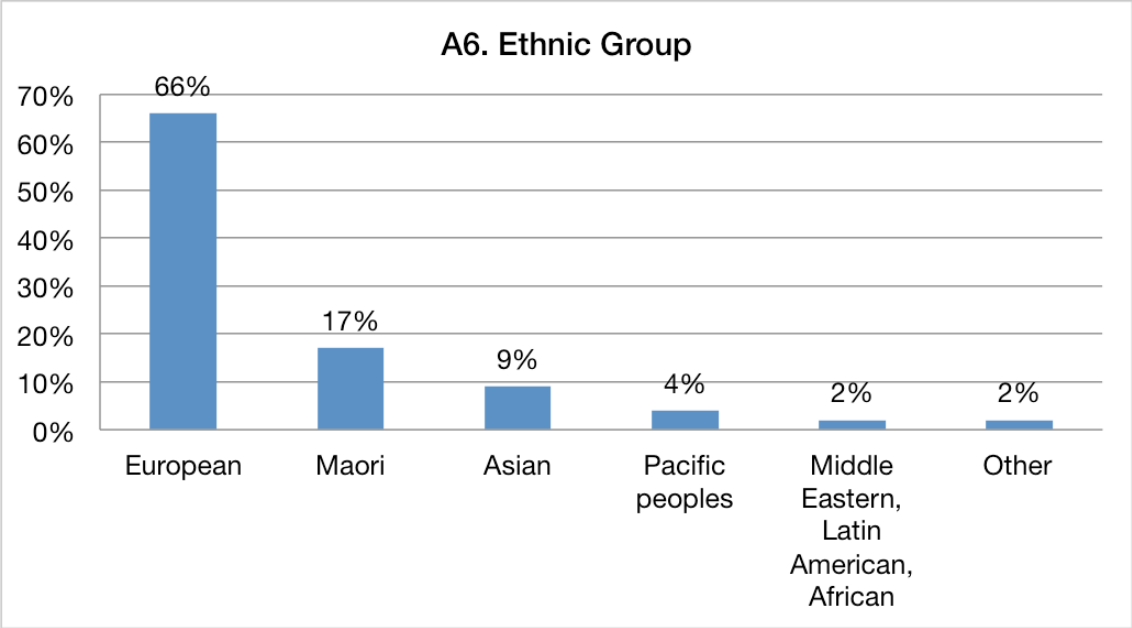

Chart 2. Percentage distinction between ethnic groups

Section B

95% of all the participants owned a mobile phone individually. Of the remaining 5%, 78% of those who did not own a mobile phone had access to mobile phones owned by another member of their household. Collectively 99% of the participants had access to mobile phones. With 48% iOS* and 52% Android* there was no significant divide noted between the mobile phone operating systems. However, as shown in Chart 3, diversity in the manufacturing brands was noted. Consequently, a significant variety of screen sizes ranging between 3.5 inches to 6.8 inches in physical sizes and 320x480 pixels to 1080x1920 pixels in resolution were present. This indicates that the variety of mobile phone screen sizes is a prominent criterion academic institutes need to consider when appointing a technical method of creating mobile-friendly websites, targeted at NCEA L3 students. Apple 48% and Samsung 31% were clearly the dominating brands amongst participants, with a collective 79% ownership.

* See glossary

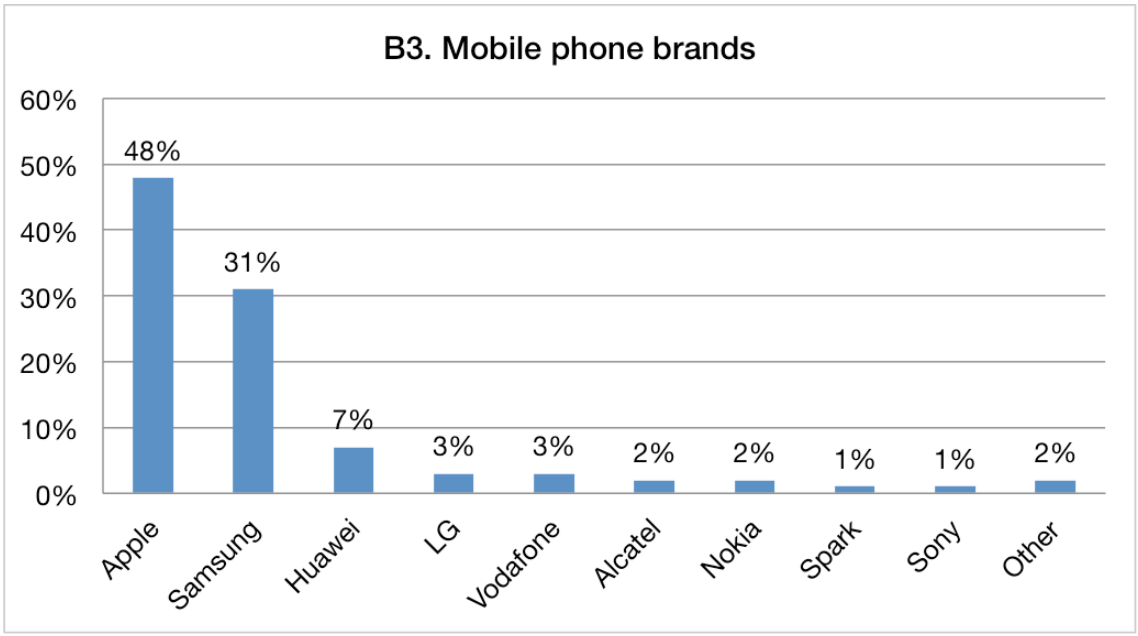

Chart 3. Mobile phone brands

As shown in Chart 4, it is interesting to note that all the participants had access to different forms of devices in their households. 92% ownership of laptops made them the most commonly owned device, with tablets and gaming consoles claiming almost equal ownerships of 71% and 72% respectively and desktop ownership was 57%. E-book readers were not as commonly owned, with only 13% ownership, and other devices such as smart televisions and iPods collectively constituted 5% ownership.

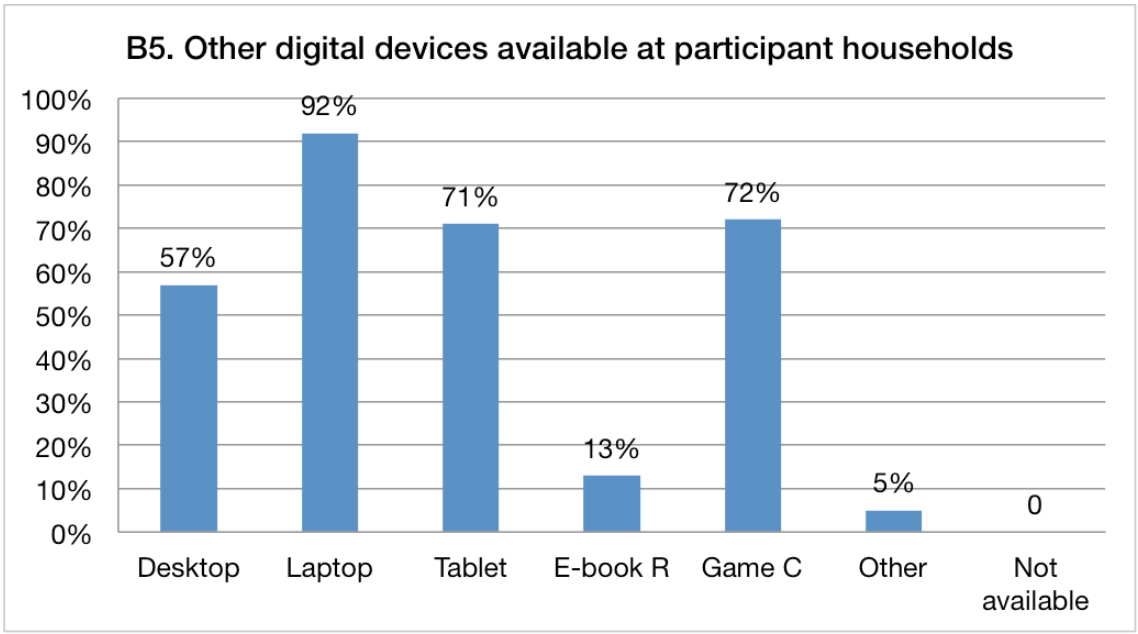

Chart 4. Other digital devices available in participant's household

* See glossary

As specified in the methodology, the scope of this survey was aimed at collective findings from the participants rather than segregated results for individual social groups. As a brief mention, findings presented in Chart 4 indicate that irrespective of the social grouping none of the participants were underprivileged in terms of device ownership for Internet access.

Section C

Question C1 of this section asked the participants to choose all the devices from the provided list that they use to access the Internet. This question also presented the first exit point where participants did not have to further participate in the survey if they did not use the Internet at all. As evidenced in Chart 5, all the devices listed in the question were used by the participants for Internet access at varying levels, however mobile phones and tablets were the most commonly used devices, with almost equal usage of 91% and 90% respectively. Similarly to Section B, this chart also confirms that all the participants had access to different forms of devices for Internet use. Only one participant out of the 201 indicated that they did not use the Internet, and therefore the respondent base for further questions dropped to 200 participants.

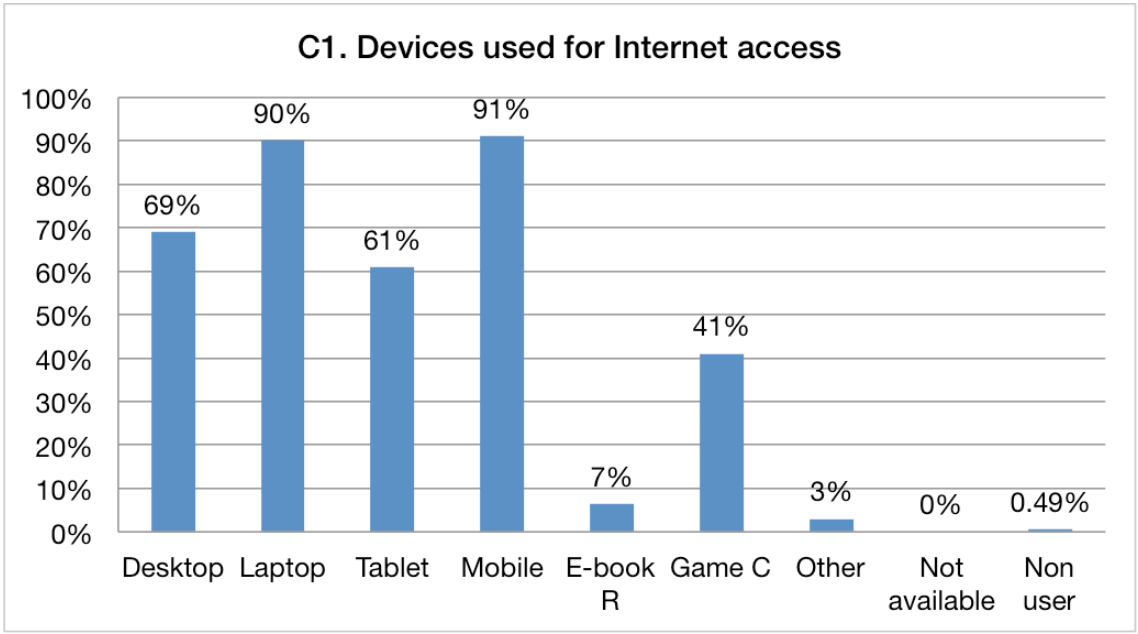

Chart 5. Devices used for Internet access

As presented in Chart 6, mobile phones significantly dominated other devices in day-to-day online activities. 63% respondents indicated that they predominantly used mobile phones for the aforementioned purpose. The only other sizeable minority were laptops.

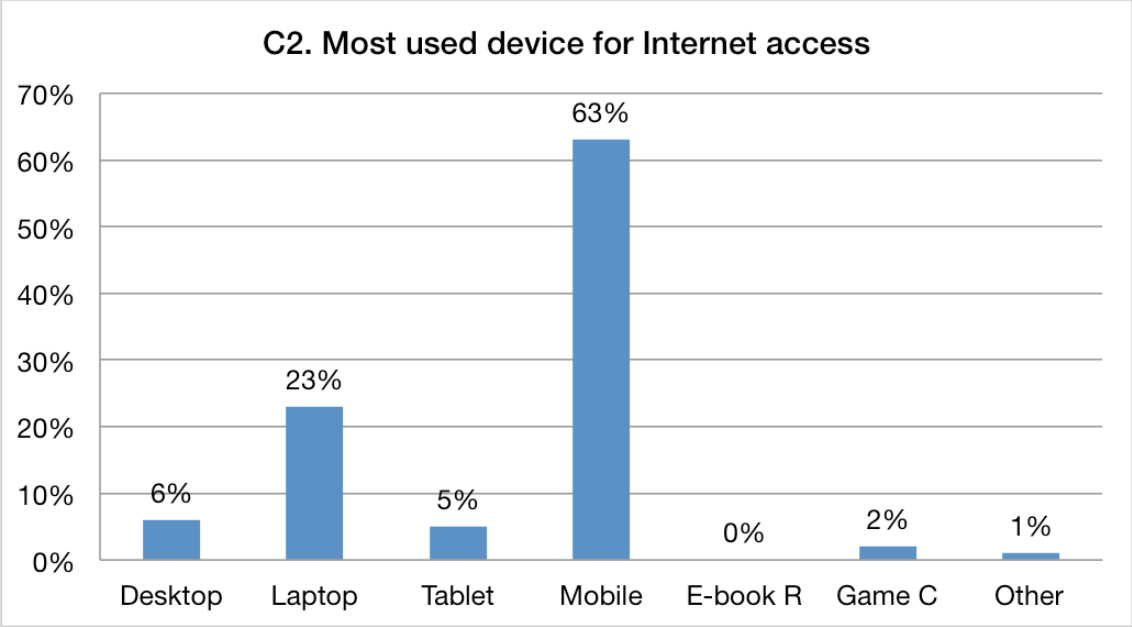

Chart 6. Most used device for Internet access

Question C3 of this section presented the next exit point for the participants. Any participants who did not use mobile phones at all for Internet access discontinued the survey from this point on. Four participants fell into this category and therefore the respondent base for further questions dropped to 196. This equals 98% of the original respondent base of 201 participants. 99% of the remaining participants had access to their own Internet sources; of which, 95% had broadband connections at home and the remaining 4% had mobile data plans. The small fraction of 1% relied on broadband connections at other places.

Chart 7 presents the most used Internet source by participants on their mobile phones. Out of all the participants, only for 79% were broadband connections at home the most commonly used. The 11% usage of mobile data plans indicates, that despite the availability of broadband connections at home, some students prefer to use mobile data plans, which may have resulted from convenience of usage, at locations other than participant households.

* See glossary

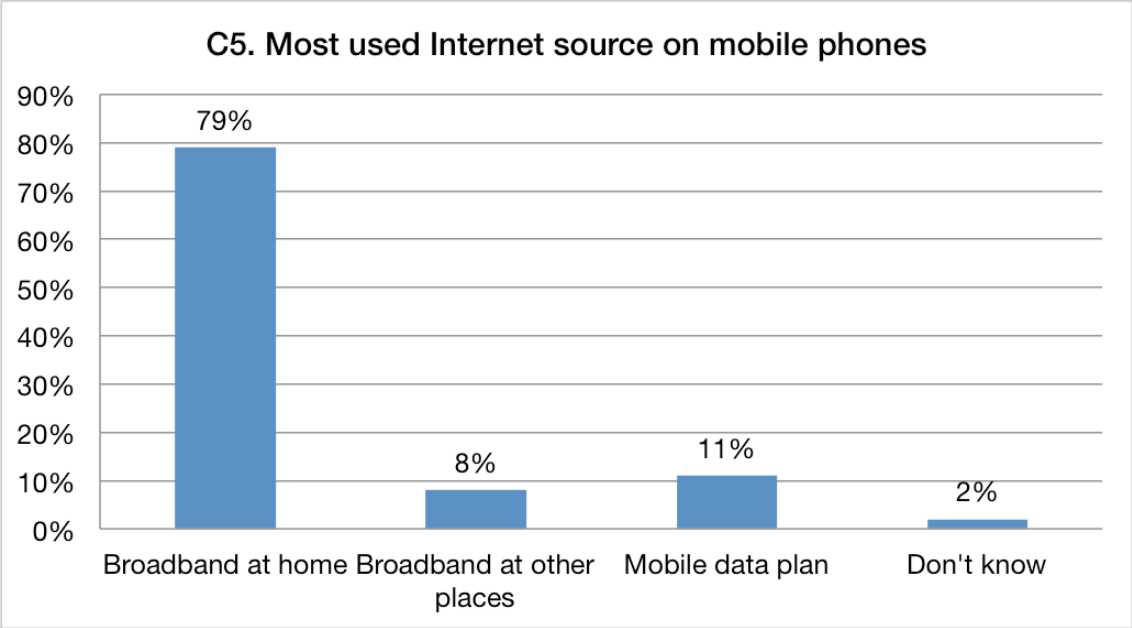

Chart 7. Most used Internet source on mobile phones

Question C6 asked the participants to tick all the reasons why they preferred to use their mobile phones for Internet access. The findings presented in Chart 8 indicate that 93% of the respondents do so purely due to convenience over other devices. In fact, the reasons provided by participants who selected the "Other" options, also loosely indicated convenience. Affordability over other devices is applicable to only 9% respondents.

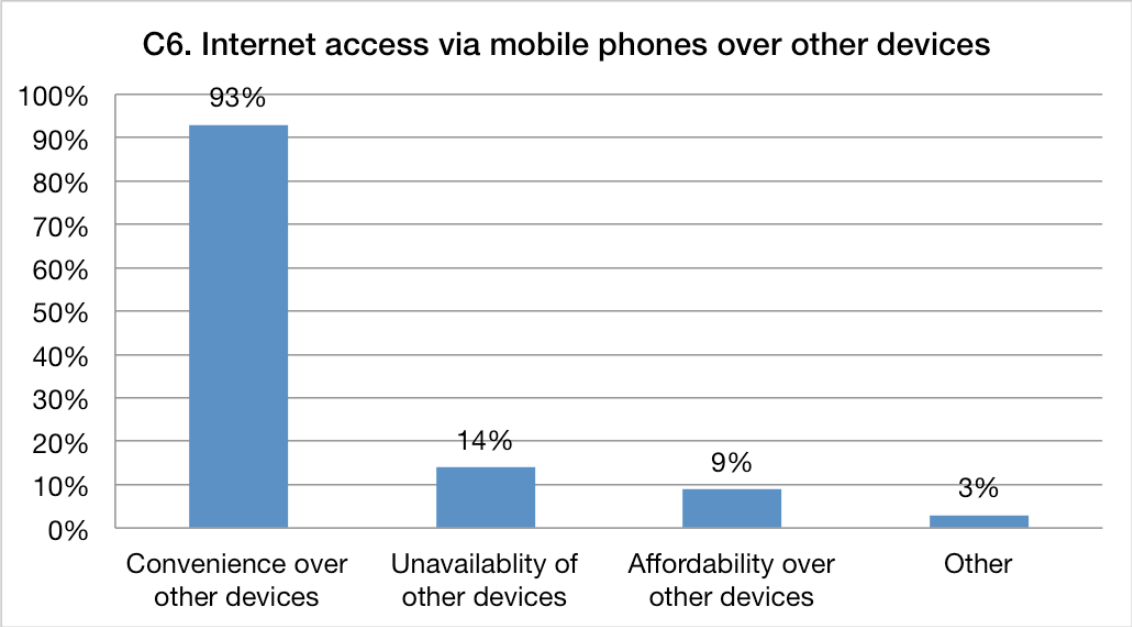

Chart 8. Internet access via mobile phones over other devices

* See glossary

Section D

As noted in the overview, question D1 provided the basis for the two pathways, namely, those who had, and those who had not accessed the websites of tertiary academic institutes for the purpose of finding educational courses. Out of the 196 remaining participants, 32 had not; therefore the respondent base for questions D2 to D5 was 164, which equalled 84%.

Chart 9 presents all the devices that the participants used for the aforementioned purpose. Laptops 86%, mobile phones 74% and desktops 60% were the three commonly used devices by the majority of participants, while tablets at 27% were a sizeable minority.

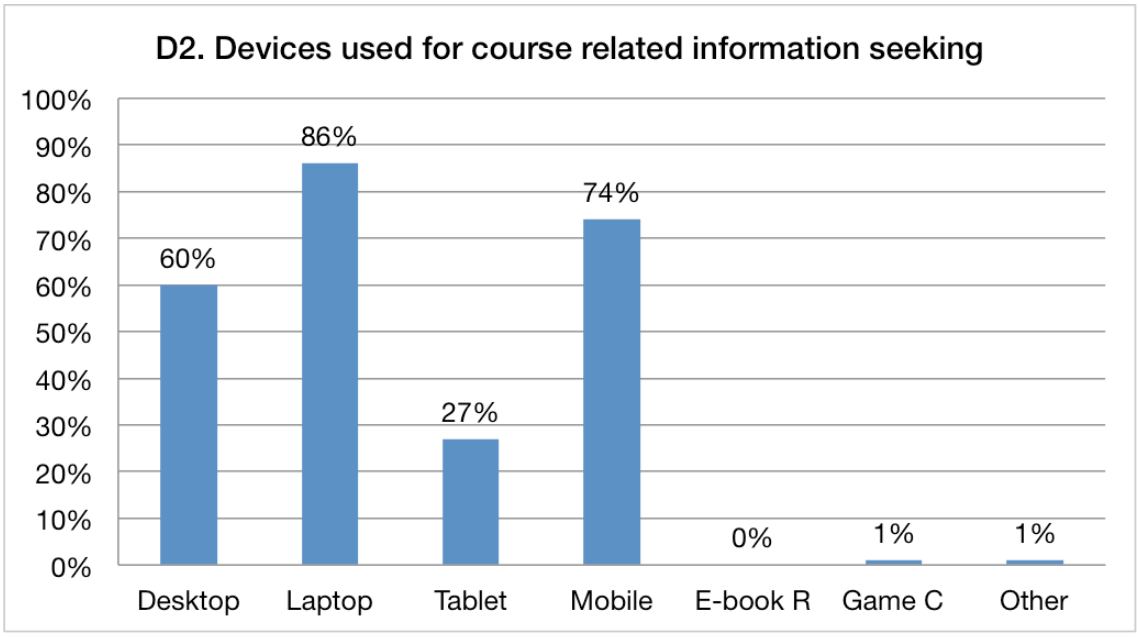

Chart 9. Devices used for course related information seeking

However, as presented in Chart 10, laptops with 62% usage significantly dominated other devices as the most used device for course related information seeking. The other significant minorities were desktops 21% and mobile phones 14%.

* See glossary

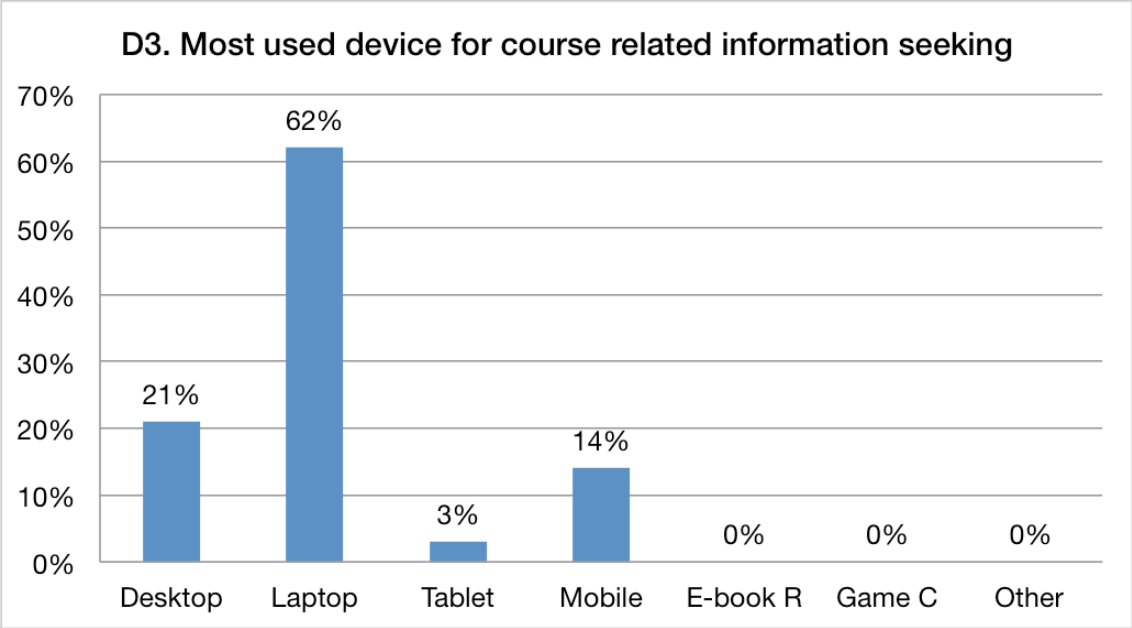

Chart 10. Most used device for course related information seeking

Chart 11 presents the results on how frequently the participants visited the websites of different tertiary institutes using all the devices available to them. 45% of the respondent base formed the majority of participants whose frequency of visits were only occasional. Collectively, 37% of the respondents visited these websites on a very frequent or frequent basis and only for 18% the frequency ranged between rarely to never. The months of September and October when the surveys were conducted are usually a busy period for the NCEA L3 students due to the upcoming assignment submissions and exams between end of October to early December (New Zealand Qualifications Authority, 2017). The frequency patterns may have resulted in different outcomes had the surveys been conducted at a different time.

* See glossary

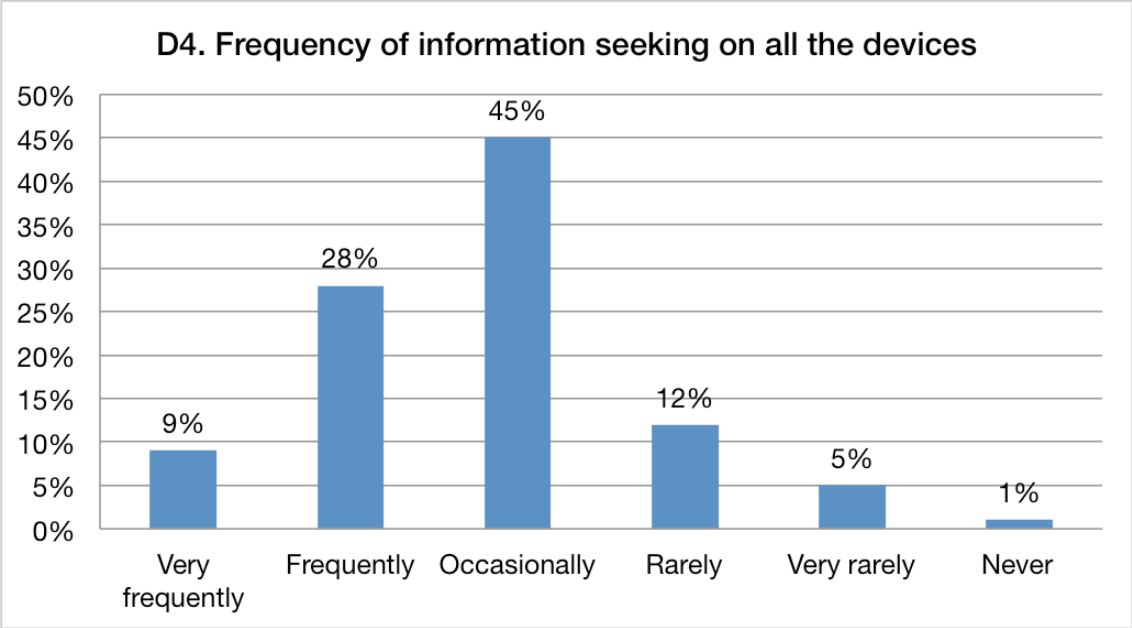

Chart 11. Frequency of information seeking on all the devices

Chart 12 presents the findings on the frequency of participant visits using only mobile phones. Similar to Chart 11, 30% occasional visitors formed the majority of the respondent base. However, in contrast, collectively only 18% of the respondents visited these websites very frequently and frequently, while for a significant collective majority of 52% the frequency ranged between rarely to never.

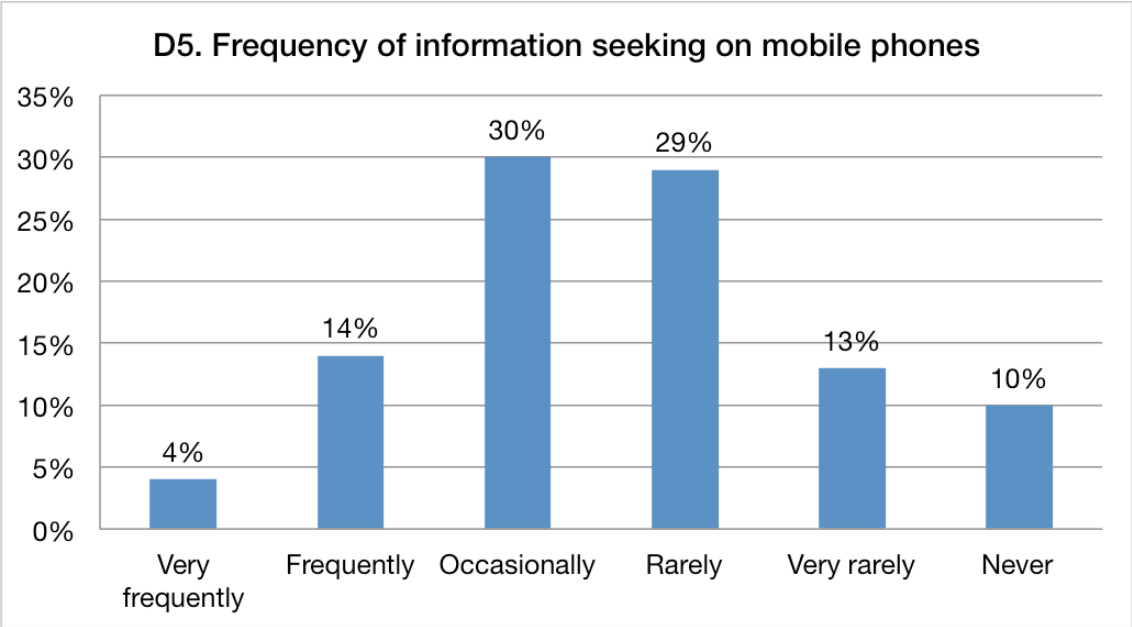

Chart 12. Frequency of information seeking on mobile phones

* See glossary

Questions D6 to D11 were the common questions for participants for both pathways; therefore the respondent base for these questions increased to 196. Chart 13 presents opinions of the participants on how important they think it is for tertiary institutes to offer mobile-friendly websites in general. Irrespective of findings in Charts 10 and 12, which indicate low individual usage, 42% of the participants regarded the supply of mobile-friendly websites by tertiary institutes as very important and 33% as important. Therefore, a collective majority of 75% indicated positively.

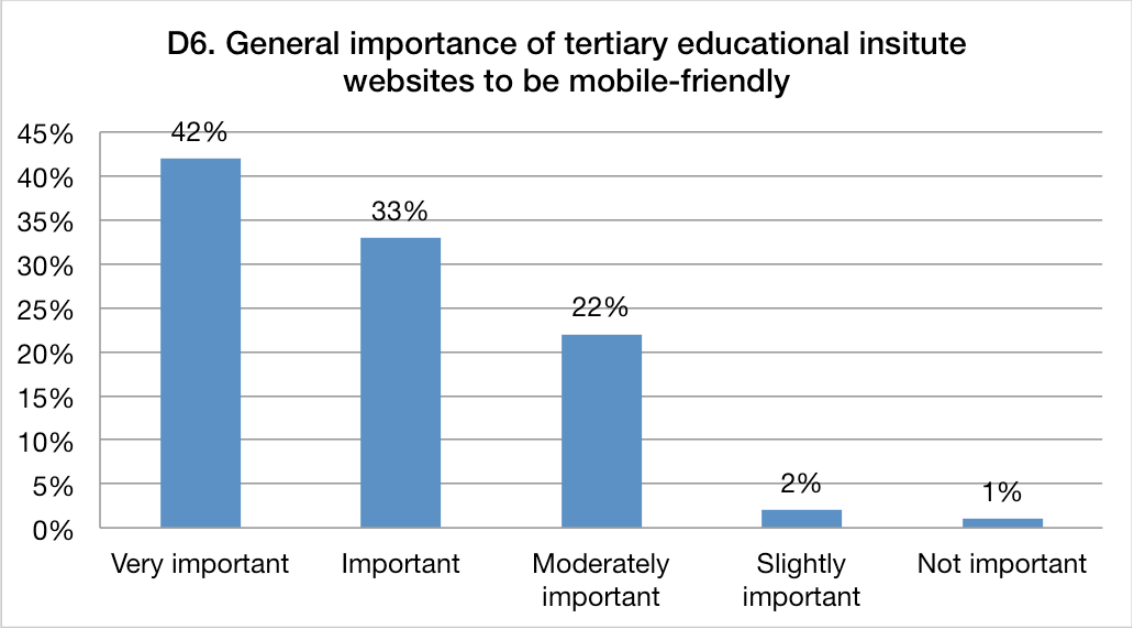

Chart 13. General importance of tertiary institute websites to be mobile-friendly

Chart 14 presented how important it was to the participants, at an individual level, to be able to access an educational institute's website on a mobile phone. As presented in the chart, there was no significant distinction between the participant responses in the selection of very important, important and moderately important categories with respective responses being 25%, 27% and 27%. However, a collective majority of 52% indicated positively by choosing the very important and important options.

* See glossary

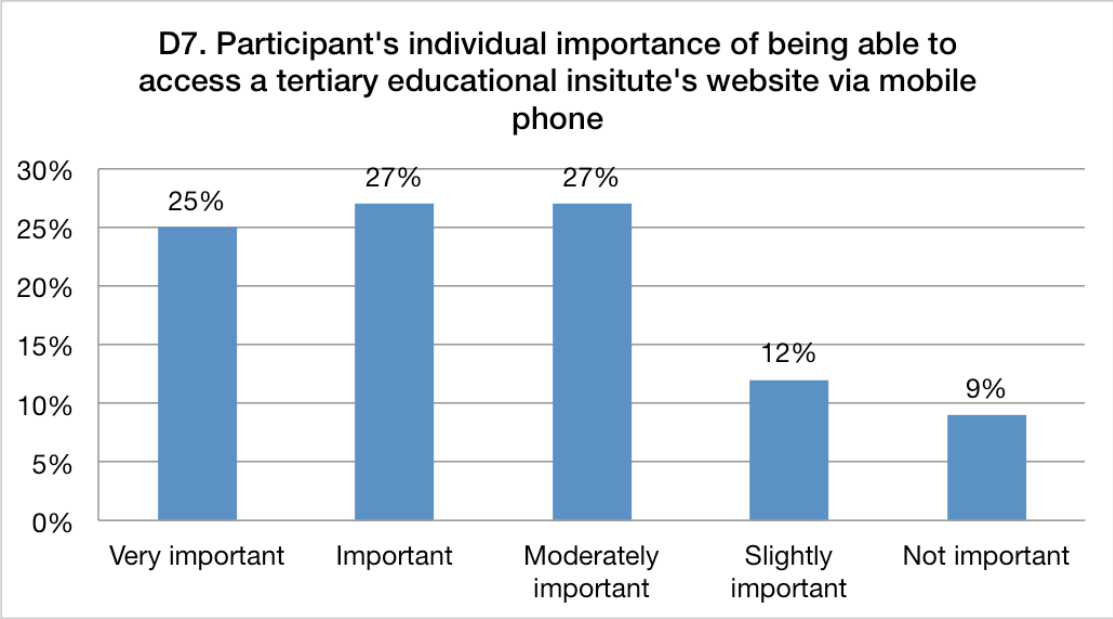

Chart 14. Participant's individual importance of being able to access a tertiary institute's website via mobile phones

Questions D8 to D10 focussed on two performance aspects of academic institute websites on mobile phones, and how these affected the student's decision-making and opinion about an institute. These two aspects were speed of access and level of content. Question D8 asked the participants to indicate which aspect out of two was more important to them for being able to access a tertiary institute's website on a mobile phone. As shown in Chart 15, 60% of the participants preferred full access to information over speed of access.

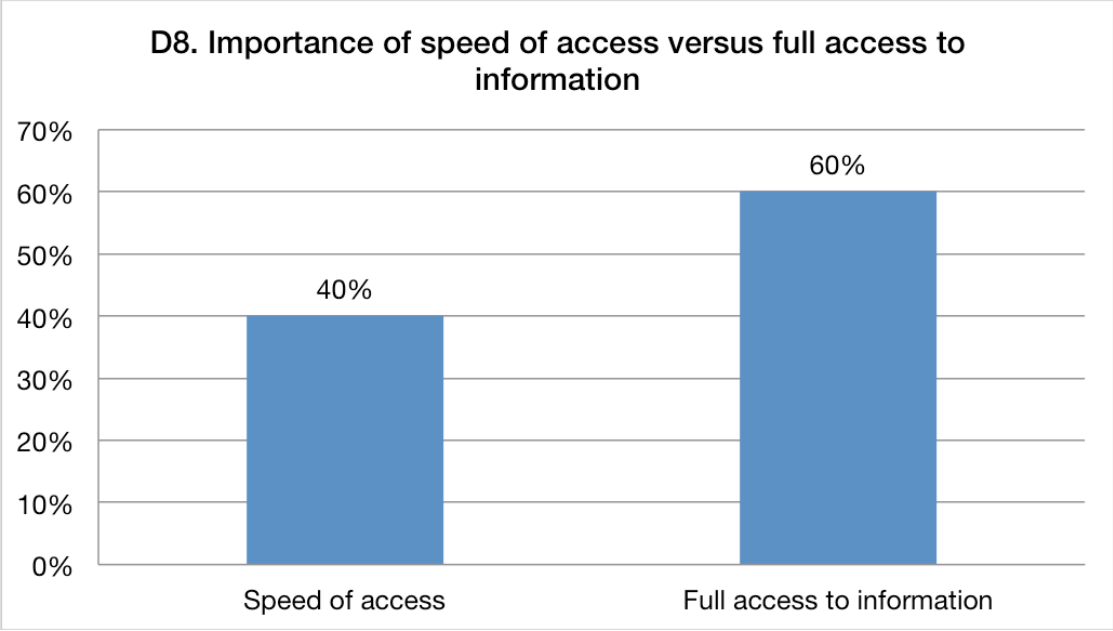

Chart 15. Importance of speed of access versus full access to information

* See glossary

Question D9 asked the participants to choose one of three provided reactions in case they were trying to find course related information using a mobile phone and encountered a slow speed. Chart 16 presents the findings of this question. Forming a majority, 51% of the participants indicated that they will switch over to another device to access the website, while 32% will try using the website again to see if it works. Therefore, a collective majority of 83% will provide the website another opportunity, in comparison to 17% who were negatively affected and will switch over to another institute's website.

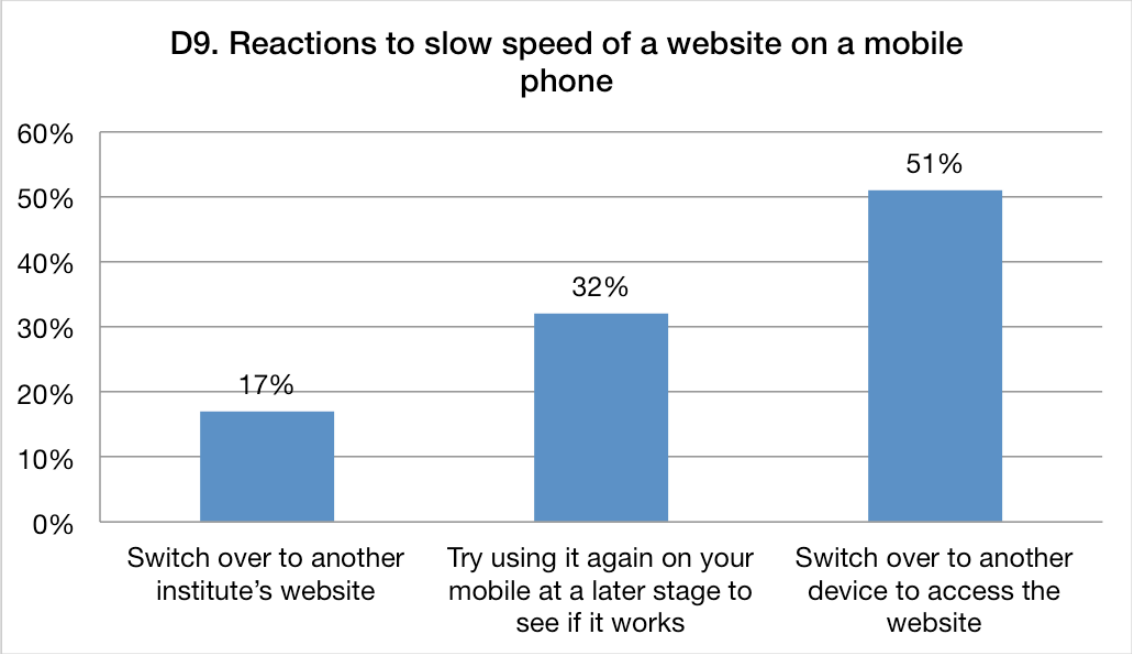

Chart 16. Reactions to slow speed of a website on a mobile phone

Question D10 showed participants an image of a mobile-friendly website. It offered only partial information and points the users to visit the desktop version for full information. Participants were asked to choose one of three provided reactions in this case. Chart 17 presents the findings of this question. 43% of the participants indicated that they will switch over to the desktop computer, while 43% will try using the desktop version on their mobile phone, which will require pinching and zooming to navigate the website.

Interestingly, a higher percentage of participants willing to use pinch and zoom, is in contrast to Google's (2015) suggestion that pinching and zooming could lead to inferior user experiences and often a lack of interest and abandonment of a website. Younger people might be more used to, and adept at using pinch and zoom techniques, than the general audiences Google had in mind.

* See glossary

Collectively, a majority of 86% participants will provide the website another opportunity in comparison to 14% who were negatively affected and will abandon the website. The findings in Charts 16 and 17 are consistent with each other.

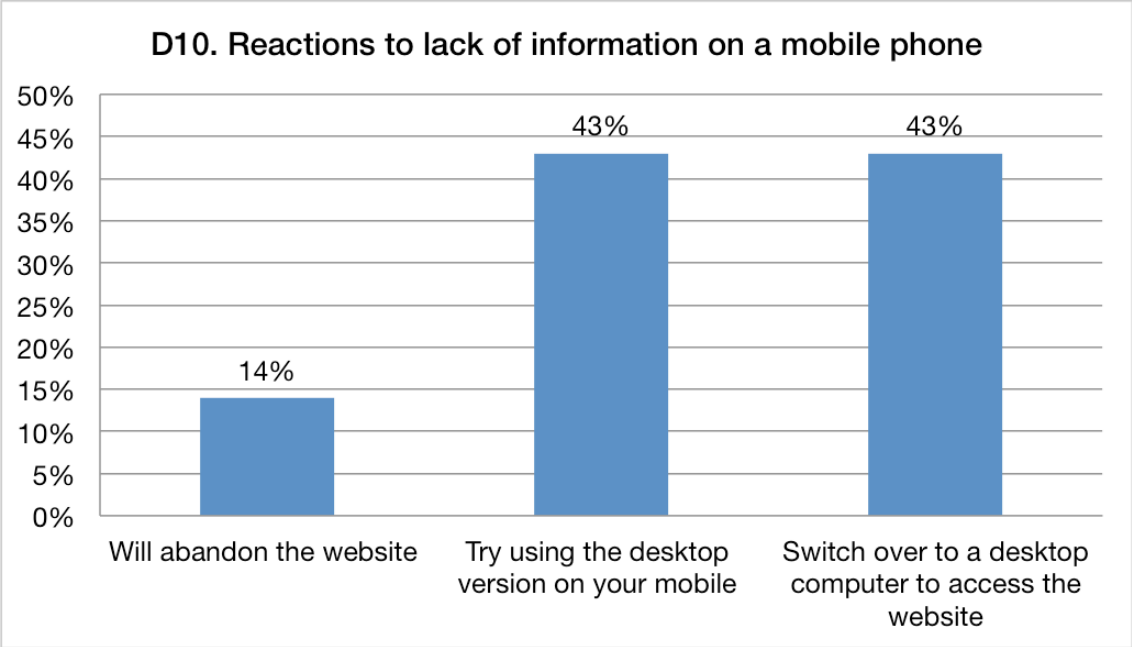

Chart 17. Reactions to lack of information on a mobile phone

The percentage of negatively affected prospective students presented in Charts 16 and 17, due to the substandard performance of academic institute websites on mobile phones, presents a significant consideration for academic institutes. Universities and ITPs in New Zealand attract thousands of student enrolments every year (Tertiary Education Commission, 2013; Universities New Zealand, 2015). The percentage of negatively affected students, if considered in actual number of student enrolments for an institute, suggests that poor website performances can potentially lead to significant revenue losses. Furthermore, if projected over the study period of a qualification, which runs for more than one year, the potential losses would be higher.

* See glossary

Question D11 asked the participants to indicate their agreement with the statement – 'The smooth running of an academic institute's website on a mobile phone affects my perception about the professionalism of an institute'. As shown in Chart 18, forming a majority, 41% agreed with the statement, while 11% indicated strong agreement. Consequently, the perceptions of a collective majority of 52% will be negative if an institute's website does not offer a device optimised performance. This is another important consideration for tertiary institutes when appointing a technical method of creating mobile-friendly websites.

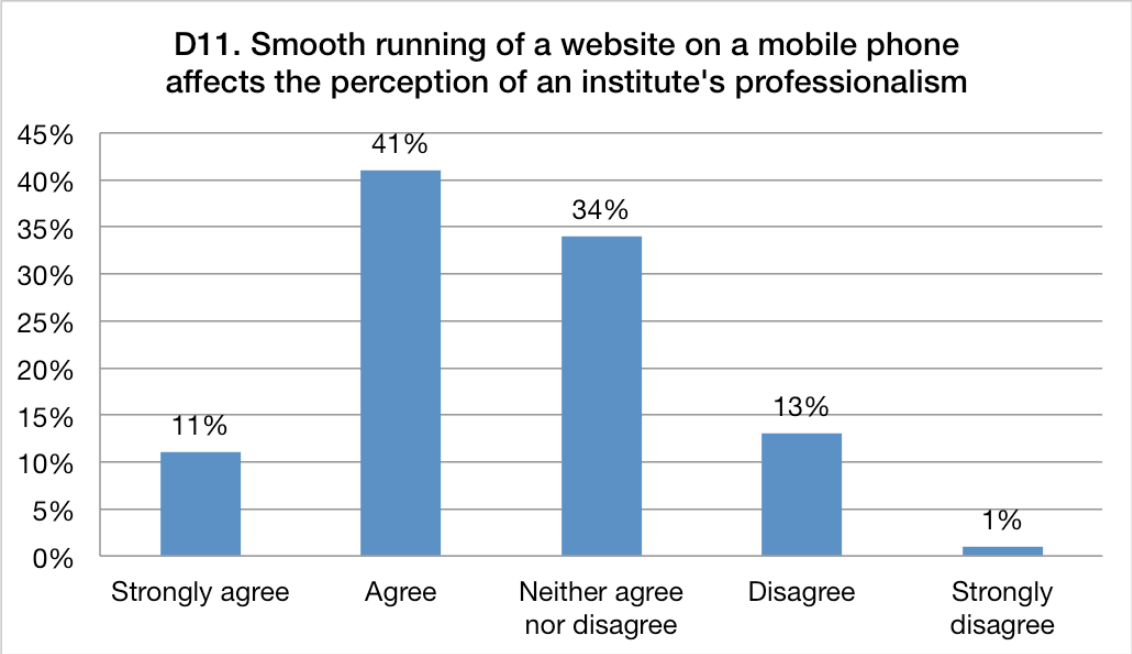

Chart 18. Effects of smooth running of a website on a mobile phones on the perception of an institute's professionalism

The respondent base for questions D12 and D13 was 32. These were the participants who had never visited tertiary institute websites for the purpose of finding educational courses. Chart 19 presents all the devices that these participants will use if they were to hypothetically access these websites for the aforementioned purpose. The order of preference was similar to the findings presented in Chart 9. Laptops 81%, desktops 69% and mobile phones 66% would be the three commonly used devices by the majority of participants, while tablets 41% would be a sizeable minority.

* See glossary

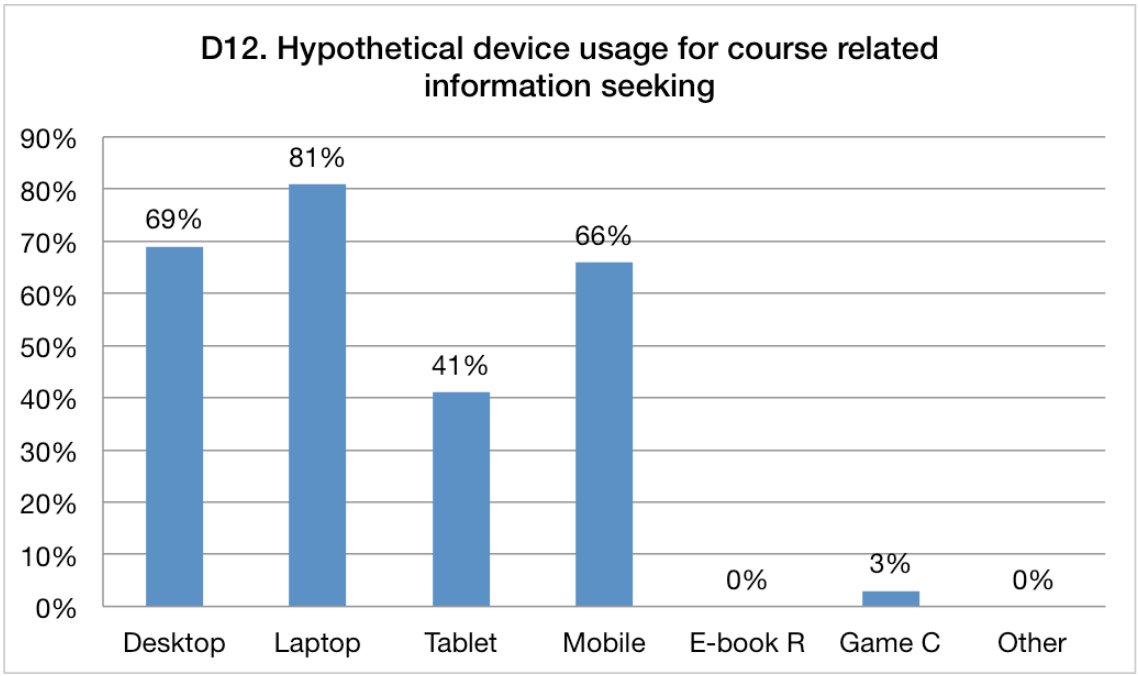

Chart 19. Hypothetical device usage for course related information seeking

Chart 20 presents the findings on what device would be the most used by the participants for hypothetical access of tertiary institute websites. Similar to the findings in Chart 10, Laptops would lead over other devices with 37% usage.

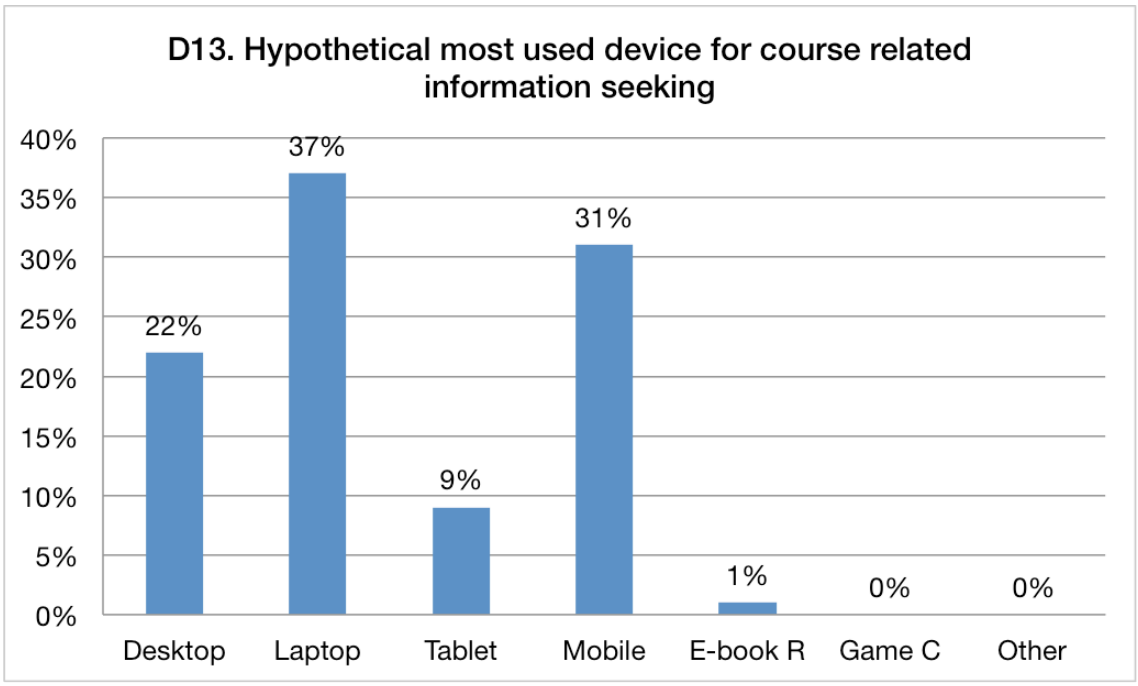

Chart 20. Hypothetical most used device for course related information seeking

* See glossary

4.2 Current status of technology usage by New Zealand tertiary institutes

Overview

This section formed the third part of this research and set out to discover the current status of technology usage by New Zealand tertiary institutes. The queries included, how many tertiary institutes in New Zealand offer mobile-friendly websites, what technical methods have been appointed and whether there is potential for technical improvements that better meet the target audience needs and keep institutions abreast of technological advancements?

As noted in the methodology section, a combination of five activities was used, which are listed as follows. Firstly, an observational test on the websites of eight New Zealand Universities and sixteen ITPs was performed to determine how many institutes have implemented mobile-friendly websites. The names of these institutes in an order of ranking (CSIC, 2017) are listed in Tables 5 and 6. Secondly, an analysis of all these sites to ascertain what technical methods the listed institutions deployed in the creation of mobile-friendly websites and how well are these implemented. Third, an interview of UCOL's Senior Communications Advisor as a case study on UCOL's newly created mobile-friendly website. Fourth, a combined interview with the Project Manager and Front End developer from Enlighten Designs, to supplement the case study and seek the company's expertise, in general, on issues with the creation of mobile-friendly websites in a tertiary academic setting, and improvements required. Fifth, interviews of relevant personnel at the institutes who had not implemented mobile-friendly websites, as further case studies.

* See glossary

Table 5. List of Universities in New Zealand

Universities in New Zealand	Campus locations
1. University of Auckland	Auckland
2. University of Otago	Dunedin
3. University of Canterbury	Christchurch
4. Victoria University of Wellington	Wellington and Auckland
5. Massey University	Manawatu, Wellington and Auckland
6. University of Waikato	Hamilton
7. Auckland University of Technology	Auckland
8. Lincoln University	Christchurch

* See glossary

Table 6. List of Institutes of Technology and Polytechnics in New Zealand

Institutes of Technology and Polytechnics (ITPs) in New Zealand	Campus locations
1. Unitec New Zealand	Auckland
2. Otago Polytechnic	Dunedin, Cromwell and Auckland
3. Waikato Institute of Technology (Wintec)	Hamilton
4. Eastern Institute of Technology (EIT)	Auckland, Hawke's Bay, Hastings, Maraenui, Ruatoria, Tairawhiti and Wairoa
5. Nelson Marlborough Institute of Technology (NMIT)	Nelson, Marlborough and Auckland
6. Ara Institute of Canterbury (ARA)	Ashburton, Christchurch, Oamaru and Timaru
7. Manukau Institute of Technology	Auckland
8. Whitireia Community Polytechnic	Porirua, Wellington and Auckland
9. The Open Polytechnic of New Zealand	Online
10. Universal College of Learning (UCOL)	Palmerston North, Whanganui, Wairarapa and Auckland
11. Southern Institute of Technology (SIT)	Invercargill, Christchurch, Queenstown, Gore and Auckland
12. Wellington Institute of Technology (Weltec)	Invercargill, Queenstown, Christchurch, Gore and Auckland.
13. Western Institute of Technology at Taranaki (WITT)	New Plymouth and Hawera
14. Northland Polytechnic (NorthTec)	Auckland, Kaikohe, Kaitaia, Kerikeri, Rawene and Whangarei
15. Tai Poutini Polytechnic	Christchurch, Greymouth, Hokitika, Auckland, Reefton, Wanaka and Westport
16. Toi Ohomai Institute of Technology	Mokoia, Taupo, Tokoroa, Waipa, Whakatane and Windermere

* See glossary

The findings from the five aforementioned activities are clustered into four subsets, the names of which are listed as follows.

- Findings 01. List of Universities and ITPs that offer mobile-friendly websites and the chosen technical methods.

- Findings 02. How well implemented are the mobile-friendly websites offered by New Zealand Universities and ITPs. A comparative analysis

- Findings 03. Summary of interviews conducted with UCOL and Enlighten Designs.

- Findings 04. Summary of interviews conducted with the institutes who had not implemented mobile-friendly websites.

The following are findings from these activities.

* See glossary

Findings

Findings 01. List of Universities and ITPs that offer mobile-friendly websites and the chosen technical methods

To conduct the observational test and analysis, the landing pages of the institute websites were visited on a desktop computer, tablet and a mobile phone. The URLs of these websites were checked to find out if the same URL was being used for all the devices. Fluidity of all the web pages was tested on the desktop computer by horizontal and vertical scaling of the browser window to discover if the layouts were responsive or adaptive. Layouts were observed across devices to note any differences and ascertain if they utilised any adaptive templates. Admission and enrolment related webpages were visited along with other pages at random to ascertain if the content was being served adaptively to devices in alternative representations.

Currently, all the New Zealand universities have a mobile-friendly website. At the time of writing only seven out of eight universities had implemented mobile-friendly websites with the exception of Auckland University of Technology (AUT). Consequently, an interview was conducted with the Web Centre Manager of AUT. The interview questions are available under "*Appendix 06. Interview questionnaire for institutes who had not implemented mobile-friendly websites"* and the responses are summarised under "*Findings 04. Summary of interviews conduced with the institutes who had not implemented mobile-friendly websites*". AUT eventually offered a mobile-friendly website around the end of 2016. Out of the eight universities, seven utilised RWD and one used a hybrid of responsive and dedicated methods. Table 7 lists the findings and the abbreviated heading MFW used in the second column stands for mobile-friendly website.

* See glossary

Table 7. New Zealand Universities that offer mobile-friendly websites

University's name and URL	MFW	Method
1. University of Auckland https://www.auckland.ac.nz/en.html	Yes	RWD
2. University of Otago http://www.otago.ac.nz/	Yes	RWD
3. University of Canterbury http://www.canterbury.ac.nz/	Yes	RWD
4. Victoria University of Wellington http://www.victoria.ac.nz/	Yes	RWD
5. Massey University http://www.massey.ac.nz/	Yes	RWD
6. University of Waikato http://www.waikato.ac.nz/	Yes	RWD
7. Auckland University of Technology http://www.aut.ac.nz/	Yes	Hybrid of RWD + Dedicated
8. Lincoln University http://www.lincoln.ac.nz/	Yes	RWD

The investigation on the ITP websites revealed that fifteen out of sixteen institutes offered mobile-friendly websites. However, one of the fifteen was only partly mobile-friendly and relied on a combination of dedicated mobile pages with an "M-dot" sub-domain* and desktop pages of the website. Out of the remaining fourteen, thirteen institutes utilised responsive web design and one used a dedicated mobile website. Table 8 lists the findings and the abbreviated heading MFW used in the second column stands for mobile-friendly website.

* See glossary

Table 8. New Zealand ITPs that offer mobile-friendly websites

ITP's name and URL	MFW	Method
1. Unitec New Zealand http://www.unitec.ac.nz/	Yes	RWD
2. Otago Polytechnic https://www.op.ac.nz/	Yes	RWD
3. Waikato Institute of Technology (Wintec) https://www.wintec.ac.nz/	Yes	RWD
4. Eastern Institute of Technology (EIT) http://www.eit.ac.nz/	Yes	RWD
5. Nelson Marlborough Institute of Technology (NMIT) https://www.nmit.ac.nz/	Yes	RWD
6. Ara Institute of Canterbury (ARA) http://www.ara.ac.nz/ http://m.ara.ac.nz/	Yes	Dedicated
7. Manukau Institute of Technology https://www.manukau.ac.nz/	Yes	RWD
8. Whitireia Community Polytechnic http://www.whitireia.ac.nz/Pages/home.aspx	No	
9. The Open Polytechnic of New Zealand https://www.openpolytechnic.ac.nz/	Yes	RWD
10. Universal College of Learning (UCOL) http://ucol.ac.nz/	Yes	RWD
11. Southern Institute of Technology (SIT) https://www.sit.ac.nz/	Yes	RWD
12. Wellington Institute of Technology (Weltec) http://www.weltec.ac.nz/	Yes	RWD
13. Western Institute of Technology at Taranaki (WITT) http://m.witt.ac.nz http://www.witt.ac.nz/	Partly	Hybrid of Dedicated + Desktop site
14. Northland Polytechnic (NorthTec) http://www.northtec.ac.nz/	Yes	RWD
15. Tai Poutini Polytechnic https://tpp.ac.nz/	Yes	RWD
16. Toi Ohomai Institute of Technology https://www.waiariki.ac.nz/home	Yes	RWD

* See glossary

As can be seen from the table, the institute that did not offer a mobile-friendly website was Whitireia Community Polytechnic. Consequently, an interview was conducted with the Manager of Marketing and Enrolments of this institute.

The interview questions are available under "*Appendix 06. Interview questionnaire for institutes who had not implemented mobile-friendly websites*" and the responses are summarised under "*Findings 04. Summary of interviews conducted with the institutes who had not implemented mobile-friendly websites*".

* See glossary

Findings 02. How well implemented are the mobile-friendly websites offered by New Zealand Universities and ITPs. A comparative analysis

The majority of the mobile-friendly websites offered by the New Zealand universities and ITPs demonstrate effective implementation. However, the divide between the well-executed websites and the ones that required improvements was significant. The poorer websites appeared to suffer planning issues in either the implementation stage or in the maintenance of the site. A smaller number of the websites had minor flaws when viewed on mobile phones, but were well executed in general. These issues may not be particularly disadvantaging to the prospective students; however they require attention. Tables 9, 10 and 11 respectively provide a list of institute websites classified into three categories: well executed websites; websites with major issues; and well-executed websites with minor issues. Whitireia Community Polytechnic and Auckland University of Technology have been excluded from these lists since the institutes did not have a mobile-friendly website at the time of writing. All three tables provide combined results for universities and ITPs, along with their rankings, dichotomous status of mobile-friendliness and methods used. The abbreviated heading MFW used in the second columns stands for mobile-friendly website. Interesting visual examples and associated explanations from the three categories are provided after the tables.

* See glossary

Table 9. Well-executed New Zealand tertiary institute websites

Well executed websites		
University's name and URL	**MFW**	**Method**
2. University of Otago http://www.otago.ac.nz/	Yes	RWD
6. University of Waikato http://www.waikato.ac.nz/	Yes	RWD
8. Lincoln University http://www.lincoln.ac.nz/	Yes	RWD
ITP's name and URL	**MFW**	**Method**
1. Unitec New Zealand http://www.unitec.ac.nz/	Yes	RWD
5. Nelson Marlborough Institute of Technology (NMIT) https://www.nmit.ac.nz/	Yes	RWD
7. Manukau Institute of Technology https://www.manukau.ac.nz/	Yes	RWD
9. The Open Polytechnic of New Zealand https://www.openpolytechnic.ac.nz/	Yes	RWD
12. Wellington Institute of Technology (Weltec) http://www.weltec.ac.nz/	Yes	RWD
16. Toi Ohomai Institute of Technology https://www.waiariki.ac.nz/home	Yes	RWD

* See glossary

Table 10. New Zealand tertiary institute websites with major issues

Websites with major issues.		
University's name and URL	**MFW**	**Method**
1. University of Auckland https://www.auckland.ac.nz/en.html	Yes	RWD
ITP's name and URL	**MFW**	**Method**
2. Otago Polytechnic https://www.op.ac.nz/	Yes	RWD
4. Eastern Institute of Technology (EIT) http://www.eit.ac.nz/	Yes	RWD
6. Ara Institute of Canterbury (ARA) http://www.ara.ac.nz/ http://m.ara.ac.nz/	Yes	Dedicated
11. Southern Institute of Technology (SIT) https://www.sit.ac.nz/	Yes	RWD
13. Western Institute of Technology at Taranaki (WITT) http://m.witt.ac.nz http://www.witt.ac.nz/	Partly	Hybrid of Dedicated + Desktop site
14. Northland Polytechnic (NorthTec) http://www.northtec.ac.nz/	Yes	RWD
15. Tai Poutini Polytechnic https://tpp.ac.nz/	Yes	RWD

* See glossary

Table 11. Well-executed New Zealand tertiary institute websites with minor issues

Well executed websites with minor issues		
University's name and URL	**MFW**	**Method**
3. University of Canterbury http://www.canterbury.ac.nz/	Yes	RWD
4. Victoria University of Wellington http://www.victoria.ac.nz/	Yes	RWD
5. Massey University http://www.massey.ac.nz/	Yes	RWD
ITP's name and URL	**MFW**	**Method**
3. Waikato Institute of Technology (Wintec) https://www.wintec.ac.nz/	Yes	RWD
10. Universal College of Learning (UCOL) http://ucol.ac.nz/	Yes	RWD

Following are some performance aspects, interesting visual examples and associated explanations of the websites as per the three classifications:

Well-executed websites

Some of the commendable traits of the well-executed websites were coherent user experiences across devices, consistency of content, well-planned layouts and navigation, sophisticated graphics and user-friendly interfaces. As a special mention, along with the aforementioned qualities, the responsive websites of Nelson Marlborough Institute of Technology (NMIT), University of Otago and Unitec also made use of adaptive content. The instances of adaptive content that were noted included NMIT's usage of tailored content targeted at domestic and international students and alternative representations of content by all three institutes to ensure optimal performance and content accessibility on mobile phones. Interesting visual examples and explanations of some of these instances are listed as follows.

As shown in Figure 40, when visiting the first time, the landing page of NMIT's website presents a splash screen. It offers two options, which the user can select to indicate if they are a domestic or an international student and also choose the country they are

* See glossary

from. It was interesting that this was not an automatic process. The splash screen also indicates the user's detected location. However, while testing the site across three devices, the mobile phone was incorrectly detected as located in Australia. It is assumed that the splash screen has been implemented to ensure that the user does not get served an incorrect version of the website.

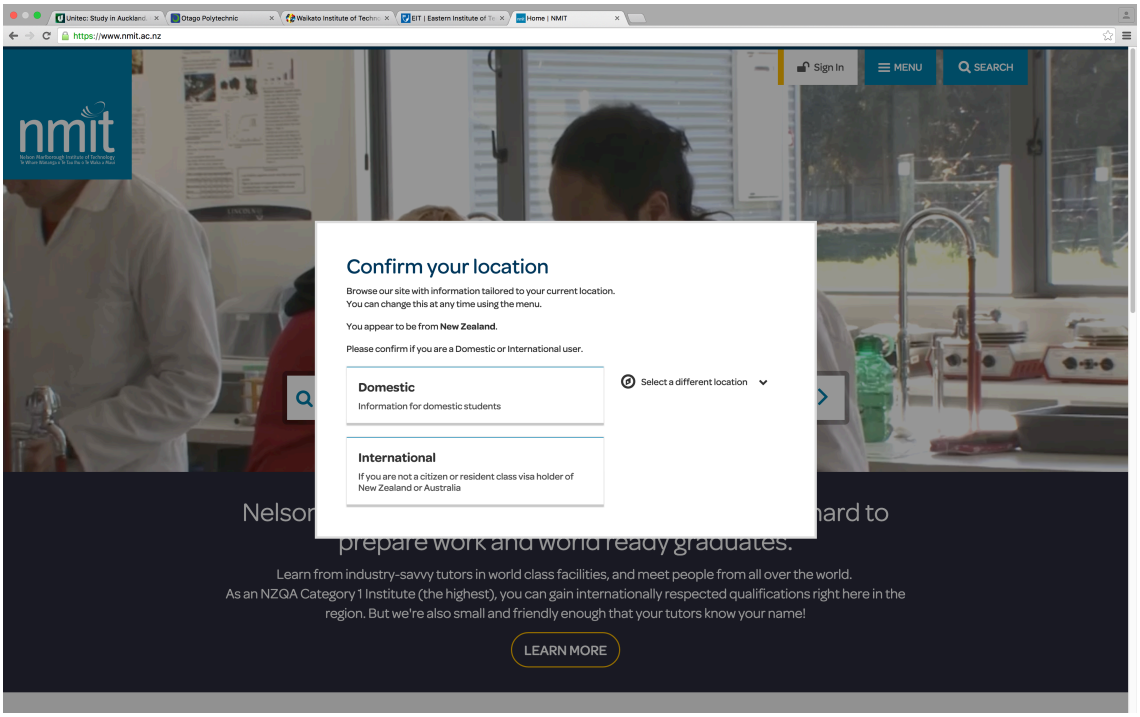

Figure 40. Location selection options on NMIT's landing page (NMIT, 2017)

Once a user chooses their location, one of two versions of the landing page is served, depending on the user being domestic or international. As shown in Figures 41, 42 and 43, these versions contain different sets of information, navigation options and visuals. Figure 41 presents three snapshots of NMIT's landing page. The top of the page on the desktop utilises a video based banner and brief introduction of NMIT underneath. The mobile version of the website uses an image rather than a video. This ensures that mobile phone users with varying Internet speeds can enjoy a visual reference and the video does not hinder the website performance. This technique has also been used by the University of Otago on their website's landing page. The desktop snapshot on the top is targeted at domestic students and the one at the bottom is for international students. The video banner in the top snapshot shows a range of on-campus activities, which feature domestic students, and the banner in the bottom does the same while featuring

* See glossary

international students. Similarly, as shown in Figure 42, the introductory text for NMIT, underneath the video banners, is different.

Figure 41. Adaptive content on NMIT's website (NMIT, 2017)

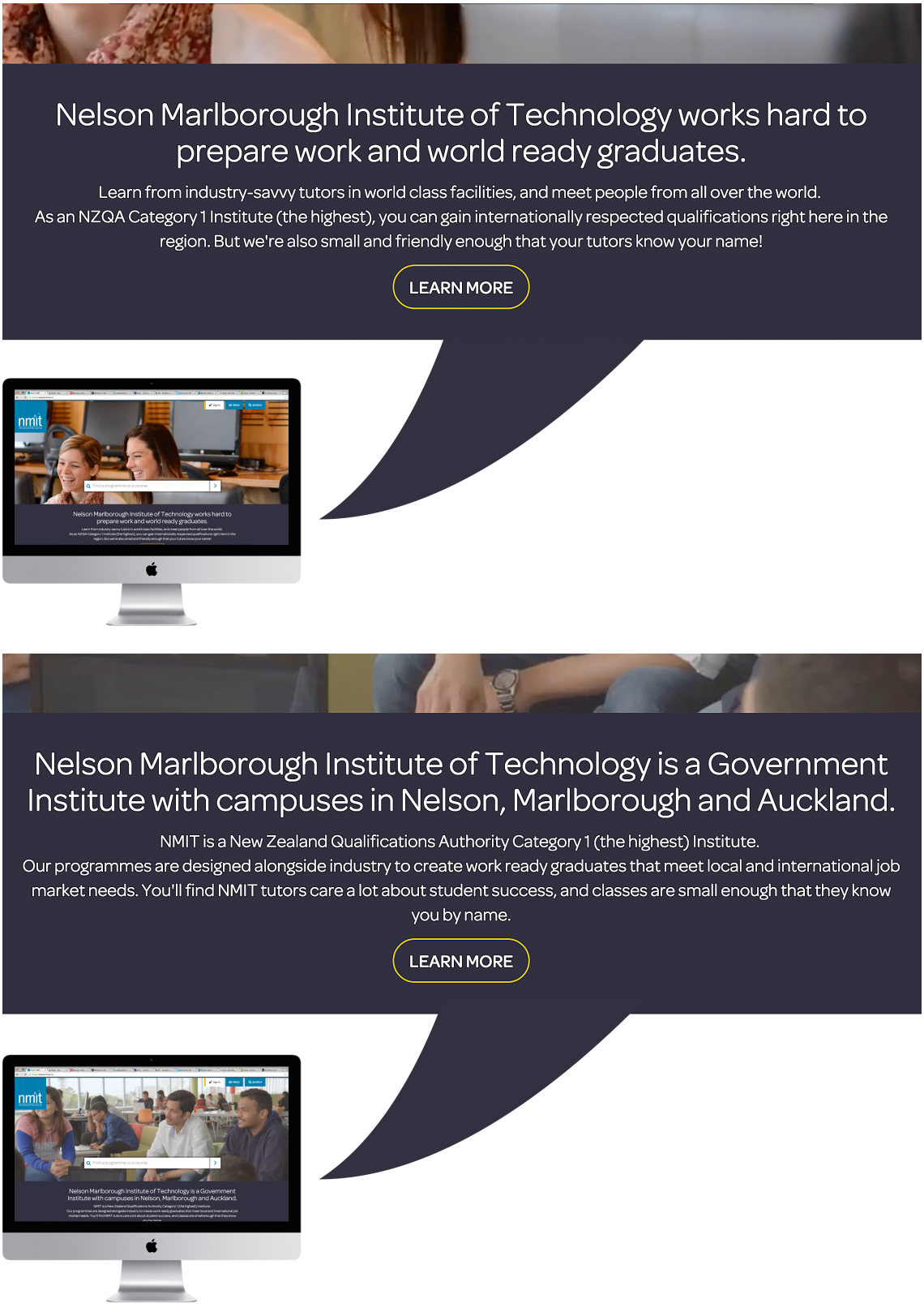

Figure 42. Different versions of introductory text on NMIT's website (NMIT, 2017)

Figure 43 presents two snapshots of this page on mobile phones, with two sets of navigation options. Those on the left are targeted at domestic students and those on the right are for international students. The differentiating options have been highlighted in red by the researcher, and lead to separately created webpages with unique sets of information for the relevant users.

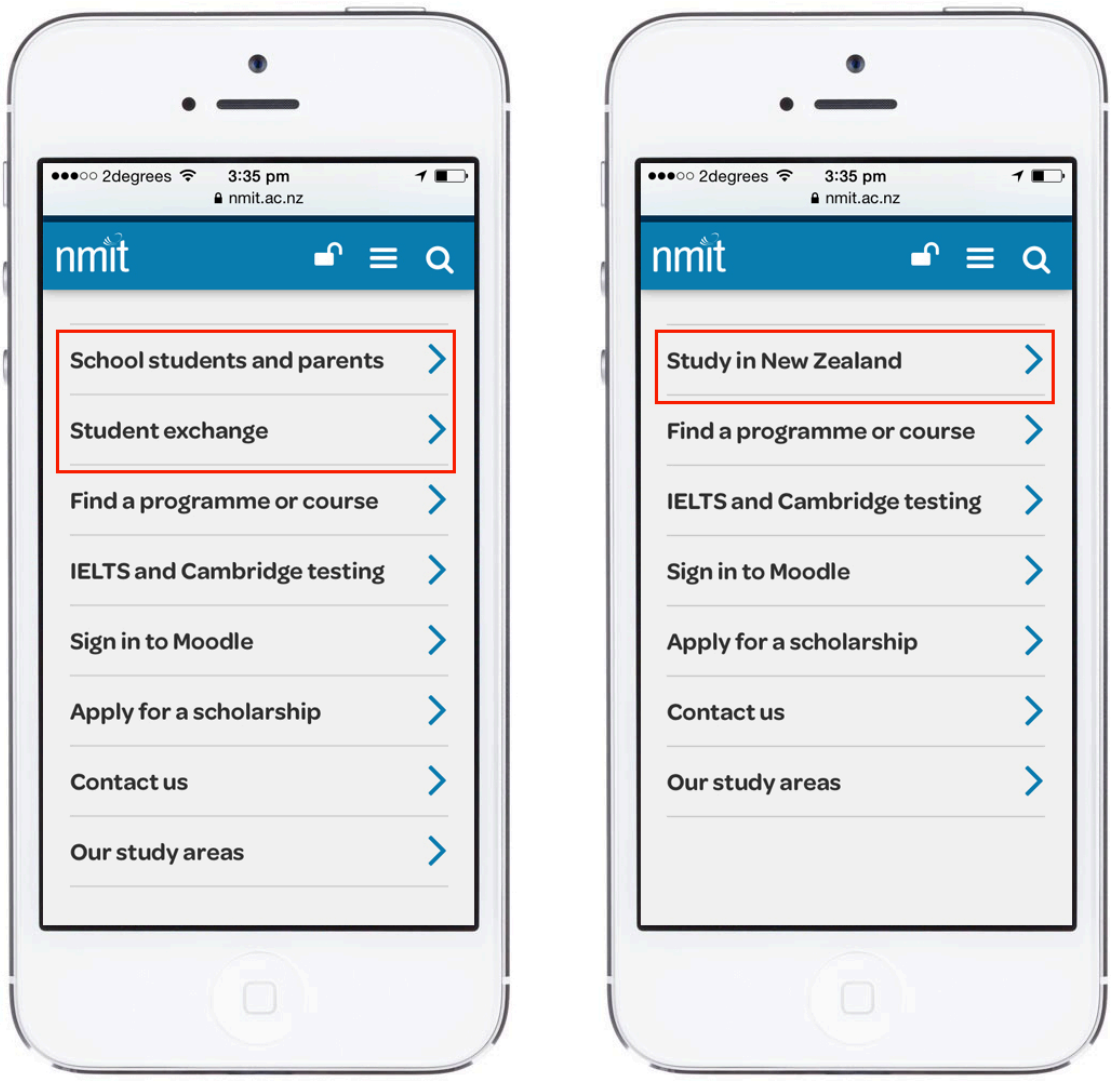

Figure 43. Different versions of navigation options on NMIT's website (NMIT, 2017)

* See glossary

Figure 44 presents a good example of alternative representations of the same content, demonstrated by Unitec's website, to suit the screen size of the device in use. The image shows two snapshots of a page on Unitec's website, which provides information on acting related courses. The snapshot on the left shows the programmes and study path related information rendered in a tabular format on a desktop screen. The snapshot on the right shows the same information presented in the form of headings and paragraphs to ensure readability on a mobile phone's screen.

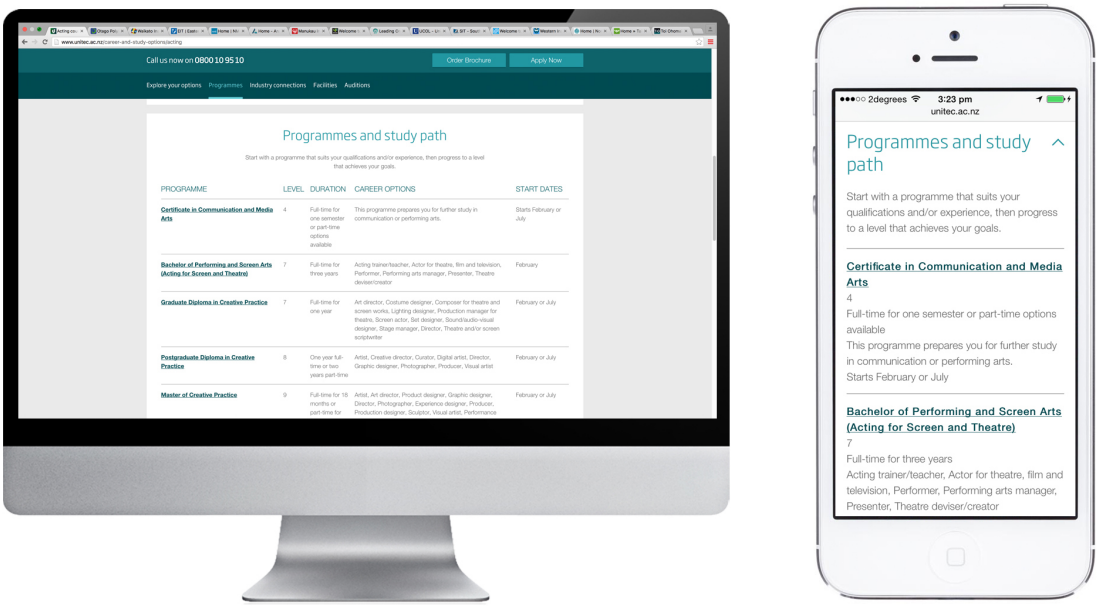

Figure 44. Alternative representation of content on Unitec's website (Unitec, 2017)

Websites with major issues

Collectively, some of the flaws discovered in the websites with major issues, that were listed in Table 10, included inconsistent user experiences, content forking, missing content, suboptimal layouts, unsuitable content not loading on mobile phone, difficult to operate page sections on mobile phone and erroneous link sharing. First impressions combined with good aesthetics made the websites seem promising. However, further investigation revealed the flaws listed above. Table 12 presents a breakdown of the individually noted issues for the respective websites. Interesting visual examples and explanations of some of the issues are provided after the table.

* See glossary

Table 12. Individual problems in the New Zealand tertiary institute websites with major issues

Websites with major issues	
University's name and URL	**Issues**
1. University of Auckland https://www.auckland.ac.nz/en.html	• Suboptimal layouts • Difficult to operate page sections on mobile phones
ITP's name and URL	**Issues**
2. Otago Polytechnic https://www.op.ac.nz/	• Inconsistent user experience • Missing content • Suboptimal layouts • Unsuitable content not loading on mobile phone • Difficult to operate page sections on mobile phones
4. Eastern Institute of Technology (EIT) http://www.eit.ac.nz/	• Inconsistent user experience • Suboptimal layouts • Unsuitable content not loading on mobile phone • Difficult to operate page sections on mobile phones
6. Ara Institute of Canterbury (ARA) http://www.ara.ac.nz/ http://m.ara.ac.nz/	• Inconsistent user experience • Content forking • Missing content • Erroneous link sharing
11. Southern Institute of Technology (SIT) https://www.sit.ac.nz/	• Suboptimal layouts • Difficult to operate page sections on mobile phones
13. Western Institute of Technology at Taranaki (WITT) http://m.witt.ac.nz http://www.witt.ac.nz/	• Inconsistent user experience • Content forking • Missing content • Suboptimal layouts • Unsuitable content not loading on mobile phone • Difficult to operate page sections on mobile phones • Erroneous link sharing
14. Northland Polytechnic (NorthTec) http://www.northtec.ac.nz/	• Suboptimal layouts
15. Tai Poutini Polytechnic https://tpp.ac.nz/	• Inconsistent user experience • Missing content • Suboptimal layouts • Unsuitable content not loading on mobile phone • Difficult to operate page sections on mobile phones

* See glossary

As an example of suboptimal layouts, Figure 45 presents two snapshots of the study options page on the University of Auckland's website rendered on a desktop and a mobile phone. The page hosts a vast number of hyperlinks. The snapshot on a mobile phone shows that the webpage drastically scales down to fit the smaller screen, with little consideration to layout readjustment for the user. To navigate the webpage, a considerable amount of pinching and zooming is required.

Figure 45. Comparison of University of Auckland's study options page on a desktop and mobile phone (The University of Auckland, 2017)

ARA utilises a separate mobile website to the desktop site. Figure 46 presents two snapshots showing the desktop and mobile versions of the study options page. Both the versions list the available qualifications in alphabetical order. As a result of content forking, the mobile website only presents two qualifications beginning with A, whereas the desktop version lists twelve. Additionally, the wording of the two common qualifications is different. This could cause confusion and frustration for viewers.

* See glossary

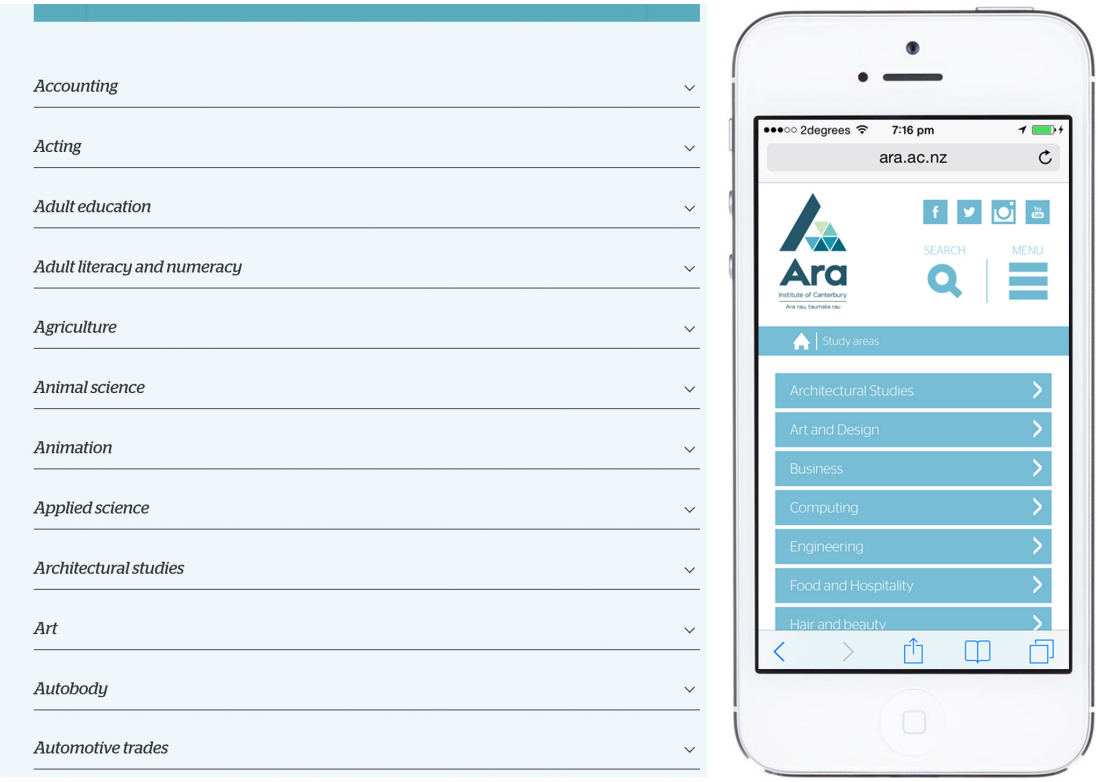

Figure 46. Comparison of ARA's study options page on a desktop and mobile phone (ARA, 2017a, 2017b)

EIT's website had a significant layout issue when accessed on a mobile phone. A simplified representation of this issue has been created in Figure 47, however on an actual phone the issue is more dramatic. The image shows two snapshots of the website's landing page. The snapshot on the left is the desktop layout and the one on the right is the representation of the mobile layout. The desktop site shows a two-column layout. The first section in the second row shows a map of the EIT's campus locations and the heading for this section is "Our campuses". On a mobile phone the content seems to disappear after the heading. As a first impression it seems like there is content missing on the mobile version of the website. However, after a significantly long scrolling through blank screens, the map which shows the campus locations appears and again after a very long scroll and blank screens, the remaining part of the website appears. As well as the tediousness of having to scroll continuously, the blank screen areas are significant problems, as they may tend to signify for viewers that no further information will be given.

* See glossary

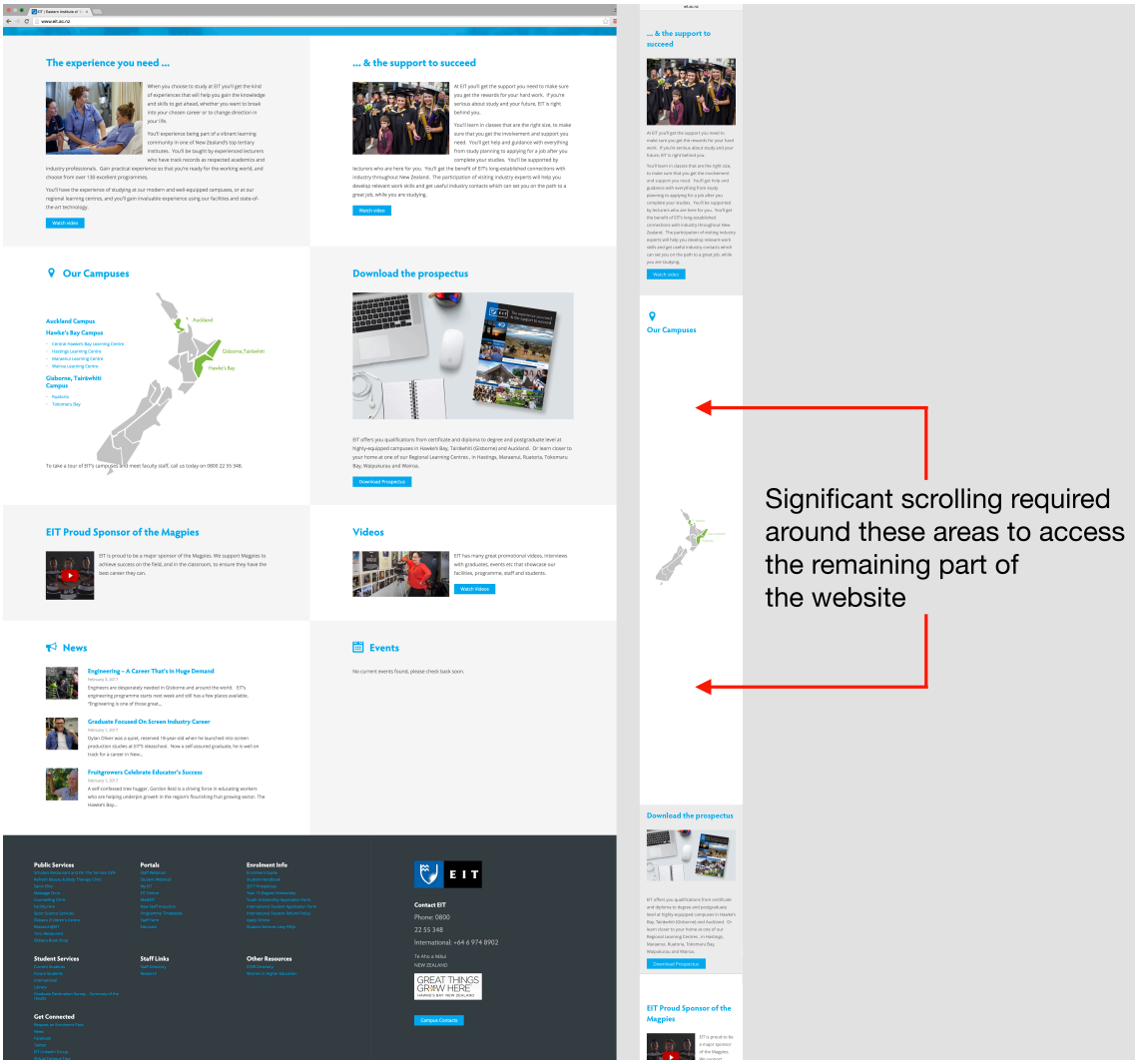

Figure 47. EIT's website's layout related issue on a mobile phone (EIT, 2017)

Otago Polytechnic's website suffered from significant cropping issues on mobile phones, including textual content and imagery. Figure 48 presents six snapshots of this website, comparing its three instances, on a desktop and a mobile phone. The first instance shows that a misplaced green coloured image crops the background image in the image slider. The second instance shows that an introductory text of the institute is cropped vertically about half way through. The third shows an image of a nursing student cropped rather than scaled down on a mobile phone. As a result, the prospective students using mobile phones will not gain a full appreciation of the key information and messages the institute is trying to deliver.

* See glossary

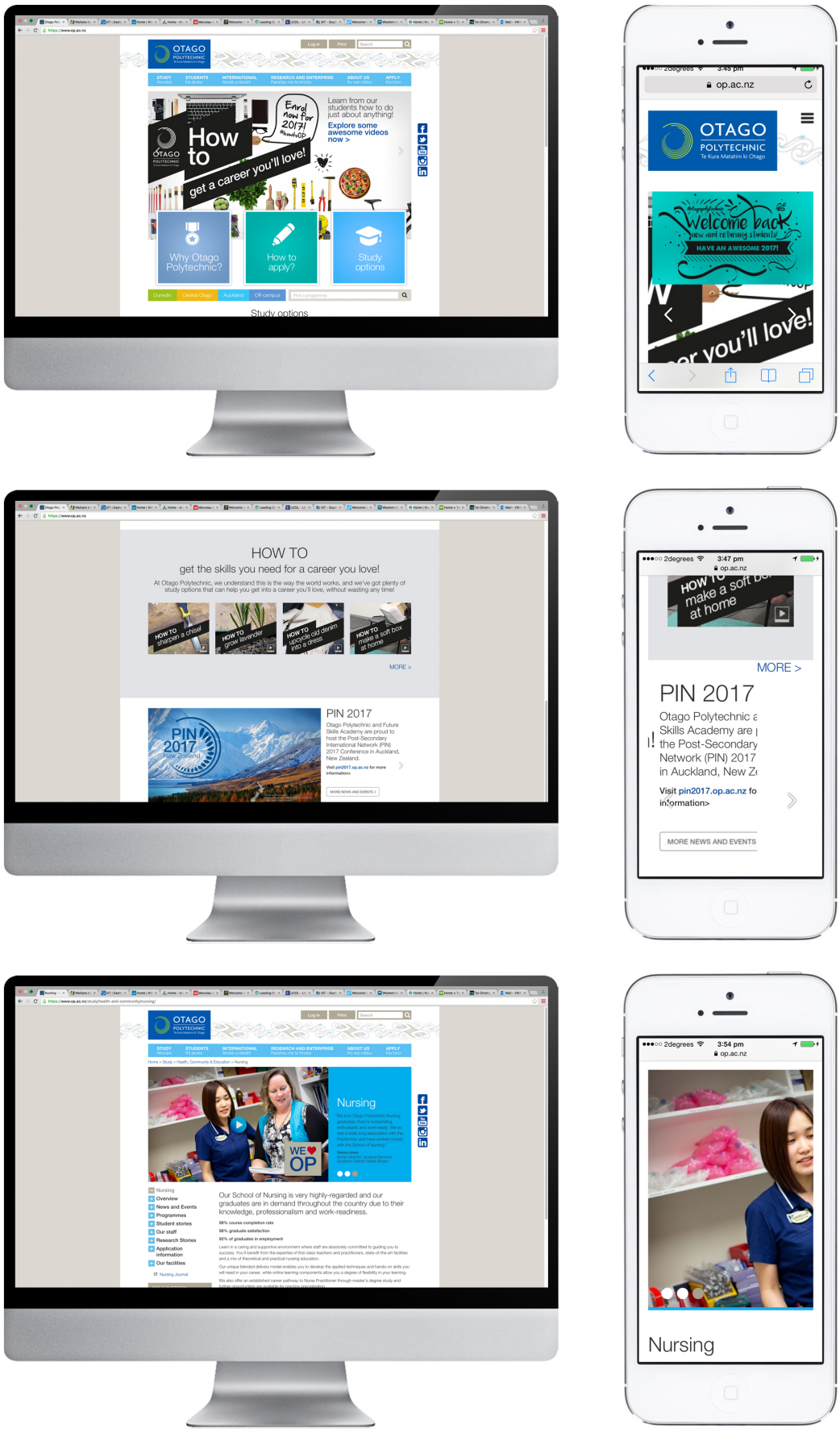

Figure 48. Instances of cropping on Otago Polytechnic's website on mobile phones (Otago Polytechnic, 2017a, 2017b)

Well-executed websites with minor issues

Some minor instances of the above-mentioned flaws that were present in a small number of the websites, when viewed on mobile phones, included cosmetic and speed issues, non-uniform scaling of images and non-responsive tables. As suggested earlier, these issues may not be particularly disadvantaging to the prospective students; however they require attention. An interesting visual example and explanation is given below.

Figure 49 presents two snapshots of a page on the University of Canterbury's website, which provides information on accounting related qualifications. When the 'future students' dropdown button is accessed on a mobile phone an error occurs. The body content of the page slides up erratically and disappears. Ultimately the dropdown menu is opened and the body content resumes normal position. This fault was also noticeable on other similar pages. The error may have been caused by improper coding or the speed at which the website performs the required operation. While testing the website, a high-speed fibre connection was used. If the latter speculation were true, the erratic behaviour could become more dramatic for prospective students with lower Internet speeds.

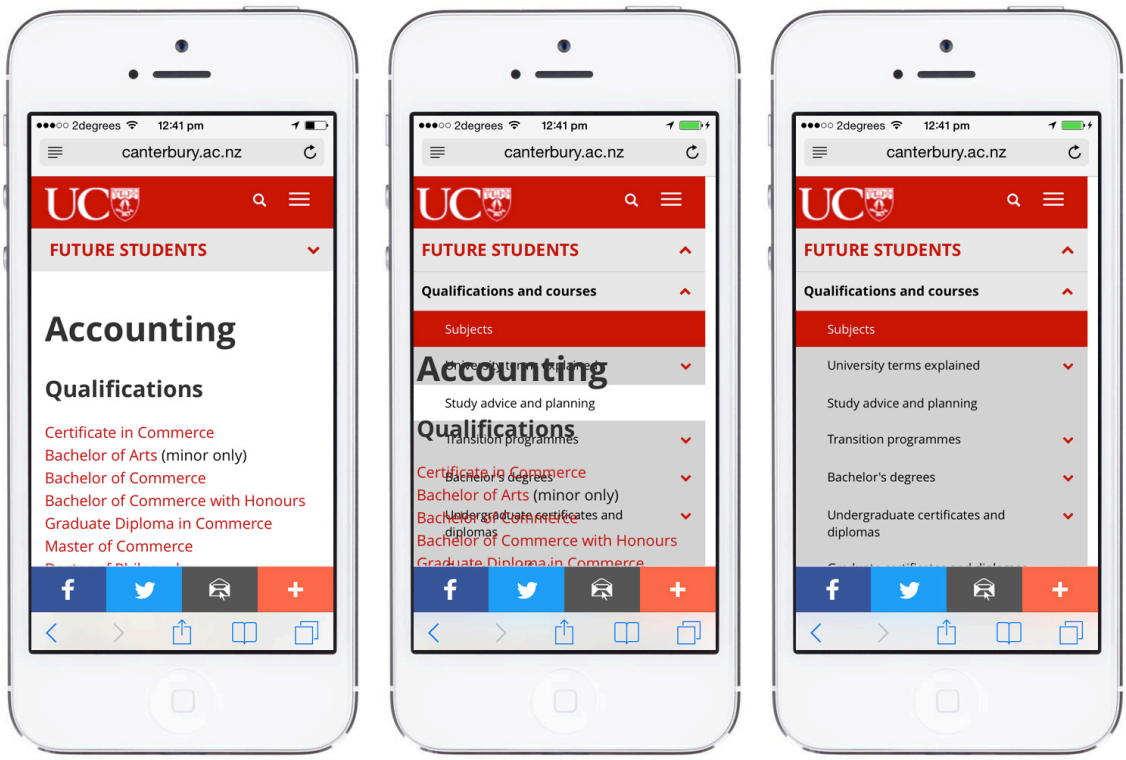

Figure 49. Erroneous loading of content on University of Canterbury's website (University of Canterbury, 2017)

* See glossary

Findings 03. Summary of interviews conducted with UCOL and Enlighten Designs.

In 2016 UCOL implemented a new mobile-friendly website created by Enlighten Designs. The findings presented in this section are a joint summary of two interviews. One was conducted with UCOL's Senior Communications Advisor, who led the project, and the other was a combined interview with the associated Project Manager and Front End developer from Enlighten Designs. Both the interviews were conducted as a case study on the newly created website, to understand the rationale behind the project and the selected method, associated processes, experienced shortcomings and recommendations for future improvements. In addition to the aforementioned aims, the interview conducted with Enlighten Designs' staff members was also done to seek the company's expertise in general, on issues with the creation of mobile-friendly websites, in a tertiary academic setting, and improvements required. Since the majority of the following information is a combined summary of the interviews, therefore citations have only been used where an explicit need to clarify the source of information was required.

UCOL's website serves as a key marketing and student recruitment tool for the organisation. The need to raise the technical and information delivery standards of the website for the purpose of increasing student enquiries and enrolments underpinned the decision. Additionally, as part of UCOL's strategic direction, the website as an interface was intended to strengthen UCOL's reputation as a supportive and innovative learning institution.

Universities and ITPs (Tertiary Education Commission, 2015; Universities New Zealand, 2015) in New Zealand rely on government funding, which constitutes a major share of financial resources required for their functioning. The creation or updating of a website for an ITP requires a special grant from the government (Beech, 2016). The process of acquiring these monetary allocations includes a significant amount of formalities and documentation before such projects can be approved. Also, the approved amount can be quite limited, which was the case in this project. Consequently, the available financial resources for the project set a major constraint to begin with. Selection of Enlighten Designs was through a tender process, which attracted a total of five submissions.

* See glossary

Key desirable outcomes specified to Enlighten designs included; mobile-friendliness and multi device access; consistency and full access to information for prospective students, irrespective of the platform; link sharing in social media; search engine optimisation; improved user experience and enhanced aesthetics. Additionally, UCOL's analytical data on device usage by its site visitors suggested that a significant amount of course related enquiries came from mobile phones. However, there was also a great amount of device diversity. In order to recommend a method for building UCOL's website, Enlighten Designs considered the following factors; aforementioned specifications; available funding; and the consideration of UCOL's limited human resources for content collation during the build process and post deployment maintenance. This included a combination of three staff members, with part-time involvement in the project, during the build and one full time staff member upon the conclusion of the project. Consequently, RWD was chosen due to higher suitability for the project requirements and its less resource intensive nature in comparison to the other methods.

Enlighten Designs suggest that on-time collation of content is one of the common issues experienced in large-scale projects such as academic institute websites. One of the key contributing factors is the significant amount of coordination required between various departments involved in the contribution process (Halvorson & Rach, 2012). Some examples include management, marketing, communications and academic units; and every department has varying levels of appreciation for the amount of work required in this process and sometimes this is underestimated. This can result in lack of coordination and delays—something also experienced by UCOL. These delays led to other issues such as unnecessary iterations of content so that it could be used temporarily while proofed versions were being worked on. Ultimately, the content development process was identified as a significant risk to the project. To resolve the issue, UCOL requested Enlighten Designs to provide extra support. Enlighten Designs' involvement and additional technical measures resolved the issues and the content related deadlines were met. The additional measures would have had financial consequences, and if not put in place, the resulting consequences of not being able to meet the required deadlines may have had dramatic implications. The entire project took about a year to complete.

According to UCOL's Senior Communications Advisor (Archer, 2016a) and Enlighten Designs' Project Manager (Hinton, 2017), both UCOL and Enlighten Designs are pleased with the end product. UCOL's Senior Communications Advisor (SCA) suggests that the

* See glossary

use of RWD has provided a website which meets the originally desired functionality for UCOL's needs at present and the foreseeable future. Since RWD relies on one set of content, rolling out of new content is less problematic for UCOL, who have only one staff member responsible this task. It should be noted that some instances of adaptive content have also been used in UCOL's approach. The image sliders in the website rely on a server side mechanism coded by Enlighten Designs, which automatically creates different versions of new images with varying file sizes. Upon device detection, only the suitable images are downloaded on the device in use, which ensures that the images work well across devices.

UCOL's SCA suggests that higher quality implementation by Enlighten Designs has resulted in minimal issues after the website went live. Both timeline and monetary constraints led to certain compromises in website features and at times basic solutions were resorted to. An example of this has been presented in the literature review and a visual reference to it has been provided again in Figure 50. The image shows that the scholarships webpage lists the available scholarships in a non-responsive tabular format. This was done as a basic solution that ensures that the table does not drastically scale down and is readable on a mobile phone. As a result, the table gets truncated on a mobile phone's screen and requires both horizontal and vertical scrolling.

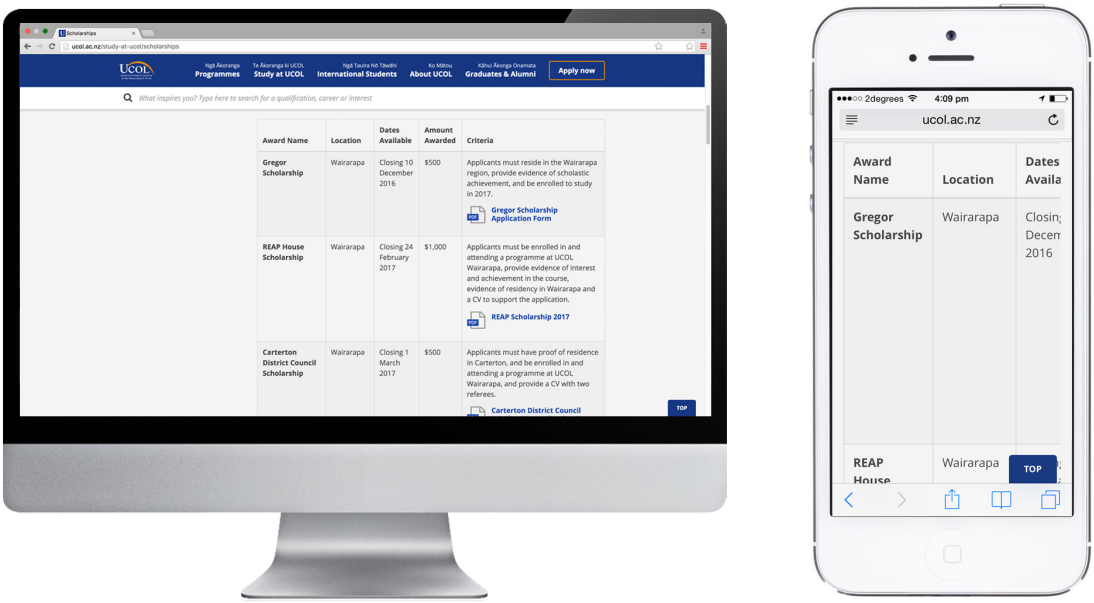

Figure 50. A table on UCOL's website rendered on a desktop and mobile (UCOL, 2016a)

* See glossary

UCOL and Enlighten Designs acknowledge the above-mentioned issues and compromises. UCOL intends to resolve any minor issues and implement additionally required functionalities in the future, based on a separate application for funding. In conclusion, the SCA suggests that the creation of a new website or an overhaul to the website content requires significant commitment, resources and planning. It is also clear that institutes need to ensure the content creation phase is not underestimated, and recognize that clarity of internal arrangements is vital to ensure a fluid process.

Enlighten Designs suggest that mobile-friendly websites are an important marketing tool for the New Zealand tertiary institutes. Although mobile phones may not be the most used device for focussed information seeking and decision-making, they are usually a starting point for these tasks amongst students. RWD seems to be the most appropriate solution for creating mobile-friendly websites for tertiary institutes in New Zealand. Along with other advantages, consistency of information, multi-platform delivery and easier maintenance are some of the key factors for its suitability. Their perspective was that the two other solutions are more applicable for organisations who can sustain a resource intensive, post-deployment maintenance of their website. Also, the company appreciates that responsive sites can take longer to read on slower Internet connections, however with better coding practices and combining adaptive solutions, as mentioned in UCOL's image sliders example, optimal performances can be ensured.

Although, as a standard process, Enlighten Designs are responsible for suggesting the technical methods to their clients, the importance for an organisation to understand their target audience needs and a clear use case for the website is stressed. Based on the interactions with the institutes that the company has dealt with, Enlighten Designs suggest that New Zealand institutes in general are aware of their target audience needs. However, any comparisons with tertiary institute websites in other countries would need to take into account varying Internet speeds. As an example, institutes in USA may enjoy the flexibility of implementing more sophisticated and heavier features in their websites due to faster Internet connections than New Zealand.

* See glossary

Following is a situation and suggestion provided by Enlighten Designs, on future research areas related to mobile-friendly websites. Releasing newer versions of mobile phone web browsers has become more frequent. Due to the fast rate of change there is a continuous need to test and, if required, to update the websites. Enlighten Designs suggest that web development companies or researchers in a similar area could investigate the processes to cope with frequent browser changes.

Findings 04. Summary of interviews conducted with the institutes who had not implemented mobile-friendly websites

AUT and Whitireia Community Polytechnic (WCP) were the two institutes who had not implemented mobile-friendly websites at the time of conducting the observational test for New Zealand universities and ITPs. Both AUT and WCP agreed that a strong online presence and a mobile-friendly website are vital to their organisations' success.

AUT's Web Centre Manager (WCM) describes their website as the primary interface between the organisation and prospective students. WCP's Manager of Marketing and Enrolments (MME) suggests that there is an increasing expectation amongst prospective students that educational institute websites should provide higher levels of engagement and responsiveness to their information seeking needs. In fact, the online engagements and observation of users' online behaviour, also enables institutes to gain a better understanding of their target audience's needs. It is therefore in the best interests of educational institutes to implement effective websites that provide accurate and useful information via multiple platforms to enhance the desired engagement.

Both AUT and WCP have seen an increase in visits to their websites through mobile phones. The MME suggests that an increase in mobile phone ownership has led to immediate access of online communication for institutes. A combination of improved mobility and widespread dissemination of information via social media through link sharing allows for strengthening an organisation's brand equity.

AUT suggested that the delay in implementing a mobile-friendly website stemmed from a couple of reasons. Firstly, the enormous amount of content in the existing website presented significant challenges and complexities. Secondly, a lack of understanding and coordination amongst the relevant personnel, regarding content strategies required for mobile-friendly websites, hindered the onset of the project. For WCP, the previously used technology to build the existing website did not allow reconfiguration for a mobile-friendly solution. The formalities around initiating a brand new approach resulted in delays.

As stated in Section 4.2, AUT eventually offered a mobile-friendly website around the end of 2016. WCP have also commenced discussion on the technical approach to build a mobile-friendly website. The commonality between both projects and desirable outcomes

* See glossary

is not only to provide a mobile-friendly solution but also an effective multi-platform access. AUT's chosen method was RWD. The key reason was the ability to deal with only one set of code in comparison to separately coded adaptive templates. Whitireia are considering both RWD and AWD for the website build.

* See glossary

Chapter 5. Conclusions

This research aimed to investigate the current state of mobile-friendly websites in the New Zealand tertiary academic sector, namely Universities and Institutes of Technology and Polytechnics (ITPs). Following were the queries underpinned by areas of interest, investigated in three parts in this thesis:

- Selection of a method - The first part compared and contrasted the suitability of the three contemporary technological methods available for the creation of mobile-friendly websites in a tertiary academic setting. These included: Dedicated mobile websites; Responsive Web Design (RWD) and Adaptive Web Design (AWD).

- Target audience needs - The second part explored the exclusive target audience needs for course related information seeking and decision-making. These included device preferences, Internet accessibility, information seeking patterns, importance of mobile-friendly websites amongst this group and how the performance of these websites impacted the student opinions about an institute.

- Current status of technology usage by New Zealand tertiary institutes – The third part explored how many tertiary institutes in New Zealand offer mobile-friendly websites, what technical methods have been appointed and ascertained key considerations for future development.

The key research question was - How well have New Zealand tertiary institutes utilised the current technology to offer mobile-friendly websites to potential students?

The secondary research conducted under the literature review, addressed the first part, and the remaining two were addressed in the primary research. Following are the conclusions based on the three key themes listed above.

Suitable technical method

To gain comprehensive knowledge for making the required recommendations, the literature review compared and contrasted three technological methods of creating mobile-friendly websites. These included dedicated mobile websites, RWD and AWD. Comparisons were made using a range of criteria previously stated. Several pros and cons of each method were discovered and discussed. In conclusion, it seemed RWD and AWD were more fitting due to the fact that both could offer not only a mobile-friendly but also a multi-platform solution. Furthermore, of the two solutions, RWD seemed to offer longevity to the return on investment. Suporting reasons include; its less resource intensive nature for website maintenance, and expansion capabilities to both new devices and varying screen sizes within a device category. However, the need for better coding to enhance the speed of responsive websites, and a consideration of a hybrid of responsive layouts and adaptive content to offer device-optimised experiences was also discovered.

An observational test conducted on the websites of the top twelve academic institutions globally, revealed that the majority had utilised RWD. The analysis also aided in validating some other findings from the literature review. The need for thorough planning and advantages of coherent user experiences offered by responsive websites was stressed.

At this stage, device preference of the targeted students was unknown. A survey conducted with the NCEA L3 students located in Wanganui, the details of which are stated later, revealed that the students used a range of devices for information seeking on academic institute websites. This reinforced the notion that for web building processes, RWD and AWD were more suitable than the dedicated method of building separate mobile-friendly websites, for New Zealand institutes.

An observational test and analysis conducted on the websites of New Zealand Universities and ITPs also discovered that the majority of the institutes had used RWD. While the research suggests that this technological solution was the best approach, given the circumstances of the NZ institutions, there were considerable problems noted in a significant number of sites that had been developed thus far. These errors pointed to a range of problems that need to be addressed in the implementation of the technological solutions. Interviews conducted with UCOL and Enlighten Designs, supported the conclusion that many of these issues tended to stem from financial, and internal

organizational difficulties. Additionally, interviews conducted with UCOL, Enlighten Designs, AUT and WCP upheld the overall conclusion. A combination of technical advantages, current target audience needs, current restrictions of funding and suitability to limited resources for post deployment maintenance in a tertiary academic setting, supported the conclusion that: under the current circumstances RWD has proven to be the most appropriate solution for building mobile-friendly websites for New Zealand tertiary institutes.

* See glossary

Target audience needs

Surveys of a sample of UCOL's target market in terms of prospective local students provided a useful example, to investigate the target audience needs for course related information seeking. Whilst one might expect some differences between this audience and those of other institutions, much of the research, methodologies and surveys should prove useful in other related studies. The samples collected from the Wanganui schools indicated that, irrespective of the social groups, students had access to a range of devices for Internet usage. A significant majority of the participating students demonstrated a *mobile only* trend for day-to-day online activities. However, this predominance stemmed mainly from convenience rather than affordability, which might be the case for some developing countries or population belonging to lower socio-economic groups in some developed countries (Hill, 2010; Lenhart, 2011; The Nielsen Company, 2012). The majority of participants had access to their own high-speed Internet sources; with some who relied on mobile data plans and an almost negligible minority having access to alternative sources. Collectively, none of the students were disadvantaged in their means of accessing the Internet.

The predominant use of mobile phones to access academic institute websites for course related information seeking was unexpectedly low. The participants indicated preference for bigger screens for this task, with the exception of tablets. Laptops were the most used device, followed by desktops. However, there were high ratings on perceived importance for tertiary institutes to offer mobile-friendly websites. Also, there was a strong correlation between the perceived smooth running of an academic institute's website on mobile phones, and the participants' perception of an institute's professionalism.

Participants indicated a high tolerance for issues such as, slow speed or lack of information, and indicated they would try alternative measures to continue accessing the website, which included switching over to another device. This may be a result of luxury of access to other devices. However, academic institutes need to take into account that a sizeable minority will abandon the websites and switch over to another institute's website, based on speed or lack of information issues. As noted in Section 4.1, substandard performances could potentially lead to significant revenue losses, if the percentages of negatively affected students were considered in actual number of student enrolments for an institute. Furthermore, if this is projected over the study period of a qualification, which

* See glossary

runs for more than one year, the potential losses will be higher. This could be compared to the cost of creating an effective mobile-friendly website.

Irrespective of the device usage, the majority of students indicated occasional usage of academic institute websites. This is in contrast to the original expectations. It is recognised that the time period of surveys may have impacted the frequency of information seeking. The majority of participants were domestic, belonged to the 17-18 age group, and came from Wanganui, which is one of the smaller urban areas in New Zealand (Statistics New Zealand, 2001). The results may have been different for other age groups, students living in bigger urban areas or rural areas, international students located overseas, and if surveyed at different times of the year.

Between speed of access and full access to information, a majority of the participants preferred the latter. As noted in the literature review, dedicated mobile websites are usually a subset of the desktop version with less content and features (Nielsen, 2012). Also, dedicated mobile websites may result in suboptimal layouts, when rendered on mobile phones whose screen size is significantly different to the dimensions for which the website was originally created (Cao, 2017). As evidenced in student survey findings in Section 4.1, a significant variety in mobile phone screen sizes was found amongst the prospective students. Participants' preference for full access to information, presence of varying mobile phone screen sizes, combined with their accessibility to a multitude of devices, validates the discussions on RWD and AWD in the previous conclusion.

Although speed of access was a preference for fewer participants, the gaps between the preferences were not significant. This further reinforces the need for device-optimised solutions that can offer prompt access. The nature of adaptive websites is, by default, aimed at providing device-optimised performance by using different versions of code for different devices. However, adaptive websites also utilise adaptive content for enhancing the speed of different versions of a website. Academic institutes need to be mindful that the content may be optimised to suit different devices, but not reduced, to ensure full access to information. Lastly, if academic institutes choose to use RWD, the need for enhancing the website speed and the possibilities offered by a hybrid model, should be considered.

* See glossary

Current status of technology usage by New Zealand tertiary institutes

Apart from the conclusions on the third part of this research, this section also has significant import for the key research question. Having visited the websites of eight New Zealand Universities and sixteen ITPs, it was found that all the institutes except one offered mobile-friendly websites. The one, which did not, is an ITP and currently in the process of implementing one. As an exception, one ITP was partly mobile-friendly, and utilised some desktop versions of the website pages.

Forming a significant majority, twenty out of the twenty-four institutes utilised RWD. One university used a hybrid of RWD and dedicated methods. One ITP used the dedicated method and the ITP that was partly mobile-friendly used the dedicated method for the mobile-friendly pages. The ITP which did not have a mobile-friendly website is currently considering both RWD and AWD.

The majority of the mobile-friendly websites offered by the New Zealand universities and ITPs were sophisticated, with many commendable traits that would aid information seeking and decision making for the prospective students. Along with the aforementioned qualities, instances of adaptive content usage in responsive websites were also found. These included, tailored content for domestic and international students, and alternative representations of content, which led to optimal performance and ease of access on mobile phones. There was a significant gap between the well-executed websites and the ones in need of improvement. There were several issues, which may have originated either as a result of a lack of proper planning or poor maintenance. Minor cosmetic and technical issues were also common amongst a small number of websites.

Findings on target audience device usage specific to UCOL's target market, noted previously, showed that students used a range of devices to access tertiary institute websites. Factors such as high quality implementation of responsive websites, which work well across a range of devices, indicated that New Zealand tertiary institutes are generally aware of the information seeking needs of their prospective students. If the findings in this research can be broadly extrapolated to other institutions, it will further strengthen the evidence.

* See glossary

Admittedly, factors such as, the complexities around content creation, organisational issues, limited finances for website creation, and limited human resources for website management are obstructions to ideal mobile-friendly implementations for institutes. However, it was also evident that inferior experiences on mobile-friendly websites can negatively impact an institute's reputation. Therefore, it is in the best interests of the institutes whose websites suffer from issues, to revise their mobile-friendly solutions. Between the two categories, ITPs are more in need of improvements to their mobile-friendly websites.

The current state of mobile-friendly websites in New Zealand seems to match the presently desired outcomes. However, it has also been discovered that the technologies and devices continue to evolve rapidly. It is an area that needs to be constantly examined by academic institutions to remain abreast of target audience needs. Consequently, several areas of potential research have been identified throughout this thesis and are restated as follows:

- Research into advanced criteria of adaptive content including device types, user context and personalisation of information.
- Detailed investigation into a hybrid concept of responsive layouts and adaptive content.
- Detailed investigation into the progress of 'RESS: Responsive Design + Server Side Components'.
- Investigating processes to cope with frequent mobile phone web browser changes.
- In-depth investigation into the correlation between an organisation's available resources and suitable technical method for creating an organisation's website.
- Detailed investigation of device usage for information seeking by prospective students of different age groups.
- Detailed investigation of device usage for information seeking by prospective students from overseas.

* See glossary

Glossary of terms

- App – An app or an application is software that gets installed on a digital device to carry out a dedicated set of tasks.
- Android – A mobile operating system developed by Google primarily for touchscreen mobile devices such as smartphones and tablets.
- Cruft – Unwanted code or software, badly designed or unnecessarily complicated.
- CSS3 – CSS stands for Cascading Style Sheets. While HTML is used to structure the content on a webpage, CSS are used to define its styling rules. CSS3 is the latest version for CSS.
- Domain name – Unique name of a website, service or a computer.
- Hyperlink – A link that redirects a webpage to another webpage, or content within a webpage, and is usually activated by clicking on text, buttons or images designated as hyperlinks.
- HTML5 – HTML stands for Hyper Text Markup Language and is used for structuring and presenting content on a webpage. HTML5 is its latest version.
- iOS – iOS is a mobile operating system created and developed by Apple Inc. exclusively for its hardware.
- Latency – the delay before a transfer of data begins following an instruction for its transfer.
- Mobile-friendly – A website whose interface and content are either specifically created or repurposed for viewing on mobile phones.
- Smartphone – A mobile phone, usually with a touchscreen interface, capable of functioning like a computer, allowing Internet access and installation of apps facilitated by an operating system.
- Sub-domain – An Internet domain, which is part of a primary domain.
- Web app – A web app is not installed on a mobile phone but accessed via a mobile phone's Internet browser and may be created as an "M-dot" sub-domain* of the desktop website such as "m.sitename.com".

* See glossary

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* See glossary

Appendices

Appendix 01. Issues discovered post hoc analysis of websites for top twelve global institutes

This appendix presents interesting visual examples of some of the issues discovered, in the websites of three top ranking academic institutes in the world (Times Higher Education, 2017). These include Princeton University, Massachusetts Institute of Technology and ETH Zurich – Swiss Federal Institute of Technology Zurich.

Princeton University

The “Undergraduate Admission & Aid” page on Princeton University’s website had several technical issues when accessed on a mobile phone including, poor user experience, suboptimal layout which was difficult to operate, and unsuitable content. A simplified representation of these issues has been created in Figure 51, however on an actual phone the issue is more dramatic. The image shows two snapshots of the webpage. The snapshot on the left shows a partial view of the webpage’s desktop layout and the one on the right is a representation of the mobile layout. The desktop layout has a video banner at the top, followed by a two-column layout featuring links to other pages. On a mobile phone the page loads up as black. As a first impression it seems like there is content missing on the mobile version of the website. However, after a significantly long scrolling through blank screens, a play button appears and again after a very long scroll, again through blank screens, the remaining part of the website appears. Not only the continuous scrolling is tedious, the blank screen areas are a substantial issue, as they may tend to suggest for the site visitors that there is no information available. Also, the play button when touched on the mobile does not play the associated video and results in an error, which says, “The operation could not be completed”. This indicates that the webpage has been implemented or maintained with little consideration to performance on mobile phones.

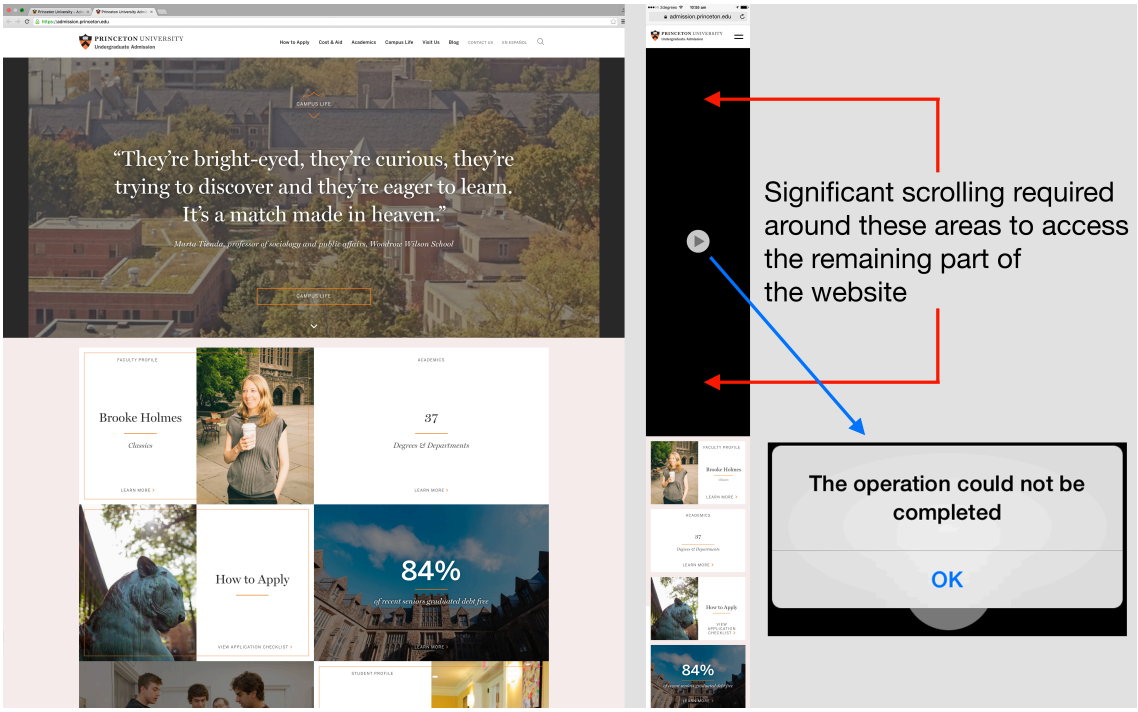


Figure 51. Mobile phone layout issue on Princeton University's admissions page (Princeton University, 2017)

Massachusetts Institute of Technology (MIT)

MIT's website, had several drastic instances of user experience disparity and suboptimal layouts. Interestingly the issues were not only present on mobile phones but also desktop computers. Although the website was built with responsive mechanisms, some of the webpages only demonstrated scaling down on mobile phones rather than readjusting. Also, there were several aesthetic and technical inconsistencies in the implementation of information pages for different schools under MIT. It would appear, that not only the website may have been implemented or maintained without thorough planning, but also suffers from disjointed practices and lack of coordination between various departments.

Figure 52 presents four snapshots of MIT's website, comparing the desktop and mobile phone layouts of two webpages. The first instance on the top shows two snapshots of the educational options page, rendered on a desktop and a mobile phone. The page hosts a vast number of hyperlinks. The right snapshot shows that the webpage has drastically scaled down to fit the mobile phone's small screen, with little consideration to layout readjustment for the user and making it difficult to comprehend the content. To navigate the webpage, a considerable amount of pinching and zooming is required. The

second instance at the bottom, presents the same issue on the academic calendar webpage.

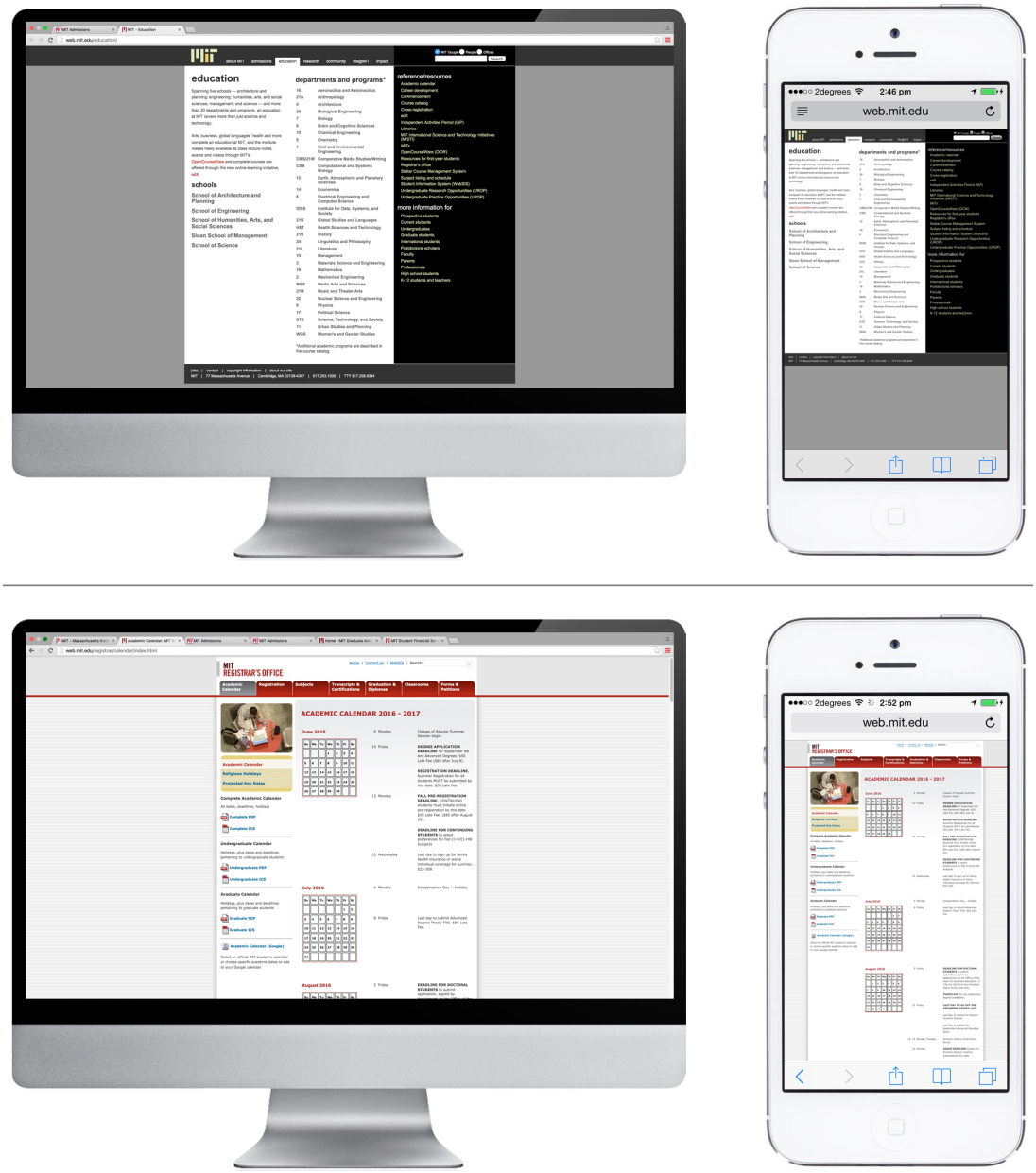


Figure 52. Instances of drastic scaling down of content on MIT's website (MIT, 2017a, 2017d)

Figure 53 presents two snapshots of MIT's School of Humanities, Arts and Social Sciences webpage rendered on a desktop and a mobile phone. Not only the webpage layout is drastically scaled down on mobile, but also fails to effectively utilise the bigger viewing area offered by the computer monitor. The rendering of the webpage on both the devices has significant blank areas, which could have been used to enhance the user interface.

* See glossary

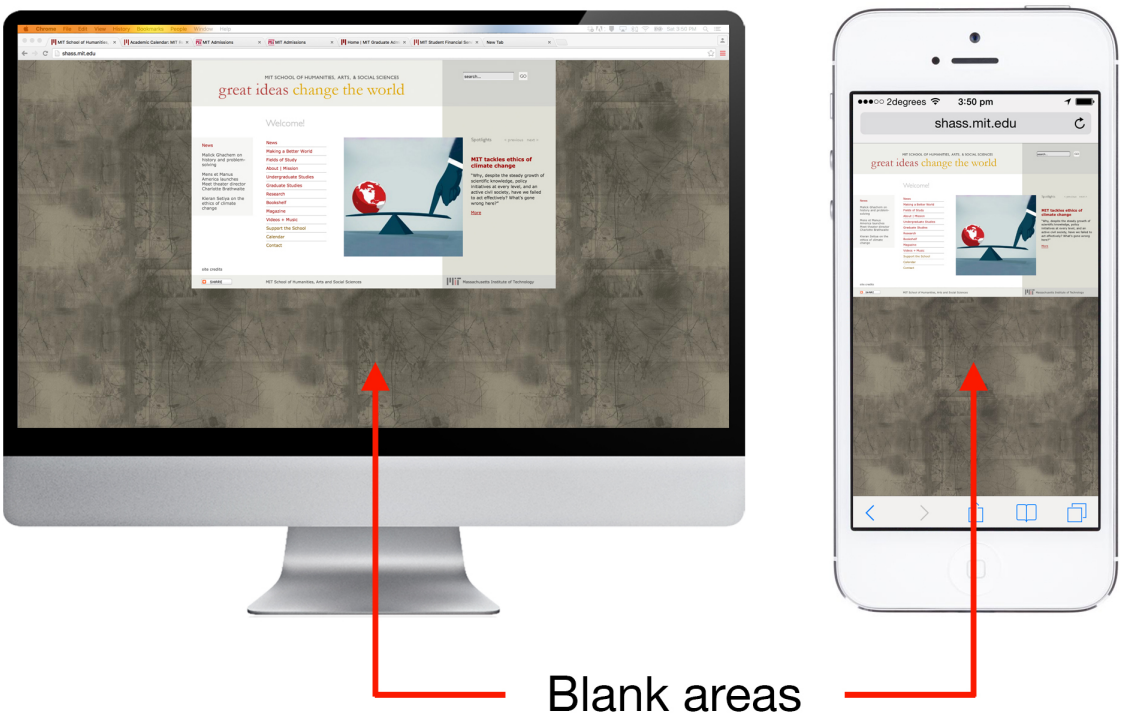


Figure 53. MIT's ineffective usage of screen space (MIT, 2017f)

Figure 54 presents two snapshots of MIT's landing page rendered on a desktop and a mobile phone. While the desktop layout does not make use of the bigger viewing area offered by the computer monitor, interestingly the mobile layout has been readjusted to suit the screen size, as expected from responsive sites (Marcotte, 2011). It shows less content, and the users can scroll down to access the remaining parts.

* See glossary

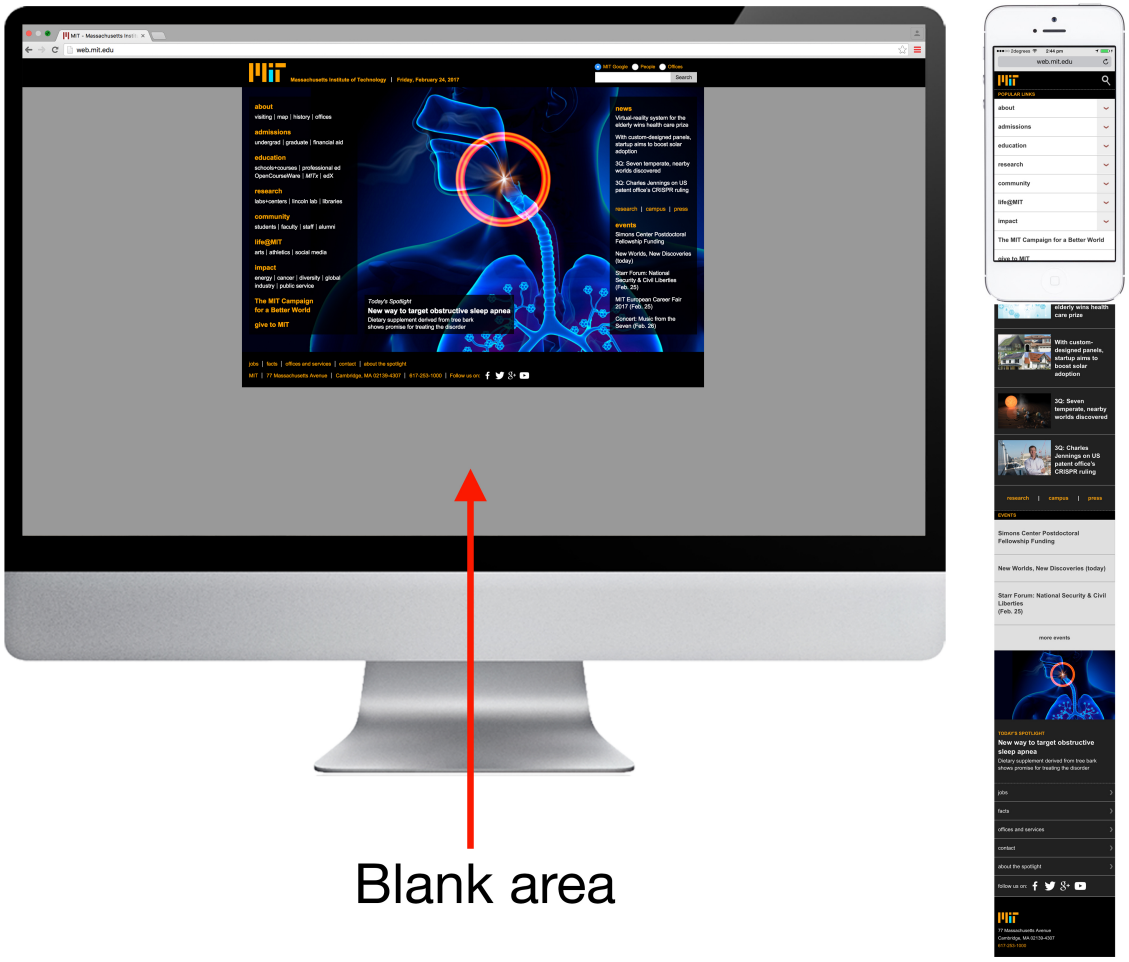


Figure 54. MIT's landing page rendered on a desktop and mobile phone (MIT, 2017e)

Figure 55 presents three snapshots of information pages for different schools under MIT, rendered on mobile phones. The left snapshot is for the School of Humanities, Arts and Social Sciences (SHASS), middle for the Sloan School of Management (SSM) and right presents a partial view of the webpage for the School of Science (SS). Where the SHASS and SSM webpages are drastically scaled down to fit the mobile phone's small screen, the SS webpage's layout is readjusted to suit the phone's screen. Collectively, there are several aesthetic and technical inconsistencies. As noted in the literature review, Google (2013) suggests, radical inconsistencies in visual interfaces of a website may lead to confusion amongst users, and the incoherent user experiences are also counterproductive for a brand's equity.

* See glossary

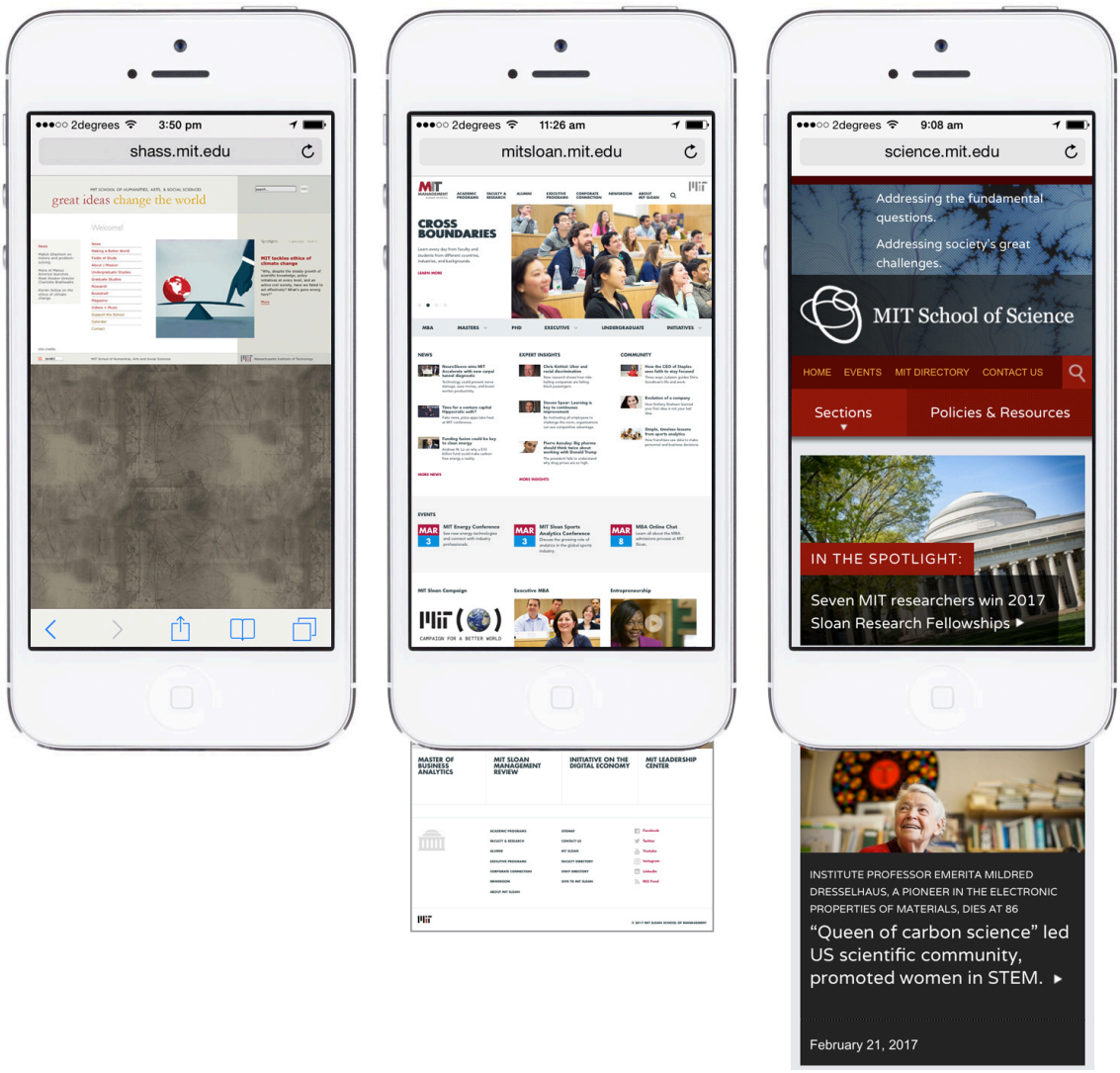


Figure 55. Instances of Inconsistent user experiences on MIT's website (MIT, 2017b, 2017c, 2017f)

ETH Zurich – Swiss Federal Institute of Technology Zurich

The website of ETH Zurich – Swiss Federal Institute of Technology Zurich, was partly mobile friendly and used a dedicated method for the mobile-friendly webpages. The significant flaws in this website were content forking, user experience disparity and erroneous server side detection. The website has two versions including English and Swiss German. On occasions, words from one language were incorrectly placed in the other language version. Figure 56 presents two snapshots showing the desktop and mobile versions of the website's studies page. Both the versions list the type of study programmes. As a result of content forking, the desktop version notably presents more options in comparison to the mobile website. Interestingly, some of the options presented in the mobile version are also not available in the desktop version. Furthermore the mobile

* See glossary

website shown in this snapshot is the English version. However, it presents two study options in Swiss German. This could cause confusion and frustration for viewers. These errors are a typical example of content forking issues, leading from the improper management of separate content versions of a website (McGrane, 2012a).

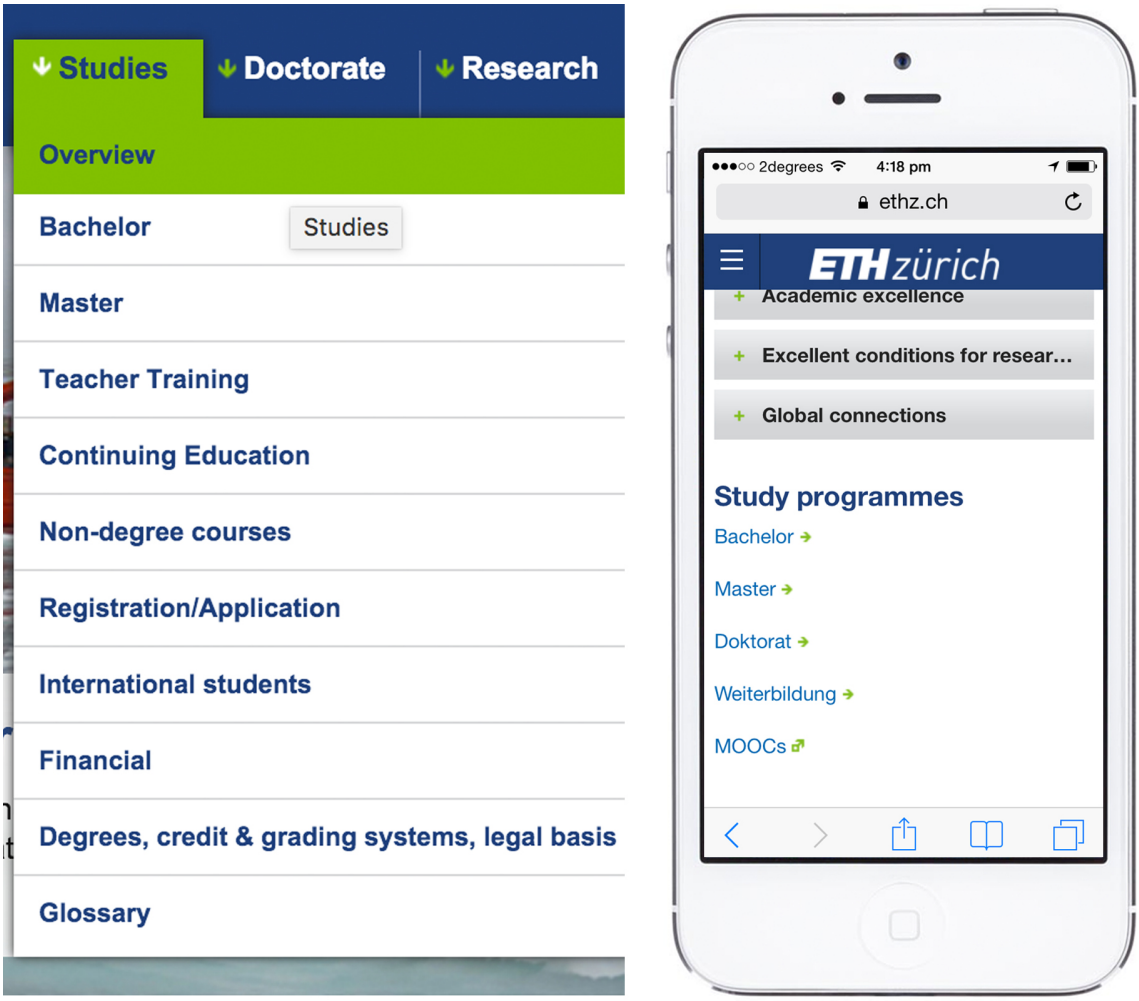


Figure 56. Content forking on ETH's website (ETH Zurich, 2017a, 2017c)

When the Bachelor study option is touched on the mobile phone, it erroneously leads to the Swiss German version of the connecting page but on the desktop the same link leads to the expected English version. The newly opened page is not mobile-friendly and significantly scales down to fit the mobile phone's screen. The page provides a link at the top right corner, with which the language can be switched to English. However, as shown in Figure 57, due to the scaling, the link is barely visible. The incorrect language versions can add to the frustration for the site visitors.

* See glossary

Figure 57. Erroneous server side detection on ETH's website (ETH Zurich, 2017b)

Appendix 02. Secondary schools student survey

Information for participants

Using mobile phones as a sole or primary Internet access device has become common, especially amongst students. This research tries to discover how many people rely on mobile phones for course related information, particularly NCEA Level 3 students aiming to enrol in New Zealand tertiary education. This research also investigates how well New Zealand tertiary academic institutes use mobile-friendly websites to give information to prospective students.

These surveys are confidential. You do not need to put your name on this survey and no personal information that identifies you is required. Upon the analysis of this data, the filled surveys will be destroyed. The participant information will not be disclosed or passed on to any other party.

Section A. Personal details

A1. Name (Optional) _____

A2. Age _____

A3. School _____

A4. Gender (Tick one) ☐ M / ☐ F

A5. Enrolment type (Tick one) ☐ Domestic student / ☐ International student

A6. Ethnic group (Tick one)

- ☐ European
- ☐ Maori
- ☐ Asian
- ☐ Pacific peoples
- ☐ Middle Eastern, Latin American, African
- ☐ Other (List ethnicity)

_____

* See glossary

Section B. Device ownership

B1. Do you own a mobile phone? (Tick one)

- ☐ Yes (Go to question B3)
- ☐ No (Go to question B2)

B2. Does your household have a mobile phone perhaps owned by a family member that you also have access to? (Tick one)

- ☐ Yes (Go to question B4)
- ☐ No (Go to question B5)

B3. Write the name and model of your mobile phone (Example iPhone5, Samsung Galaxy S7).

_____ (Go to question B5)

B4. Write the name and model of the mobile phone in your household (Example iPhone5, Samsung Galaxy S7).

_____ (Go to question B5)

B5. Tick all the digital devices available at your household from the following list:

- ☐ Desktop computer
- ☐ Laptop
- ☐ Tablet (Such as iPad, Galaxy Tab, Xperia, Nexus and Matebook)
- ☐ E-book reader (Such as Kindle, NOOK and Kobo)
- ☐ Game console (Such as PlayStation, Wii and Xbox)
- ☐ Other (list the device)

  _____
- ☐ Not available (If there are no digital devices owned in your household)

* See glossary

Section C. Device usage for Internet access

C1. Tick all the devices from the following list that you use to access Internet (The devices may be personal or belong to your school or another institute such as a local library):

- ☐ Desktop computer
- ☐ Laptop
- ☐ Tablet (Such as iPad, Galaxy Tab, Xperia, Nexus and Matebook)
- ☐ Mobile Phone (Such as iPhone, Samsung Galaxy and Nexus)
- ☐ E-book reader (Such as Kindle, NOOK and Kobo)
- ☐ Game console (Such as PlayStation, Wii and Xbox)
- ☐ Other (list the device)

  _____
- ☐ Not available (If there are no digital devices owned in your household)
- ☐ I do not use Internet (You do not need to further participate in the survey)

C2. Out of all the devices mentioned in question C1 name one device that you use the most to access Internet.

_____

C3. Do you use or have ever used a mobile phone to access the Internet? (This includes activities like social media, emails, watching videos or information finding). (Tick one)

- ☐ Yes (Go to question C4)
- ☐ No (You do not need to further participate in the survey)

C4. Do you have a broadband connection at home? (Example ADSL, VDSL, Optical Fibre or Mobile Broadband such as Vodem). (Tick one)

- ☐ Yes
- ☐ No
- ☐ Don’t know

C5. Which of the following Internet sources do you use the most to access Internet on your mobile phone? (Tick one)

- ☐ Broadband at home
- ☐ Broadband at other places (Such as your school or a local library)
- ☐ Mobile data plan
- ☐ Don’t know

* See glossary

C6. Out of the following options tick all the reasons why you use a mobile phone to access Internet:

- ☐ Convenience over other devices
- ☐ Unavailability of other devices
- ☐ Affordability over other devices
- ☐ Other (List the reason)

_____

Section D. Prevalence of using mobile phones as Internet access devices

D1. Have you ever accessed the websites of tertiary educational institutes in New Zealand for the purpose of finding educational courses for your further education? (This includes Universities, Institutes of Technology and Polytechnics (ITPs), Industry Training Organisations (ITOs), Private Training Establishments (PTEs) and Wānanga). (Tick one)

- ☐ Yes (Only attempt questions D2 to D11)
- ☐ No (Only attempt questions D6 to D13)

D2. Tick all the devices from the following list that you use for the purpose of finding educational courses on the websites of tertiary educational institutes in New Zealand.

- ☐ Desktop computer
- ☐ Laptop
- ☐ Tablet (Such as iPad, Galaxy Tab, Xperia, Nexus and Matebook)
- ☐ Mobile Phone (Such as iPhone, Samsung Galaxy and Nexus)
- ☐ E-book reader (Such as Kindle, NOOK and Kobo)
- ☐ Game console (Such as PlayStation, Wii and Xbox)
- ☐ Other (list the device)

_____

D3. Out of all the devices mentioned in question D2 name one device that you use the most for finding educational courses on the websites of tertiary educational institutes in New Zealand?

_____

* See glossary

D4. How often would you say you search for course related information on a tertiary educational institute's website using all the devices you ticked in question D2? (Tick one)

- ☐ Very Frequently
- ☐ Frequently
- ☐ Occasionally
- ☐ Rarely
- ☐ Very Rarely
- ☐ Never

D5. How often would you say you search for course related information on a tertiary educational institute's website using a mobile phone? (Tick one)

- ☐ Very Frequently
- ☐ Frequently
- ☐ Occasionally
- ☐ Rarely
- ☐ Very Rarely
- ☐ Never

D6. Considering mobile phones have become a very common device for Internet access, how important do you think it is for tertiary educational institutes to offer websites, which are suitable for viewing on mobile phones?

- ☐ Very Important
- ☐ Important
- ☐ Moderately Important
- ☐ Slightly Important
- ☐ Not Important

D7. How important is it for you to able to access a tertiary educational institute's website via a mobile phone?

- ☐ Very Important
- ☐ Important
- ☐ Moderately Important
- ☐ Slightly Important
- ☐ Not Important

* See glossary

D8. To provide a website suitable for viewing on mobile phones sometimes it is required to offer less information in comparison to a website suitable for viewing on a desktop computer. This is mainly done to enhance the speed of the website on mobile phones. Which of the following is important to you for accessing an academic institute's website on a mobile phone? (Tick one)

- ☐ Speed of access
- ☐ Full access to information

D9. If you were trying to find course related information on an academic institute's website using a mobile phone and encountered a slow speed. Which of the following actions will you most likely take? (Tick one)

- ☐ Switch over to another institute's website
- ☐ Try using it again on your mobile at a later stage to see if it works
- ☐ Switch over to another device to access the website

  (List the device) _____

* See glossary

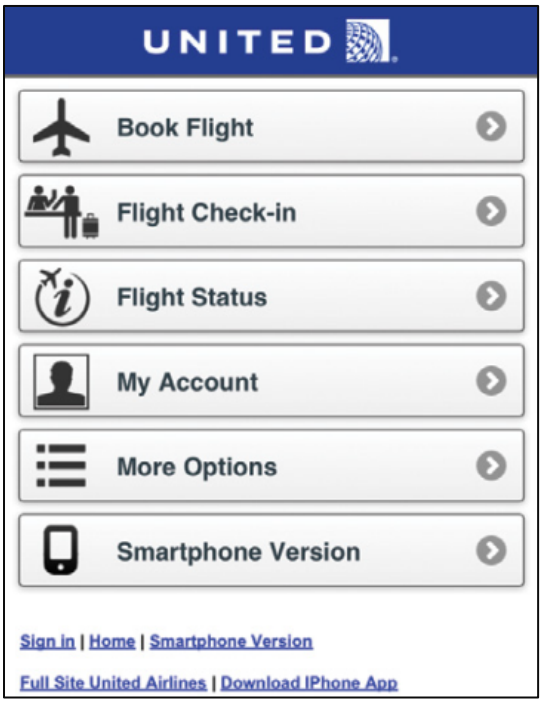
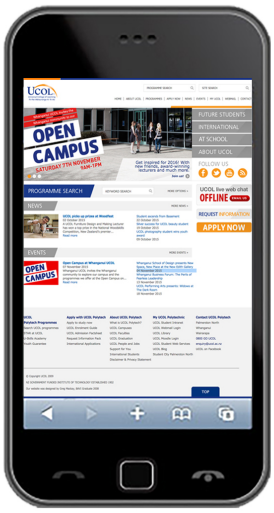


Figure 01. This is an example of United Airlines' website designed for mobile phone use. If you needed more information (for example, membership details) you would need to click on the link at the bottom left. This would then open the full website which is originally designed for use on a computer and will require pinching and zooming on the mobile phone's screen to access information.

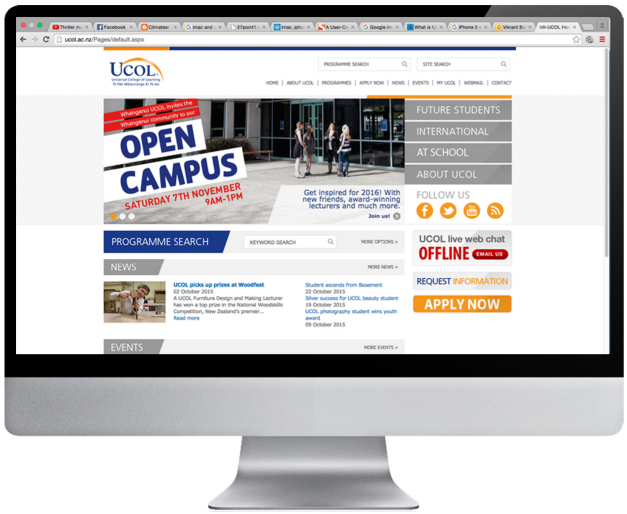
D10. If you were accessing an academic institute's website on a mobile phone to find out a suitable educational course for further study and were only able to find limited information and the mobile version of website points you to visit the desktop version of the website for full information. Which of the following actions will you most likely take? (Tick one)

☐ Will abandon the website

☐ Try using the desktop version on your mobile as shown in the following image:



☐ Switch over to a desktop computer to access the website as shown in the following image:



D11. How much do you agree with the following statement - The smooth running of an academic institute's website on a mobile phone affects my perception about the professionalism of an institute.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neither agree nor disagree
- ☐ Disagree
- ☐ Strongly disagree

D12. Tick all the devices you would use in case you wanted to find educational courses on the websites of tertiary educational institutes in New Zealand.

- ☐ Desktop computer
- ☐ Laptop
- ☐ Tablet (Such as iPad, Galaxy Tab, Xperia, Nexus and Matebook)
- ☐ Mobile Phone (Such as iPhone, Samsung Galaxy and Nexus)
- ☐ E-book reader (Such as Kindle, NOOK and Kobo)
- ☐ Game console (Such as PlayStation, Wii and Xbox)
- ☐ Other (list the device)

_____

D13. Of these, name one device you would use most for finding educational courses on the websites of tertiary educational institutes in New Zealand?

_____

* See glossary

Appendix 03. Student survey explanation

Section A focussed on establishing the demographic distinctions of the participants. This has been done only to determine the general constitution of the participants. The scope of this survey is aimed at collective findings rather than segregated results for individual social groups, such as gender or ethnicity. It is acknowledged that further investigations in succeeding sections for individual social groups may have presented distinctions in the findings.

Section B aimed to discover the participants' diversity of device ownership with a specific focus on mobile phones. The section aimed to examine if the participants owned a mobile phone individually, and in case they did not, did they have access to a mobile phone in their household. This information was required, to discover in Section C, if the participants prefer to use mobile phones for Internet usage irrespective of the ownership. Mobile phone brands and models were queried to ascertain the diversity of screen sizes and operating systems, which is an important consideration for an organisation when creating a mobile-friendly website (Marcotte, 2011; McGrane, 2012a; Wroblewski, 2011a). Lastly household ownership of other digital devices apart from mobile phones was also examined.

Section C aimed to discover the participant usage of devices for day-to-day online activities, and also the Internet sources available to them. The device-specific investigation intended to ascertain contrasts in device preference for general Internet usage versus course related information seeking, which was examined in Section D. These devices could have been personal or belonged to other sources such as the participant's school or a local library. At the time of preparing this survey, it was assumed, some of the participants might not own any digital devices due to financial or other unknown reasons. If this were true, can these participants rely on other sources for Internet access? Devices, both generally used and most used, for Internet access, were also queried. The aim was to discover, if the participants demonstrated a *mobile only* trend, or, were there any other trends present.

Queries related to Internet sources aimed to discover, what percentage of participants had access to broadband connections in their households. Alternatively, did participants

rely on other Internet sources, including Internet access at other places, or mobile data plans. Mobile data plans are usually limited in Internet data and expensive in comparison to broadband connections (Spark, 2016). The combined aim was to discover if the prospective students are limited in their means of Internet access via mobile phones, which is another important consideration for tertiary academic institutes when building mobile-friendly websites (Hill, 2010). As noted in the introduction chapter, financial limitation is one of the most prominent reasons why individuals hailing from developing nations and lower socio-economic groups, and students, tend to become *mobile only* users for Internet access (Bhavnani et al., 2008; Hill, 2010; A. Smith, 2012). However, for some, the *mobile only* access stems mainly from convenience and constant companionship, rather than affordability (McGrane, 2012a).

Lastly, this section asked the participants, their unique reasons for using mobile phones for Internet access. In order to generate cumulative statistics, Section C had a couple of exit points for participants who either did not use the Internet at all, or did not use mobile phones to access the Internet.

Section D aimed to examine various aspects of participants' access to tertiary academic institute websites. This section was structured to offer the participants two different pathways within the section, starting from Question D1. The participants who had previously accessed the websites of tertiary academic institutes for the purpose of finding educational courses, had to attempt questions D2 to D11, under pathway one. These questions were structured with four themes. These included: device preferences; information seeking patterns; importance of mobile-friendly websites; and how certain performance aspects of these websites on mobile phones affected the student's decision-making and opinion about an institute.

The participants who undertook pathway two had to attempt questions D6 to D13. Apart from the overlaps with the above-mentioned themes between questions D6 to D11, question D12 and D13 were structured to discover the device preferences in the hypothetical scenario of accessing academic institute websites for course related information seeking.

* See glossary

Appendix 04. Interview questionnaire for UCOL

Information for participants

The title of my research is "The state of mobile-friendly websites in the New Zealand Tertiary academic sector". Collectively it explores three queries to produce a body of knowledge that informs future practical implementations and research focussed on the creation of mobile-friendly websites within the New Zealand tertiary academic sector. This research tries to discover how many people rely on mobile phones for course related information, particularly NCEA Level 3 students aiming to enrol in New Zealand tertiary education. This research also investigates to what extent New Zealand tertiary academic institutes use mobile-friendly websites to give information to prospective students.

UCOL has been chosen as a specific case study to review the creation process of its new mobile-friendly website. The researcher intends to discover how UCOL approached the content creation for the new website and the justifications behind choosing the strategic solutions. This case study can also further educate on the associated factors of this process such as any potential obstructions, interdepartmental factors or monetary constraints that surround the creation of a project of this nature. It will also help to gain an insight on the extent to which UCOL thinks the new mobile-friendly site has been implemented, what part of the process could have been improved and what new learning has been generated from an organisational point of view which can inform future research in this area.

Section A. Personal details

A1. Name _____

A2. Position _____

A3. Institute _____

Section B. Project rationale

B1. How important do you consider is it for UCOL to offer a strong online presence for connecting with prospective students? (Tick one)

- ☐ Very Important
- ☐ Important
- ☐ Moderately Important
- ☐ Slightly Important
- ☐ Not Important

* See glossary

B2. Please suggest your main reasons for your response in question B2.

Answer.

_____

B3. Please explain the contributing factors leading to UCOL's decision to implement a mobile-friendly website. (Examples include but are not limited to targeting prospective students and strategic advantage)

Answer.

_____

B4. UCOL's new mobile-friendly website was implemented in 2016. It had not been updated since 2007. Suggest the main reasons for this gap.

Answer.

_____

B5. Please explain the types of hindrances and issues a tertiary academic institute may face in the creation of a project of this nature? (Examples include but are not limited to lack of funding, organisational issues, lack of awareness, timeframes etc.)

Answer.

_____

Section C. Web development system

C1. Which web development system out of the following did UCOL utilise for the creation of their mobile-friendly website?

- ☐ Responsive Web Design
- ☐ Dedicated mobile website
- ☐ Adaptive Web Design
- ☐ Don't know

C2. Apart from the web development system ticked in C1, did UCOL consider any of the other technologies listed in C1?

- ☐ Yes
- ☐ No
- ☐ Don't know

* See glossary

C3. List various factors that led to the selection of the web development system that UCOL has implemented for its mobile-friendly website. (Examples include but are not limited to financial reasons, strategic advantages, technical comparisons with other web development systems listed in C1).

Answer.

_____

Section D. Content strategy

D1. UCOL's website has been recreated and hosts an enormous amount of content. Describe what resources (examples include but are not limited to human and financial) and processes (examples include but are not limited to coordination with parties such as various internal departments and the web development company) were put in place for the content creation of the website?

Answer.

_____

D2. Describe any issues, which may have hindered this process (Examples include but are not limited to difficulties in coordination with different departments).

Answer.

_____

D3. UCOL is a large organization with many departments such as management, marketing, communications, finance and academic. Usually every department has their own vision when it comes to creation and selection of content for an organization's website. How was the decision making around the quantity, quality and relevance of content carried out?

Answer.

_____

D4. Does UCOL update content (Such as student achievements, new courses or important announcements) on its website on a regular basis?

- ☐ Yes (Go to question D5)
- ☐ No (Go to question D7)

D5. Are there any dedicated staff at UCOL for the regular maintenance (updating and archival) of web content on UCOL's website?

- ☐ Yes (Go to question D7)
- ☐ No (Go to question D6)

* See glossary

D6. How does UCOL maintain (update and archive) content on its website?

Answer.

_____

D7. Does UCOL's website have a separate version of web content for its mobile phone users in comparison to its users for other devices such as desktop or tablets?

- ☐ Yes (Go to question D8)
- ☐ No (Go to question D9)
- ☐ Don't know (question D9)

D8. What measures are put in place by UCOL to ensure a consistent delivery of content to different digital devices every time the content is updated?

Answer.

_____

D9. What Content Management System (CMS) does UCOL use for its website?

Answer.

_____

Section E. Further improvements

E1. In your opinion how well does the chosen web development system work for the mobile-friendly website and would you rather consider a different technique if hypothetically UCOL were to recreate its website in the near future?

Answer.

_____

E2. In your opinion how well does the new mobile-friendly website serve its various intended purposes and what improvements if any could have been made to the website?

Answer.

_____

* See glossary

E3. In your opinion what improvements if any could have been made to the processes around the creation, development and implementation of this project?

Answer.

_____

E4. Are there any additional suggestions around the new learning generated from the creation of this project from an organizational point of view, which can inform future research in the creation of mobile-friendly websites for tertiary academic institutes?

Answer.

_____

* See glossary

Appendix 05. Interview questionnaire for Enlighten Designs

Information for participants

The title of my research is "The state of mobile-friendly websites in the New Zealand Tertiary academic sector". This research aims to investigate the current state of mobile-friendly websites in the New Zealand tertiary academic sector, namely Universities and Institutes of Technology and Polytechnics (ITPs).

In order to do so, this research has been broadly divided into three parts. The first compares and contrasts the suitability of three contemporary technological methods available for the creation of mobile-friendly websites in a tertiary academic setting. The second explored the exclusive target audience needs for course related information seeking and decision-making. The third explored the current state of mobile-friendly offerings by New Zealand tertiary academic institutes and ascertained the need for future improvements.

Ultimately the significance of this research is to produce a body of knowledge that informs future practical implementations and research focussed on the creation of mobile-friendly websites within the New Zealand tertiary academic sector.

Forming the third part of this research an interview was conducted with UCOL as a case study. This was done to understand the rationale behind the project and the selected method, associated processes, experienced shortcomings and recommendations on future improvements. To further extend the case study, you have been invited to participate in an interview due to your company's impressive portfolio, which includes some reputable names in New Zealand education. Also your company has built UCOL's new website. Apart from the aforementioned aims, this interview aims to seek your company's expertise in general on issues with the creation of mobile-friendly websites in a tertiary academic setting and improvements required.

Section A. Overview of UCOL's project

A1. Have you ever done work for UCOL before?

A2. Between you and UCOL, who was responsible for choosing RWD for creating UCOL's website?

A3. How important was it to make the website mobile-friendly or was delivery over multiple platforms the the key motivating factor?

A4. Do your clients in general and particularly from the educational sector understand the differences and decide between the three methods of creating mobile-friendly websites (dedicated / responsive / adaptive) or do they mainly rely on your advice?

A5. What were the various contributing factors that led to the selection of RWD? (Examples include but are not limited to available resources, timelines, target audience needs and technical advantages).

A6. Were adaptive or dedicated methods considered and what were the primary reasons for not choosing these methods?

A7. In an ideal case scenario where resources and timelines aren't an issue which method of creating mobile-friendly websites would you suggest to academic institutes?

A8. There is a non-responsive table that sits under the scholarships page of UCOL's website and requires sliding of the table to view it on a mobile phone. Was there any discussion or consideration of adaptive content such as an alternative representation of data?

A9. If your answer was yes in question A5 please explain why adaptive content was not used and if your answer was no then list the reasons on why adaptive content was not considered?

A10. In your opinion how well does the website work both in general and as a mobile-friendly website? Also, what improvements if any could have been made to the website?

A11. What kind of hindrances and issues a tertiary academic institute may face in the creation of a project of this nature? (Examples include but are not limited to lack of funding, organisational issues, lack of awareness and timeframes)

A12. Were the challenges in this project similar to the standard issues mentioned in the previous question or were there any unique issues?

* See glossary

Section B. Mobile-friendly websites in the NZ tertiary sector

B1. How important are mobile-friendly websites as a marketing medium in New Zealand in general and tertiary academic sector OR should the institutes focus more on multi platform delivery of content for prospective students?

B2. In your opinion how well do you think NZ tertiary academic institutes have implemented mobile-friendly websites to aid information seeking for prospective students and what future improvements if any, can you suggest?

B3. In your opinion how well do you think NZ tertiary institute websites work in a multi platform environment to aid information seeking for prospective students and what future improvements if any, can you suggest?

B4. One of the key criticisms of RWD is slower site performance on mobile phones due to heavier file sizes while other web developers contend that with effective coding practices responsive sites can be made as fast as or faster than dedicated mobile websites and adaptive websites. What is your opinion on this?

B5. Some web developers suggest that a hybrid of responsive layouts and adaptive content (using alternative representations of same content) can offer a device-optimised solution for a range of devices. What is your opinion on this and how well accepted is this solution in New Zealand tertiary institutes?

B6. Should NZ institutes offer adaptive content to its prospective students via alternative representations of the same content OR tailored versions of the same site targeted for different types of prospective students such as domestic and International students?

B7. In a global comparison, how effectively have the mobile-friendly websites been implemented by NZ tertiaty insitutes as a marketing medium and are there any areas of improvements to match the leading international standards?

B8. Are there any future research areas that you can suggest related to NZ tertiary institute websites in terms of aiding information seeking and deicion making for prospective students? (This may relate specifically to mobile-friendliness or multi platform delivery of content)

* See glossary

Appendix 06. Interview questionnaire for institutes who had not implemented mobile-friendly websites

Information for participants

The title of my research is "The state of mobile-friendly websites in the New Zealand Tertiary academic sector". Collectively it explores three queries to produce a body of knowledge that informs future practical implementations and research focussed on the creation of mobile-friendly websites within the New Zealand tertiary academic sector. This research tries to discover how many people rely on mobile phones for course related information, particularly NCEA Level 3 students aiming to enrol in New Zealand tertiary education. This research also investigates to what extent New Zealand tertiary academic institutes use mobile-friendly websites to give information to prospective students.

Your institute have been chosen to participate in this questionnaire because it is amongst other institute who currently do not have a mobile-friendly website. The information obtained from this questionnaire will help gain a general understanding of the rationale behind it including any hindrances an institute faces for investing into projects of such nature. Upon the analysis of the responses, the filled questionnaire will be destroyed. The participant information will not be disclosed or passed on to any other party.

Section A. Personal details

A1. Name _____

A2. Position _____

A3. Institute _____

Section B. Online presence

B1. Describe in your own words, why your institute does not offer a mobile-friendly website at the moment? Comprehensively explain all the contributing factors (Examples include but are not limited to lack of funding, awareness, demand etc.)

Answer.

_____

* See glossary

B2. How important do you consider it is that your institute offer a strong online presence for connecting with prospective students? (Tick one)

- ☐ Very Important
- ☐ Important
- ☐ Moderately Important
- ☐ Slightly Important
- ☐ Not Important

B3. Please suggest your main reasons for your response in question B2.

Answer.

_____

B4. How important do you consider it is that your institute offer a mobile-friendly website to prospective students? (Tick one)

- ☐ Very Important
- ☐ Important
- ☐ Moderately Important
- ☐ Slightly Important
- ☐ Not Important

B5. Please suggest your main reasons for your response in question B4.

Answer.

_____

B6. Does your institute intend to offer a mobile-friendly website in the future? (Tick one)

- ☐ Yes (Go to question B7)
- ☐ No (Go to question B9)
- ☐ Don't know (Go to question B7)

B7. If your institute were to implement a mobile-friendly website, which of the following development systems will your institute consider or utilise. (Tick all the valid options)

- ☐ Responsive Web Design
- ☐ Dedicated mobile website
- ☐ Adaptive Web Design
- ☐ Don't know

* See glossary

B8. Please suggest your main reasons for your response in question B7.

Answer.

_____

B9. What was the number of student enrolments at your institute last year?

Answer.

_____