



**RELATIONSHIP BETWEEN WEBSITE USABILITY AND WEB METRICS IN AN
EDUCATIONAL WEBSITE**

by

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ABSTRACT

Education technology plays an important role in learning processes at all levels of education. Higher Education Institutions (HEIs) use Learner Management Systems (LMSs), mobile applications, and tutoring systems for purposes of learning. The contribution of Information and Communication Technologies (ICTs) is important in education, as these engage and allow learners to work at their own pace, using their own learning styles. However, there are certain dimensions that need to be explored and can be considered to be crucial to provide a positive learning experience; one of them is the usability of all LMSs and the way in which learners perceive them.

The initial purpose of implementing website usability in computer websites was to ensure that these websites are easy to use and that they enable users to access information without any difficulties. All websites should be designed to empower customers to complete all online transactions or other actions satisfactorily, effectively, and efficiently.

It is also important for proper web metrics to be applied to a website as it is almost impossible to measure the effects on visitors without it, while it is equally important to know which tool would be appropriate for the unique user's needs.

The purpose of this study was to determine whether there is any correlation between the usability of a website and web metrics to assist to predict the success of an educational website. Google Analytics (GA) and statistical calculations were used to measure the records of a website's relevant metrics. The study's results proved that web metrics can be used to predict the success of an educational website. The web metrics statistics showed that when there is a change in a website's usability, then it is indicated on the website's metrics. This means that web metrics can be used to predict how users will respond to certain changes in a website's level of usability.

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- Dr Gie, my HOD, for her support and encouragement.

DEDICATION

I dedicate this research to my late parents, my brothers and sisters, and my son, Sange, with whom God has blessed me.

GLOSSARY and ABBREVIATIONS

Terms/Acronyms/Abbreviations	Definition/Explanation
BCA	Business Computer Applications, the name of a subject for first-year students at the Cape Peninsula University of Technology (CPUT), where they learn Microsoft Office modules.
GA	Google Analytics (a free reporting tool from Google used by websites to track user interaction as well as web traffic across website domains).
e-Learning	Electronic learning (the use of technology or digital resources to facilitate learning).
ICT	Information and Communication Technology (the infrastructure used in computing for communication, networking, and broadcasting of information).
LMS	Learner Management System (this is software or an online system, which is used in the e-Learning environment to teach, administer, share, record and assess learning processes, for example, Moodle, Blackboard, Canvas).
Orbisius	Simple notice (the notice on top), which can be placed on the home page or on all the website's pages for attention.
Plugins (WordPress)	Pieces of software mostly used on websites to extend its functionality or to add new features.
TAM	Technology Acceptance Model (this is the theory of the ease of use of technology, which users accept).
Usability	The quality attribute used to measure the degree of ease with which to use the interface of a computer system to achieve a goal.
Website usability	The ease of using a website.
Web metrics	Indicators used to measure how users interact with a website. Also called web analytics.

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CHAPTER ONE: BACKGROUND

1.1 INTRODUCTION

Higher education institutions have been pursuing adopting technology through digital transformation techniques since the beginning of the technological revolution (Syed *et al.*, 2021). The author argues that there are several ICT challenges facing digital transformation, from traditional to e-Learning in terms of operational risks. Some of the challenges that the author cites include a lack of faculty experience in e-Learning, resistance to change, as well as the quality of the LMS used. Francom *et al.* (2021) assert that LMSs have been extensively adopted by the higher education sector to support blended and online learning.

DeLone and Mclean (2004) argue that many companies are making huge investments running their businesses online but are still facing challenges to evaluate their online success. Arthur-Nyako *et al.* (2019) define e-Learning as a process of creating interactive learning by using computers and the internet. Arthur-Nyako *et al.* (2019) further acknowledge that the introduction of ICTs for distance learning has contributed to making the content available anytime and anywhere. It is, therefore, vital to determine the behaviour of learners when accessing resources such as digital tools and the internet.

Further, Arthur-Nyako *et al.* (2019) contend that improving student education by using online technologies can be determined by several factors consisting of learners' access to the required resources. Gillingham *et al.* (2012) opine that the enhancement of student learning may depend on what learners prefer, as well as their experiences. Many factors determine whether student learning will be enhanced – some of these concern learners' access to resources, while the same authors are of the opinion that learners' preferences and experiences also play a role to enhance student learning.

Bekavac *et al.* (2015) claim that the rapid awareness of the world about the internet has been noticed and the high rate of internet involvement and growth, with more users online, has been considered. This resulted in organisations and businesses realizing the need to be more available in the web domain to attract more customers.

The said authors posit that this is because of the direct impact of web space availability on a user's beliefs of the strategic importance of modern businesses and their success.

Bekavac *et al.* (2015) continue to state that it is important for businesses to apply relevant metrics to their website's business models. This is because it is difficult to measure the impact on the visitors, while it is also important to be aware of which tools are specific for the needs of the users.

Bekavac *et al.* (2015) identify five common goals for web business models, as listed below.

- 1.1.1 Products and services are sold online - how to measure outcomes based on how many are sold.
- 1.1.2 Establishment of a potential database for customers and the measurement of results based on the number of visitors' contacts collected through the websites.
- 1.1.3 Publication of content, which is aimed at attracting as many users as possible, which then translates to a revenue income from advertising.
- 1.1.4 Making the information available for all visitors on the website.
- 1.1.5 Branding of the company.

The primary objective of website usability has always been to keep websites usable without difficulties, whilst permitting users easy access to information without problems. International research reveals that usability is an important component for all websites in the education sector (Nielsen 2000).

If the websites developed for these organisations are difficult for users to work on, then it would become easy for them to lose interest, resulting in the loss of potential clients. This is because users prefer to work on websites that are efficient, secured and not difficult to use for smooth progress. In the educational environment, a website is critical for success, thus the usability of websites remains a key factor in respect of the website's quality.

Nielsen (2011) defines five components of usability, which are presented below.

- 1.1.6 The ease of completing a basic mission for the first time using the website (**Learnability**).
- 1.1.7 The fastest time in which a user completes a task after learning the design of the site (**Efficiency**).

- 1.1.8 The experience gained by the user to work more professionally when they use the website again after being away from it for a long period; the degree of remembrance of using the site (**Memorability**).
- 1.1.9 The faults that users make during interaction with the website and their recovery rate and speed as a result of those faults (**Errors**).
- 1.1.10 The level of pleasantness or satisfaction of the users during their interaction with the website (**Satisfaction**).

Although website usability is not easy to measure, it has been established that it is a solid indicator of its success. Web metrics can be defined as being indicators of the way in which users interact with a website. These are presented in graphical format, using figures and graphs (see Figure1), indicating an extensive range of activities, as illustrated below.

- 1.1.11 The number of visitors over a period of time.
- 1.1.12 How much time the users have spent on a webpage.
- 1.1.13 What is the source of the traffic to the webpage?
- 1.1.14 Which pages have been visited by the users on the website?

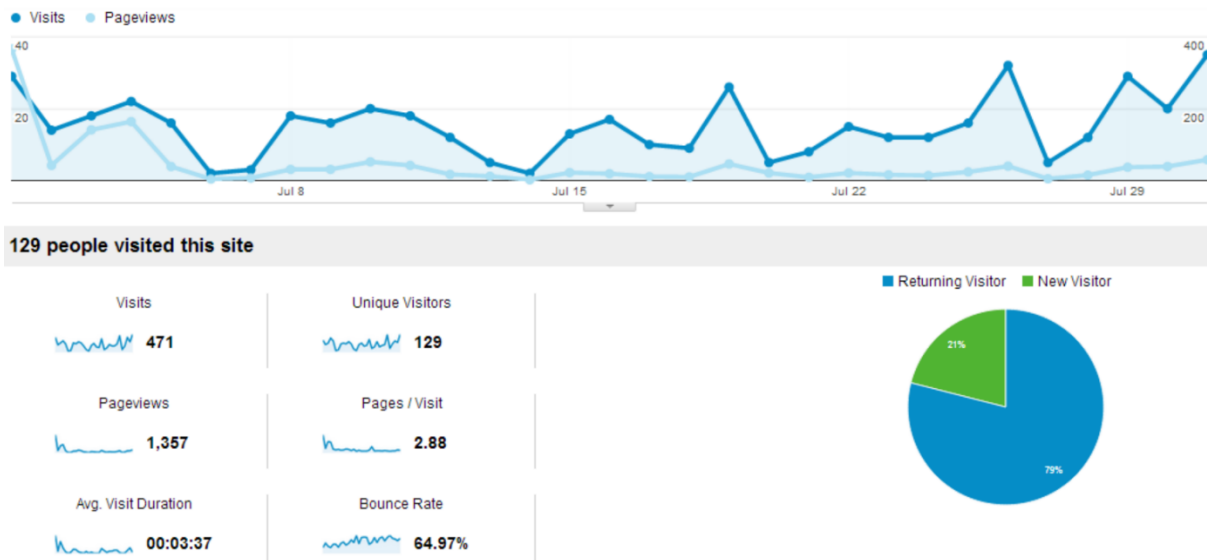


Figure 1: Typical display of analytics produced from a website

These are the analytic measures, which are typically easy to measure, using numbers (quantities), which produce a clear representation of the website's activities. A clear picture can be formed when comparing similar websites' analytics - the relative success and popularity of each website can also be deduced.

Usability is difficult to measure (user testing sessions are required, producing mostly qualitative data), while web metrics are relatively easy to measure because they are quantitative. **Therefore, this research study sought to determine if there is a correlation between web metrics, which are easy to measure and usability, which is difficult to measure, to use the one to predict the other.**

It is unknown if existing website measures can be used to predict the success of an educational website and if a relationship between such measures exists.

1.2 Statement of research problem

Universities around the world perceive the creation, development, management, and use of websites seriously as these websites showcase them to the world (Tella, 2020). Apart from the fact that university websites provide information about the institutions, they also provide services such as electronic databases, online learning, instructional materials, and tutorials.

As the vast growth of internet resources and new searching and sharing tools such as Facebook, Google, WhatsApp, LinkedIn, YouTube, and others provide more fun, power, and ease of information seeking, academic websites are seeing tough competition although they provide better scholarly information (Schmutz *et al.*, 2018). According to Sitbon (2020), university websites should meet users' preferences for and expectations of access to information and information seeking by being appropriately designed and developed.

While there has been much enhancement in respect of user preferences for website usage content, few studies have been conducted on users' preferences for university websites. There are various factors that could determine preferences for website use, which range from the design, interface, interactivity, and usability to aesthetics (Tella, 2020). Therefore, the current research problem is as follows: **User testing can provide valuable insights to predict the success of an educational website. It can be expensive, time consuming and difficult as user expectations are involved-therefore it would be better to use a facet of usability to make this prediction, where this facet is easy to measure.**

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

Chapter One discussed a background of the research study, focusing on the importance of the internet and the use of websites in the educational world. The introductory chapter also presented the use of technology in higher education institutions and the importance of e-Learning, as well as website usability and relevant web metrics in the IT industry. Chapter Two focuses on the theoretical concepts which underpin the research topic, including e-Learning, educational technology, website usability, web metrics and Google Analytics (GA).

2.2. e-LEARNING

e-Learning is defined as an education system that relies on the use of ICTs, which do not need the physical component of education (Al-Malah *et al.*, 2020). According to these authors, e-Learning makes communication easier between the lecturer and the students and provides opportunities for distance learning. García-Peñalvo (2021) states that transformation to a digital world is a much-needed must-have for society. Grajek *et al.* (2019) define digital transformation as a group of well-co-ordinated changes, which can empower new models for education. It can also change the operations of an institution through its strategic directions and certainly its value propositions. The said authors further claim that universities, similarly to other fields, need to embrace the important transformation of the digital institutional model. Naidu *et al.* (2019) agree that with the rapid increase of ICT, educational institutions are re-aligning their curricula and structures to bridge the technological gap that exists.

2.3. Educational technology

Education technology plays an important role in the process of learning at all levels of education currently (Vlachogianni *et al.*, 2021). Higher Education Institutions often use LMSs, mobile applications, and tutoring systems for the purposes of learning. Vlachogiani *et al.* (2021) attest that many researchers agree that the contribution of ICTs is significant in education as most of them are quite engaging and allow learners to work at their own pace, whilst using their own learning styles. However, they all agree that there are certain dimensions that need to be considered and explored to enhance the learning experience, and one of them is usability of these systems of technology and the way in which learners and other stakeholders perceive them.

According to Gregory *et al.* (2021), Davis has developed a model called the Technology Acceptance Model (TAM), which was aimed at determining whether technology education was likely to be adopted by users or not. Early implementations of TAM comprised of two constructs, namely perceived ease of use and perceived usefulness, which was expanded over the years to include the attitude of users towards use and user's behavioural intention to use the technology. According to Gregory *et al.* (2021) Davis describe perceived usefulness as the technology tool that will enhance the task performance or job, whilst the authors mention that perceived ease of use is the belief of a user that the technology tool will require less effort.

Alanazi *et al.* (2020) postulate that ease of use and the relationship between technology satisfaction and users have much weaker relationships with learner performance, leading them to the understanding that information system companies and online education organisations should consider stressing usability when designing LMSs if the goal is to improve performance and satisfaction.

2.4. Website usability

Website usability can be accomplished by ensuring that the user or visitor experiences the website positively. This is achieved by designing the website in a way that will allow users to find valuable information with ease. Usable websites allow users to find what they want when navigating the website in an effective and efficient manner (Nielsen, 2000). Barnard *et al.* (2003) aver that trust, security and credibility are on the forefront of user concerns that should be addressed to ensure website usability.

Barnard *et al.* (2003) further state that certain pages should be included in every website. These include an About Us web page, as well as Contact Information, Company Overview, Feedback and Testimonials pages. Eisenberg *et al.* (2008) contend that website usability is one method of completely removing impediments, which may hinder the user's positive experiences. The Website Standards Organization (WSO) states that it can take as little as 10 seconds for a visitor before he/she decides if they want to continue navigating the website or not (Schevchenko, 2020). There is a high probability that if a visitor leaves the website because of a bad first experience that they encounter during their interaction with the website, then they may never return.

Nielsen (2000) suggests that if a web page presents a large amount of text to the user, it is an obstacle in the way of achieving high website usability. This is a result of the fact that

users seldom read an entire document. Instead, they look for keywords, headings and any other important information that attracts their attention. Nielsen (2000) opines that visitors expect to see all the important text first without scrolling too much. However, Nielsen (2000) also suggests that the text on the homepage should be minimized, which is not a simple matter, as (normally) the first few hundred words on any webpage should answer the following user questions:

2.4.1 What is the main topic of the web page?

2.4.2 What is the product, information, or service, which is discussed on this page?

2.4.3 Does the website address my information needs?

2.4.4 Are there any other web pages, which are better able to satisfy my information needs?

According to Muhammad *et al.* (2021), there is a growing trend in the Higher Education sector to offer information to students and academic users through websites. The said authors further confirm that most higher education institutions have made it their goal to ensure that their website displays high qualitative standards and is able to perform their academic operations well, whilst achieving success through effectiveness, efficiency and user-friendliness, all worthy of an academic website. Muhammad *et al.* (2021), therefore, assert that it is important to understand one's target users so that their needs and expectations are met (for any successful website).

The diversity of users hinders the efficient and effective use of academic websites because many of them have not been designed for the needs of those who use them; consequently, many users fail to accomplish their tasks, become frustrated and seek outside assistance (Muhammad, *et al.*, 2021).

2.5. Web metrics

Web metrics are defined as measurements, which are used as indicators of how visitors use a website. These are the numbers used to track the website's performance statistically. Web metrics are simply ways that one can use to show how users behave while visiting websites (Weischedel *et al.*, 2006). Many organisations use web metrics to improve their websites as these provide statistical indications of how the visitors are using their sites. Weischedel *et al.* (2006) further state that the use of web metrics is not an explored area even though companies are busy with website optimisation.

Khoo *et al.* (2008) indicate that web metrics were first developed as a method of tracking customers and purchases to understand the success of commercial websites. The said authors also confirm that web metrics are the result of collecting and analysing the website's traffic. Web metrics can be used to measure the achievement of users' goals by calculating if they have achieved their goal on a website. They can also be used to design websites by supporting usability studies, as these can provide feedback for developers, website managers and other stakeholders regarding how the website is used.

Certain websites are updated daily to meet customer expectations and to attend to the organisation's goals. Weischedel *et al.* (2006) observed changes and updates on websites, caused by environmental changes, whilst trying to understand how visitors interact with the website. Organisations should use web metrics on their websites to understand customer interaction with the websites.

According to Weischedel *et al.* (2006), the field of web metrics is becoming a booming business as its potential to unlock and inform operations of the business has been realised. Web metrics represent a large area of research that has yet to be explored. Web metrics are mainly used to provide more information which will allow companies to improve the quality and usability of their websites. However, many academics and researchers seem to concentrate more on customer surveys, which provide limited understanding into the use of web metrics (Weischedel *et al.*, 2006).

According to Khoo *et al.* (2008), the number of visitors, time spent on a website, date when it was visited, referrals concerning whether they used search engines or links to access the website, location of the IP addresses of the visitors, how much time they spent on individual pages and the number of page views on a website, are some of the most reported web metrics. There is no standard definition for some of the web metrics, allowing these to change over time. Single page visits, for example, have been included and excluded by GA as these were regarded as mistakes, which skewed the average session length data owing to short visits.

Available web metric tools may be used for analysis reporting and can focus on critical and specific questions to analyse the website. Khoo *et al.* (2008) advises that there must be careful reflection when comparing metrics between websites, as there is no standardisation in web metric tools. Awichanirost *et al.* (2020) postulate that websites have become an integral part of business performance monitoring, with an increase of internet and web metrics.

Jansen *et al.* (2022) aver that organisations are using web metrics to monitor web traffic to stay ahead of the others by identifying popular pages and determining their user's interests. Lang *et al.* (2020) opine that changing the structure of a website can influence the behaviour of many users; hence, it is important to monitor the website's users and record how they behave.

Massanelli *et al.* (2021) assert that web metrics are practical measures of the usefulness of websites and an up-to-date website helps to improve user engagement. Nielsen (1996) argues that most usability testing is qualitative in nature, and that it includes how users use the product or website, showing their likes and dislikes, and whether or not they experience any difficulties whilst using the website. According to Nielsen (1996), it is rare to take time to find out how well or poorly users experienced the website. The said author further argues that although qualitative measures are usually enough to improve a website, it is sometimes necessary to collect metrics for some of the projects.

2.5.1. Visits

A visit is defined as a visitor's sequential viewing of various web pages on a website, using the same IP address (Khoo *et al.*, 2008). The visit is considered to be over when there is no longer any activity from the same IP address over some time, which is normally 30 minutes (adjustable). This is when the visitor is assumed to have ended interaction with the website and closed the browser.

Gesualdo *et al.* (2020) define the visit as a collection of all the interactions, which one visitor has within a given period of time on a website.



Figure 2.1: Visits (www.similarweb.com, 2020)

Figure 2.1 shows a typical example of visits by users on the website over a three-month period.

2.5.2 Unique visits

A unique visit is defined as a single visit by a new user to the website within a particular period of time, which could be a year, month, week, or a day. The recurring cookie or the IP address of the current visitor is used to identify a unique visit. The counting for every visitor is only done once, and it cannot be duplicated. If a user visits the website every day of the week, the analytics will count it as a unique visitor each day at the end of the week (if the time period is fairly short) – the same applies when visits are spread over four consecutive weeks, which are counted as monthly unique visits (Khoo *et al.*, 2008).

2.5.3 Page views

These are defined by how many times a web page has been accessed, which includes a repeat view of the same page. The number of page views refers to the number of times a web page on the website is accessed during a single visit. The figure includes any viewings done repeatedly on the same web page. AJAX (asynchronous JavaScript and XML) technologies make it difficult to track and define page views because

they allow the refreshing of in-page content without the actual page being refreshed, causing the AJAX content to count as one page view within the same visit (Khoo *et al.*, 2008).

Paez *et al.* (2022) suggest that it is important to understand the meaning of numbers when interpreting pageview data, as these determine the number of times a page is viewed, using a unique URL. In general, the page view metric is considered to be a reliable measure of activity on a website.

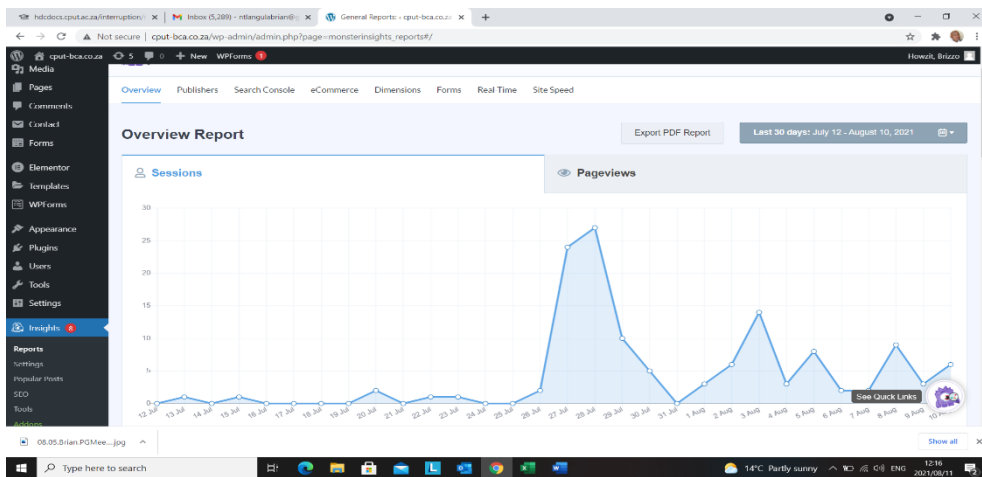


Figure 2.2: Pageviews

Figure 2.2 shows typical website pageview numbers over a given period.

2.5.4 Hits

Khoo *et al.* (2008) define hits as being requests for a page or any elements of a page like frames, images, movies, audio files, and so on from a server. It is possible that users can generate many hits from viewing a single web page. This, however, does not necessarily indicate the popularity of a website; for example, if a user views a page with ten embedded images, the page will generate at least eleven hits. Hits refers to a metric that is seldom used for traffic although it is commonly referred to as website traffic by some. The reason is because a lot of hits can be generated by one user on a small number of pages. Within the same website, there can be more hits generated than page views, while a web page can generate many more hits than page views and more page views can be generated than visits. Therefore, hits are regarded as an unreliable metric – it is an indication of web page complexity rather than popularity.

2.5.5 Referrals

Khoo *et al.* (2008) state that referrals are web metrics that are used to track how web page visitors arrived at a particular website. This can be achieved by clicking on a hyperlink for the webpage, which is supplied in the Search Engine Results Page (SERP) or by simply typing the web address into the address bar of the web browser. Information supplied as referred data can be used to

find voluminous referring sites, as well as top-level domains like .edu versus .com. This is because they can be utilised as a sign of the site's website visibility (Weideman, 2020).



Figure 2.3: Referrals

Figure 2.3 shows referrals from the GA of the test website. It also shows the devices used to access the website, new and returning visitors, as well as the users' geographical locations (countries).

2.5.6 Bounce rate

In terms of web metrics, the bounce rate refers to the number of visitors to a website and who exit without going to any other web pages on the same website. This may be owing to a lack of user-friendliness and/or a poorly designed website. When visitors take more time to navigate and understand the website features, there is a high probability that the bounce rate will be higher even if its content is qualitative. If the structure of the website is not clear, and there are several errors that users cannot understand, or even keywords that are not relevant, then the rate of visitors leaving the site without doing anything will be high. While Google does not use the bounce rate alone as part of the algorithm for rankings, it certainly could play a role in the algorithm that decides on the ranking of web pages, including factors like duplication of content and site download speed (Khoo *et al.*, 2008).

It appears that some practitioners have noted that 30% is a maximum acceptable bounce rate, but no empirical evidence could be found for this claim.

Kamerer (2020) refers to the bounce rate as the percentage of visits with a one-page view only, which many web analysts consider to be a failure. The author believes that while the bounces are seen as failures, some can be meaningful, especially long sessions that do not include all views of web pages.

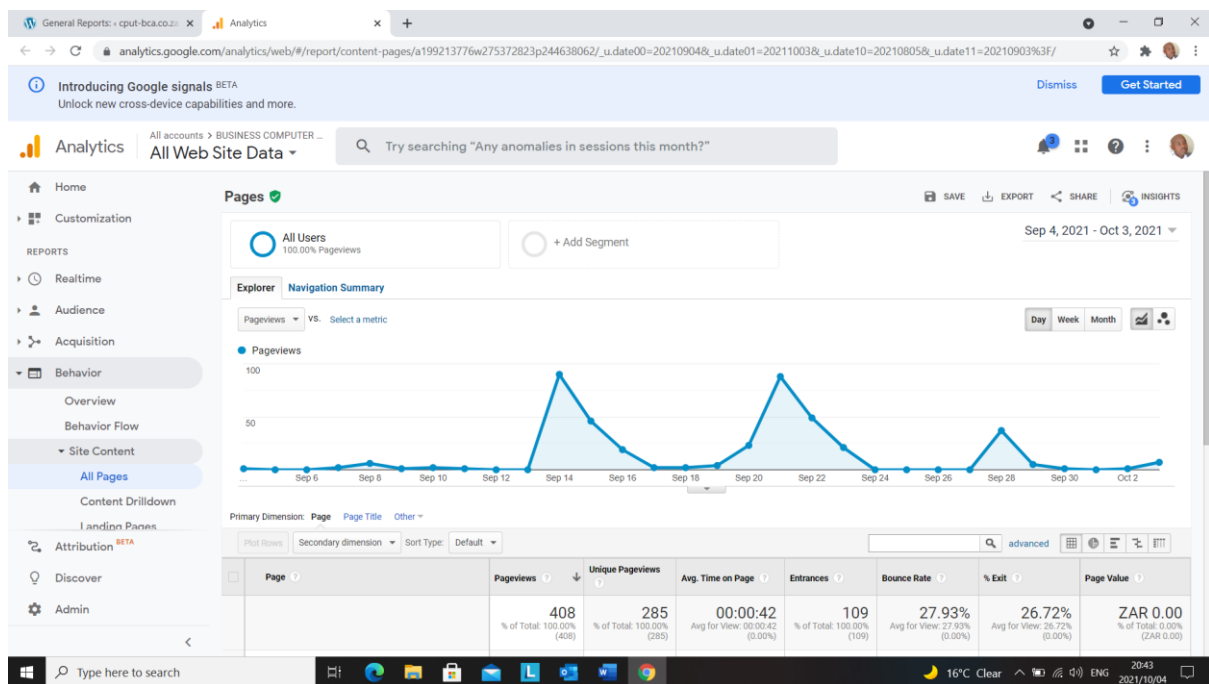


Figure 2.4: Bounce rate

Figure 2.4 shows the bounce rate on a test website in September 2021.

2.5.7 Session lengths

Session length is more popular as a measure, as it is presumed to offer information which can be considered to be more accurate than the number of page views. The amount of time that a visitor spends actively on a website is considered to be the session length. It is not always possible to determine whether the visitor was active whilst on the website during the time that GA collected data about the length of time, because the user may have been busy with other websites on the browser tabs or visited a different

application altogether (Khoo *et al.*, 2008). Session length on its own is not a reliable metric for popularity since a user might step away from the device for a while the browser is still open on a web page.

2.6 Google Analytics (GA)

GA is a web analytics instrument that collects, analyses and reports website traffic data, which was released when Google acquired a company called Urchin. Urchin was a web analytics tool, which was priced beyond the reach of most library budgets. After acquiring Urchin, Google modified its tracker and web interface and released GA in 2005, making accessing it free (Farney *et al.*, 2013). Google has taken GA through a number of versions – the latest is GA4 (Anonymous, 2022). At the time of designing the test website, however, only GA3 was available; hence, this version was used for the research study.

GA was made available to the public in 2006 to create GA accounts. It was established as a free analytics tool, which provides a useful foundation for web analytics applications. It is also known to use the page-tagging approach to collect data (Hasan *et al.*, 2009). GA's software presence has been acknowledged by a number of studies and has been applied as a useful tool to measure the effective design of a website in terms of its content and to improve it. Hasan *et al.* (2009) also acknowledge that researchers suggest that the tool (GA) could be used to improve websites, especially for user-centred design purposes. This is because GA's reports highlight challenges, making them easy to identify. It also assists to determine the value of the content for the user.

Hasan *et al.* (2009) define web analytics as a GA tool, which can assist with the collection, monitoring, measurement, reporting and analysis of data usage from the website to provide better insight into the experiences of its users. Web analytics can be valuable to optimize websites to accomplish organisational goals and to improve trustworthiness from customers by gaining their approval in this regard.

Chong *et al.* (2022) define GA as a tool to assess website usage information, which can be used to successfully improve the usability of websites.

Kirsh *et al.* (2020) mention that GA acts as web analytics Key Performance Indicators (KPIs), which are significant metrics to evaluate websites and web pages against set criteria.

Ranade (2020) claims that web analytics is useful to uncover the user's insights, making it possible to capture users' behaviours that can help to drive the research and make the content consumable.

In addition to measuring conversions and increasing sales, GA also provides website owners with an understanding of how visitors use their websites, how they found out about them, and how can they retain them. Even though GA is a powerful tool for web analytics, it has certain limitations: it is designed to be a service, which is hosted, and this means that data that is collected about the website's visitors is saved on a Google server, and not on the owner's computer (Farney *et al.*, 2013).

The added advantage of using GA is that it is easy to use and does not require additional financial expenditure when using it, which makes it more popular (Porsche *et al.*, 2022).

Categories of GA that are available include the following:

- Analysis tools;
- Content analytics Social Mobile analytics
- Conversion analytics
- Advertising analytics

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Punch (2005) defines research as “the collection of data, building theories to explain the data and test those theories against the data”. The author further explains that data comes in two forms, namely quantitative and qualitative, where quantitative data uses numbers and qualitative data uses mostly verbal expressions.

Terr Blanche *et al.* (2006) claim that research design is “the planned framework binding together the research questions and the application of the research”. A quasi-experiment design method is “sometimes the next logical step in a long research process where lab-based experimental findings need to be tested in practical situations to see if the findings are useful” (Fife-Schaw, 2012).

Website usability is defined as a way of making a website usable, thereby enabling users to interact with it without many challenges. It is also expected that users must be able to use the website without undergoing any special training before they can use it. Many companies and organisations struggle to achieve their goals because of bad decisions that they make before designing their websites, leading to poor design and lack of usability. Most of these companies still find it difficult to identify real problems in their websites.

Conversely, web metrics is a collection of data about the interactions of visitors within the website. GA, which is a chunk of JavaScript tracking code, embedded within every web page, is used to collect web metrics. This gives a clear indication of details about traffic on the website by collecting metrics on how the users view pages, how they landed on the website in the first place, and when they exit. The use of web metrics is one area that has not been used by many companies to monitor their websites, although this can be used to improve websites through statistics collected from the website (Jansen *et al.* 2022).

According to Porter (2007), when one is designing a website, the aim is to achieve a particular goal and deliver a message to the audience. There are two messages conveyed by any website: the desired message (by the owner) and the one that gets delivered. This is because sometimes the desired message is lost because it has been loaded with uncertainty on the website. There are many cases where the desired message is not delivered at all.

Kyrnin (2010) suggests that if 80% of what the users are looking for on a website is found, then it is declared usable. Most websites contain only 50% of the information, which is the main purpose of the website, while the rest is adverts and unnecessary content. This hampers the website's usability, as visitors will not find what they are looking for and leave the site. If they leave without getting what they wanted though, then there is a high probability that they might not come back.

Although most users do not have a problem with scrolling, it is advised that the website should be kept simple and clean, without too much content below the fold, which would necessitate scrolling.

The overall objective of this research was to establish whether the use of website metrics (easy to measure), as opposed to website usability (difficult to measure), can be used to predict the success of an educational website.

Table 3.1 shows a summary of questions, which relate to that which the research sought to achieve.

3.1 Research problem, research question, sub-questions, and objectives

Research problem	User testing can provide valuable insights to predict the success of an educational website. It can be expensive, time consuming and difficult as user expectations are involved, Therefore it would be better to use a facet of usability to make this prediction, where this facet is easy to measure.	
Research question	Is there a correlation between measures that best predict the success of an educational website?	
Research sub-question	Research methods	Research objectives

What are the attributes of website usability that affect the use of a website?	Literature survey and GA	1. To determine why users do not like or use certain websites.
How do the attributes of usability affect a website?	Literature survey	2. To describe the usability of a website.
What are the attributes of metrics, which best predict success of a website?	Use of special analytics coding, GA.	3. To measure and collect metrics of a website.
Which measures best predict the success of educational websites?	Experimenting and literature survey	4. To determine what are the best measures for the success of an educational website.
What is the relationship between the identified metrics and the usability attributes of an education website?	Analyse results	5. To identify the nature of the relationship.

Table 3.1: Summary of research questions

3.2 Methodology

The research study used both quantitative and qualitative data collection methods. A test education website was developed. Website usability was changed, while web metrics were used to compare the human experience of an education website with some of the usability attributes, as cited by usability experts. Many users visited the website over a period, and it was tracked to see if changes made to the website had any effect on the website's traffic and other measures. The GA system was used to track the web metrics generated from the developed website during the same period. The results of the usability changes to the website were analysed for equivalence to the web metrics to see if there is a link between them.

3.2.1. Quantitative research

Quantitative research is a formal and systematic process to obtain information about the world. It is most often presented in a numeric form and analysed by way

of using statistics. It is used to test, examine and describe the causes and effects of relationships (Bhandari, 2020).

GA provides a large amount of quantitative data for user visits and other website usage attributes. The study's data was collected over a period of time from the designed test website. The statistics provided by the collected metrics provided an indication of how often users visited the website and, which pages they visited more. This data represents the quantitative aspect of the current research. A comparison was made to check the relationship between website usability and web metrics.



Figure 3.1: Typical display of the results of web metrics tracked by GA from the test website

Figure 3.1 shows the results of an earlier pilot study, which was conducted on a test website. Web metrics were tracked using GA between the period of 13 July and 12 August 2013. A grand total of 3883 unique users visited the website during this period. Visitors were categorized according to different metrics. For example, new and returning visitors were captured, meaning that one person could be counted more than once for a visit, hence a number of visits were logged as being higher than the number of visitors. Each user accessed 1.44 pages per visit and approximately 64% of the visits were new visitors. During all the visits, web pages were viewed 8,126

times, including repeat visitations to the webpage. Approximately 80% of the visitors navigated away without visiting any other pages, which resulted in a bounce rate of around 80%.

3.2.2. Qualitative research

Ospina (2004) defines qualitative research as a “systematic and empirical inquiry into meaning”. This type of investigation is founded in the world of experience, while the enquiry into meaning shows that researchers are trying to understand how others make sense of their experience. This research study collected qualitative data by deducing users’ experience from the quantitative data in terms of how users experienced the website.

3.3 Research model

No specific research model was used during this research, as the research was based on a quasi-experiment, where the website was evaluated by using the proposed measurement criteria.

3.4 Population

Computer literate participants were sought and, in this case, specifically university students to do the “usability testing” on the website over a period of time. The researcher developed a test (educational) website for this purpose (www.bca-cput.ac.za). GA code was used to track and collect the web metrics within the website (the GA tracking code is embedded on every web page of the website). Usability changes were made, while the fluctuations in the web metrics were plotted against these changes.

3.4.1. Sampling

“When the set of all possible items in a population is too large, it becomes costly and time consuming to do a comprehensive analysis of all items” (Westfall 2009). The author also suggests that if the client pool is large, then it might be too expensive to survey all the customers, as well as their satisfaction level.

It may be much more efficient to only evaluate the characteristics of the system or process by using a representative sample.

Nielsen (2000) argues that testing only five users would provide the tester with 80% or more of the usability issues. The author claims that this would render the same results as testing a higher number of participants. Between 100 and 150 students used the test website during the research period; hence, the researcher considered it to be an adequate indication of the website's usability.

Users who are current students in the identified subject, and who have internet experience participated in the test website's usability testing by visiting the site over a period. During this period, usability changes were made to the website, while web metrics were used to indicate whether there is a link between the website's usability and the recorded web metrics.

3.5. Ethical considerations

A website was developed for the purpose of the study. GA was installed on the website and was used to collect data about the website's usage from the developed website. The website is an educational website, which was loaded with information relevant to education. Users who understand English and who are computer literate, preferably students doing the BCA course, used the website. No student was forced to use the website. GA does not collect or store any of the website users' details, which could possibly be used to identify any individual or organization. The website does not require anyone to enter their personal details.

3.7 Website development

This section presents the development of the test website from which data was extracted to show the website's web metrics. Changes that were made throughout the development were recorded, as well as any effects that they may have in terms of usability and web metrics.

3.7.1. Framework design for the website

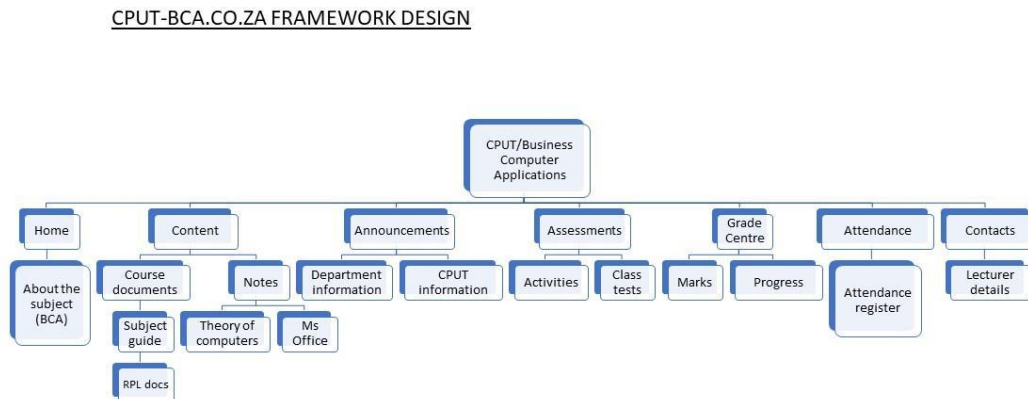


Figure 3.2: Framework design for the website

Figure 3.2 shows the wireframe design of the website that was developed for the purpose of this research study, including a sketch of different pages that were developed for the website. The pages changed over time and according to the user's requirements and the website's content.

3.7.2. Website domain registration, April 2021

A domain name called cput-bca.co.za was selected for the website, and the domain was checked for availability before it was registered.

A free open-source content management system called WordPress, was used to develop the website. WordPress features include a plugin architecture and a template system referred to as themes. A username and a password were created during registration for the administrator.

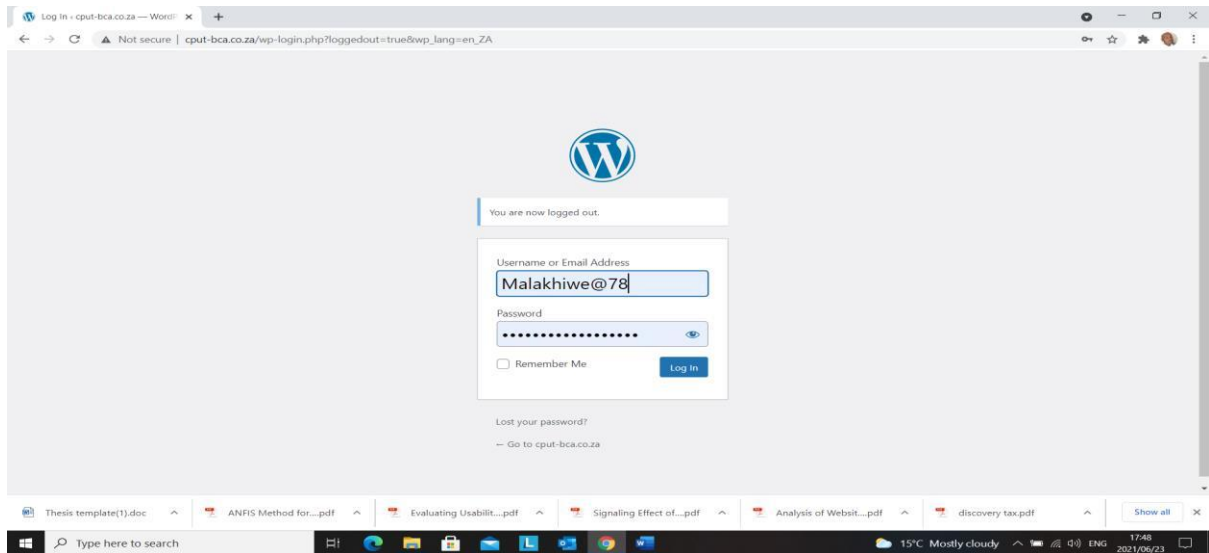


Figure 3.3: Login screen for administrator

Figure 3.3 illustrates the screen that the administrator used to login to WordPress to develop and make changes to the website. The administrator could add other users who would then be able to effect changes to the website. The administrator was also able to allow other users access to the GA to monitor the website metrics.

3.7.3. Development of the website, May 2021

Once the domain name was registered, WordPress was used to develop the website. The pages, which were designed from the framework, were created on the WordPress dashboard.

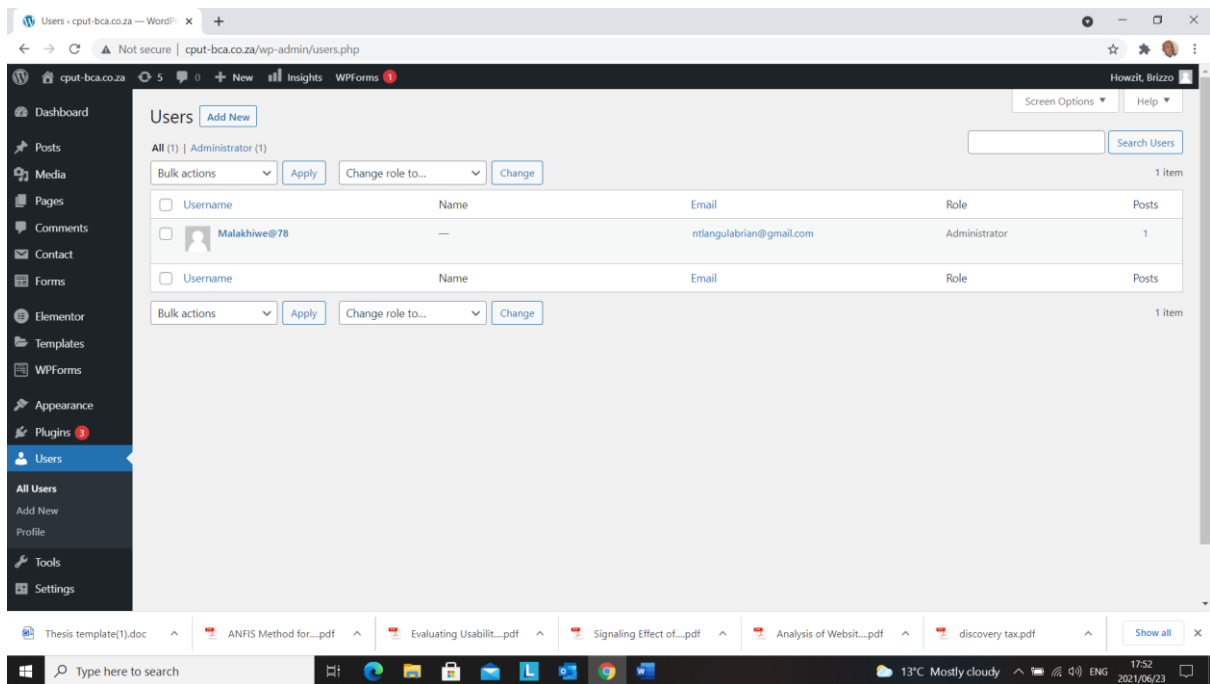


Figure 3.4: Administrator screen

Figure 3.4 shows the administrator's screen, showing that the website's administrator could add more users to the website, giving them certain rights to administer it.

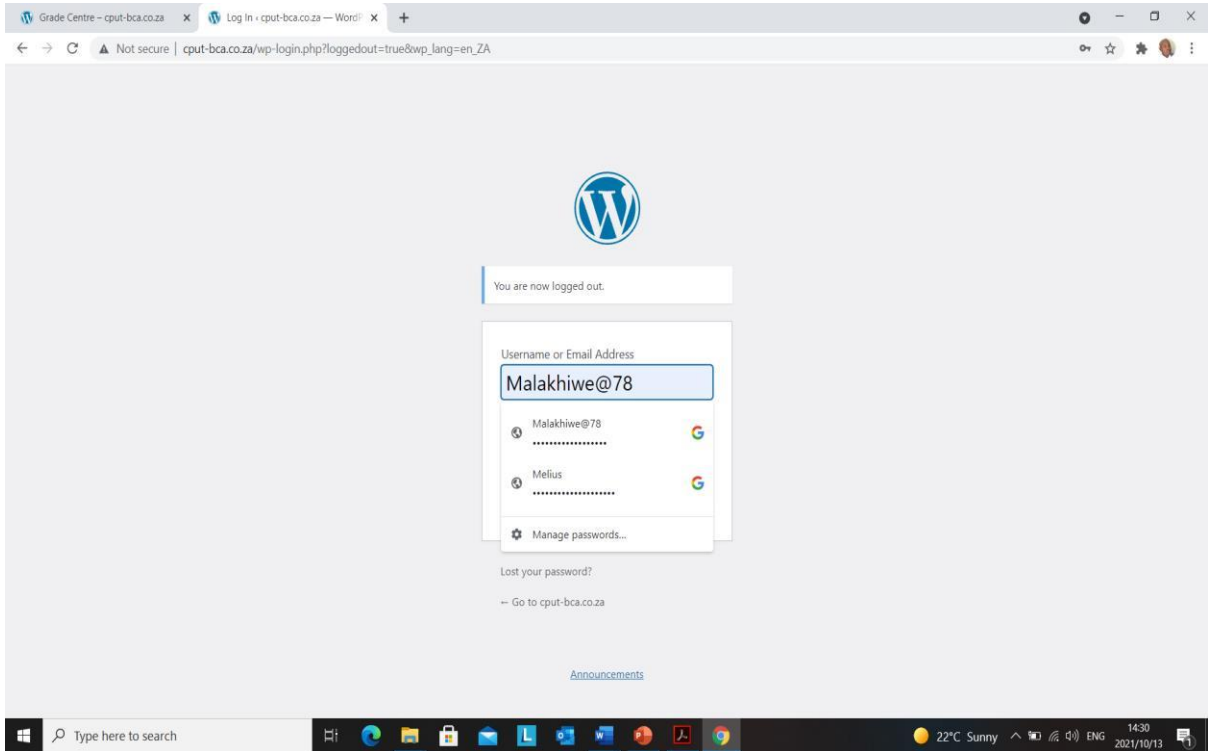


Figure 3.5: A login screen with an additional user

Figure 3.5 shows a screen, where an additional user was added by the administrator. The additional user was able to do most things on the website but did not have the full rights that the administrator enjoyed.

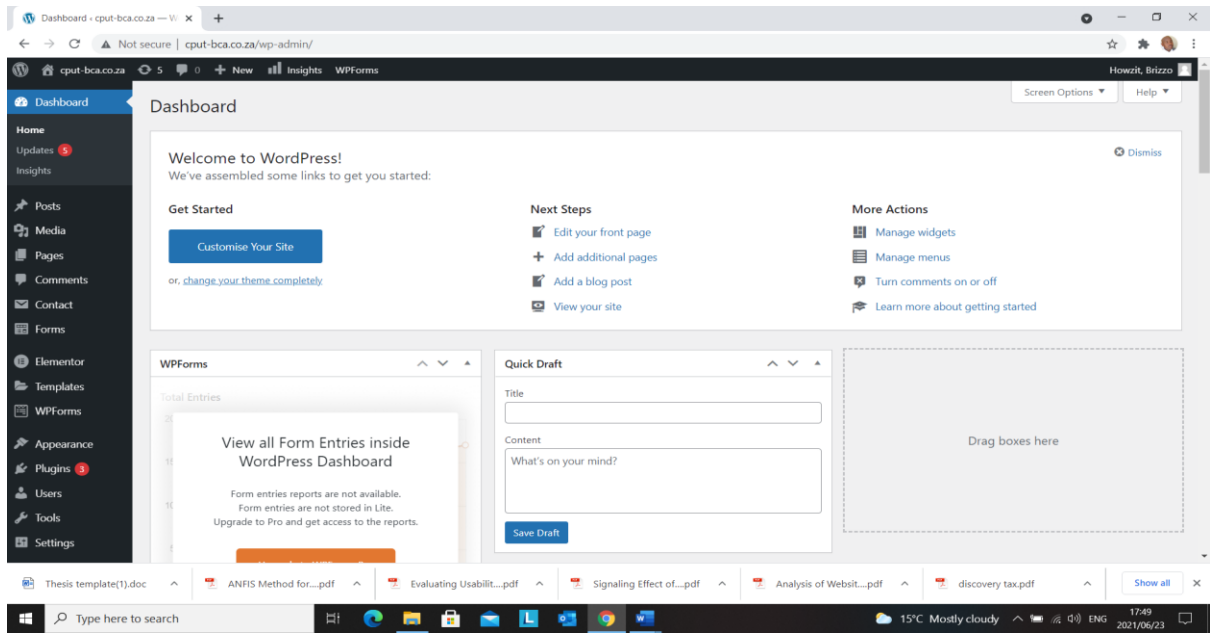


Figure 3.6: An overview of the dashboard screen after login

Figure 3.6 shows the dashboard, which is the first screen that appears after the administrator has logged in. It provides an overview of the tools used to develop the website on WordPress, as well as the gadgets, plugins and themes that the website used.

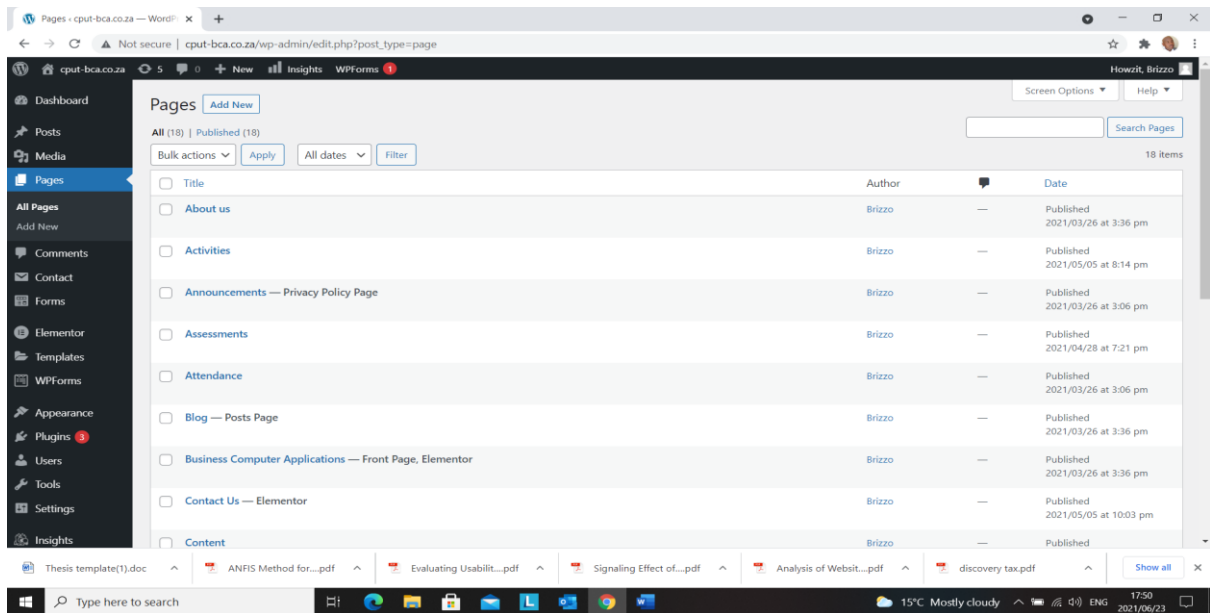


Figure 3.7: Website pages

Figure 3.7 illustrates the screen that shows the website’s pages, as developed from the framework design. These pages were created from the administrator’s screen’s dashboard.

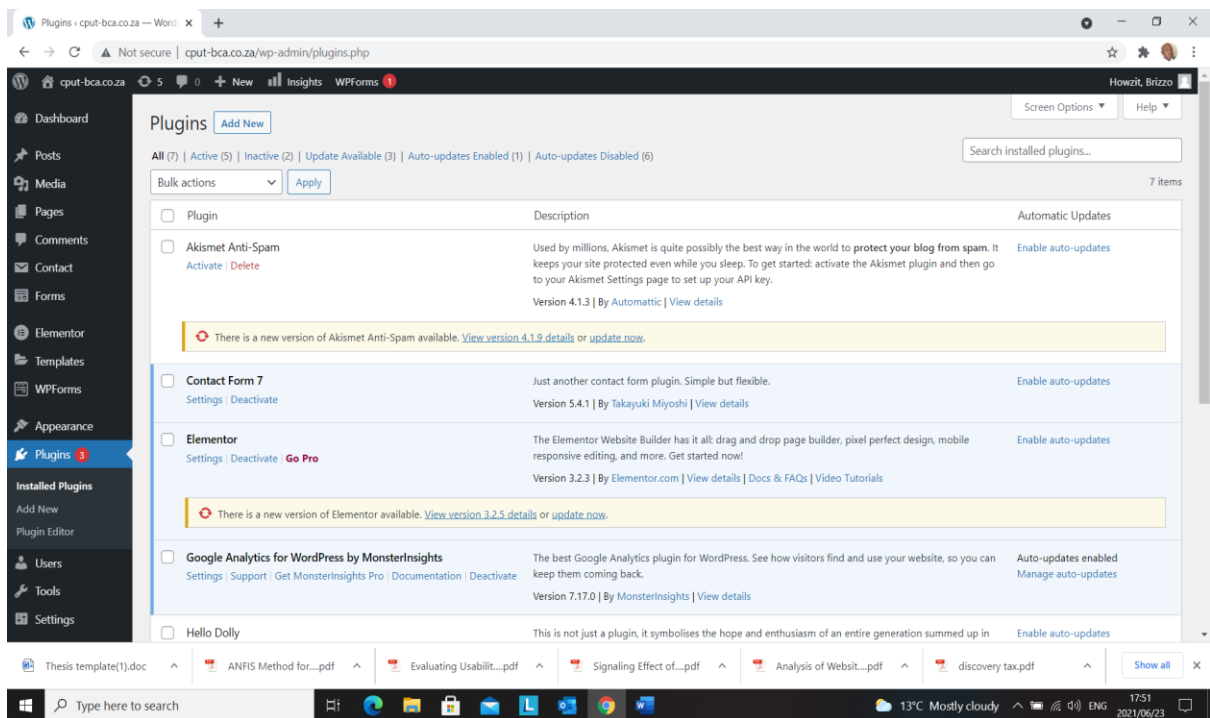


Figure 3.8: Plugins

Figure 3.8 shows the plugin screen - plugins are software modules that improve the website's functionality, whilst helping to add some features to the website. More plugins can be added to enhance the website's functionality.

3.7.4. Installation of GA code

```
<!-- Global site tag (gtag.js) - Google Analytics -->
<script async src="https://www.googletagmanager.com/gtag/js?id=UA-199213776-1"></script>
<script>
  window.dataLayer = window.dataLayer || [];
  function gtag(){dataLayer.push(arguments);}
  gtag('js', new Date());

  gtag('config', 'UA-199213776-1');
</script>
```

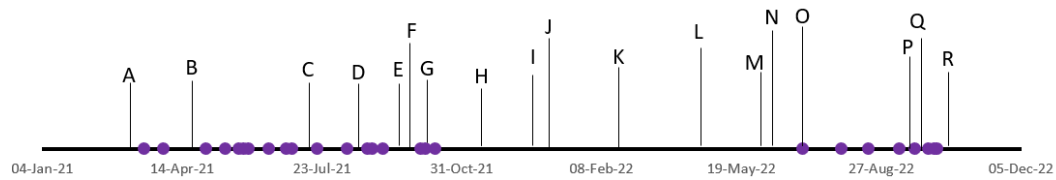
Figure 3.9: GA code supplied.

Figure 3.9 shows the GA code that was used to collect the website's data or metrics such as the session's duration, bounce rate, and pages visited per session. The GA code can only be installed by the website's administrator, making it possible to track website traffic once installed. The GA tracking code was installed on each web page on the website.

3.7.5. Usability changes and timelines

The process to develop the website to test the relationship between usability and web metrics began with selection of the domain name. The domain name, cput-bca.co.za, was selected and registered with the hosting company. A structure of what the website should look like was drafted (see Figure 3.2) with relevant menus for use of the website, allowing students to obtain information from the menus. From time to time changes were made to the website to check if they had any effect on web metrics that were collected, using GA. After every change made, the web

metrics were monitored to determine if they changed in accordance with the website's changes.



- A. Framework design of the website (Chapter 3, figure 3.4, March 2021)
- B. Website domain registration (April 2021)
- C. Design of the BCA website (Chapter 3, figure 3.8, May 2021)
- D. Installation of Google Analytics to the website (May 2021)
- E. Make BCA website live (May 2021)
- F. Took a snapshot of the GA code (Chapter 3, figure 3.11)
- G. BCA students start using the website (June 2021)
- H. Took snapshot for 1st landing page of the website (June 2021)
- I. Made changes that affect usability (June 2021)
- J. Took snapshots after changes (Chapter 3, Figure 3.13)
- K. Made changes that affects usability (Chapter 3, figure 3.24, July 2021)
- L. Took snapshot of the Web metrics (Chapter3, figure, 3.21, 10 Aug 2021)
- M. Made changes affecting usability (August 2021)
- N. Took snapshot of web metrics (Chapter 3, Figure 3.23, 28 Aug 2021)
- O. Made changes affecting usability (September 2021)
- P. Took snapshot of Web metrics (Chapter 3, figure 3.27, 02 October 2021)
- Q. Make changes affecting usability (October 2021)
- R. Took a snapshot of Web metrics (Chapter 3, figure 3.27, 12 October 2021)
- S. Usability changes (July 20 – August 16, 2022)
- U. Usability changes made (September 2022)
- V. Usability changes made (October 2022)

Figure 3.10: Timeline of changes

Figure 3.10 shows the timeline of the website's development and the accrued changes.

The test website was initially developed in March 2021 and went live in May 2021, while students started using it in June 2021 once GA was installed to monitor the site's usage through the web metrics. Certain changes were identified to check if they affect how the users visit and use the test website. Some changes affect a website's usability according to the usability attributes identified by usability authors. Screenshots were taken, showing the test website's usage and web metrics during the timelines.

3.7.5.1. Changes

3.7.5.1.1. Content – In respect of usability, experts claim that if users do not find what they are looking for or do not obtain the relevant information, then they simply leave the site, resulting in a high bounce rate, which is undesirable. Relevant content is one of the measurements for usability. Various pages of the test website were loaded with relevant content, for example, the ‘about us’ page, detailing relevant information about the people/organization behind the website. Content changed accordingly for different pages, depending on users’ needs.

Fang (2007) posits that changing website content and using GA to compare web data usage after the changes, can help to improve the website in several ways.

3.7.5.1.2. Downloadable links – The creation of links or buttons reduces confusion amongst users; sometimes users can skip a download link without realising it, but if anchor text in the link is present or it is clear that it is a link, this eliminates any potential confusion, and users can easily realise that it is a clickable link. Some of the website pages have clickable links for content such as notes or related activities.

3.7.5.1.3. Menus – These were meant to measure if the menu design had any effect on how the users view the website. Menus were created and arranged to minimize or eliminate confusion amongst users. Menus with sub-menus were created, where necessary, to assist users with ease of navigation.

3.7.5.1.4. Colours – A website’s colour scheme can determine its user-friendliness, enhance brand recognition, and emphasize certain elements. The website’s initial colours were changed to suit users and for the purpose of the website.

3.7.5.1.5. Navigation – Changing how navigation is done on the website can contribute to ease of use or a lack thereof. Some navigation changes can be measured against certain metrics on the website. Elements such as sub-menus were used to see if users were able to navigate all the pages.

3.7.5.1.6. Pictures – Having pictures on the website can help to improve the user's experience and attract their attention. Relevant pictures such as computer-related ones were used on the test website, either as logos or background images.

Earlier, Figure 3.10 showed a timeline of the website's changes. The impact of these changes is evident in the web metrics statistics taken from the website's various development stages.

The website's changes also impact certain usability attributes, as presented below.

Learnability - amount of information populated on website; too much or too little information can confuse users and lead to abandonment of the task that they wanted to do on the website.

Efficiency – this checks if the website does that, which it was designed to do. This is considered, as the menus are effective initially in terms of users' attention and have a high retention rate.

Memorability - navigation on a website is important as it enhances the user's experience, which helps users to access information as quickly as possible, making the website easy to use.

Error handling – displaying error messages and being able to recover from them.

Satisfaction – buttons are created on the website to complete a task, download items and submit documents.

CHAPTER FOUR: RESULTS AND ANALYSIS

4.1 INTRODUCTION

As noted in the preceding chapter, the research study used both qualitative and quantitative data analysis. According to Cumberbatch (2004), quantitative research expresses collected data by using numbers. Cumberbatch (2004) further notes that several items and reaction times are recorded during this process.

In this study, GA was used to collect web metrics, namely the number of visitors, bounce rate, unique visitors and page views. Cumberbatch (2004) also notes that qualitative analysis involves participants' experiences and the stated meanings that they attach to themselves, other people, and their environment, which are all often explained in words.

Users' experiences of the website were observed by using the collected web metrics over a period.

4.2 Web metrics collected on the test website.

Statistics from the website were collected for certain website metrics, using GA.

4.2.1. Average session duration – this refers to the duration of each session, which is divided by the total of number of sessions. This means that if there were three sessions each with a duration of 90 seconds, then the average session duration will be 270 seconds divided by 3, which will be 90 seconds or 1 minute 30 seconds each.

4.2.2. Bounce rate – this refers to the number of visitors to the website, who leave without interacting with the site. A good bounce rate is said to be between 26%

and 40%, whereas an average bounce rate is between 41% and 55%, with anything between 56% and 70% being considered as high.

4.2.3 Pageviews – this is the number of times that users visited the webpages; if a user visited the website and went to 10 pages, then GA would collect 10 pageviews for that single session.

4.2.4 Unique pageviews – this refers to the number of different users that visited the same web page.

4.2.5 Sessions – this refers to all the interactions between users and the website when they visit it over a given period. It starts from when the user visits the website and ends when the user leaves the site or after 30 minutes (or as set by the administrator) when the user is inactive.

4.3 Usability changes and web metrics

Certain changes were made to the test website since its development and these are discussed below.

Changes made during the period of 12 July – 10 August 2021

The website was populated in May 2021 and students began accessing it in June 2021. Changes were made after population, as shown below.

Content – Information was added to the website pages, assisting students with knowledge of the website. The following statistics emerged from the metrics after the changes:

12-25 July 2021 – users accessed the website but did not view or stay too long on the website; and

26–30 July 2021 - downloadable files and **sub-menus** were added to the website.

The statistics showed that website usage increased. Most of the website's usage occurred during the period of 26–30 July, when downloadable files were added to the website for users.

Between 30 July and 02 August, the website’s usage decreased drastically, as nothing new was posted and no further changes were made to the website.

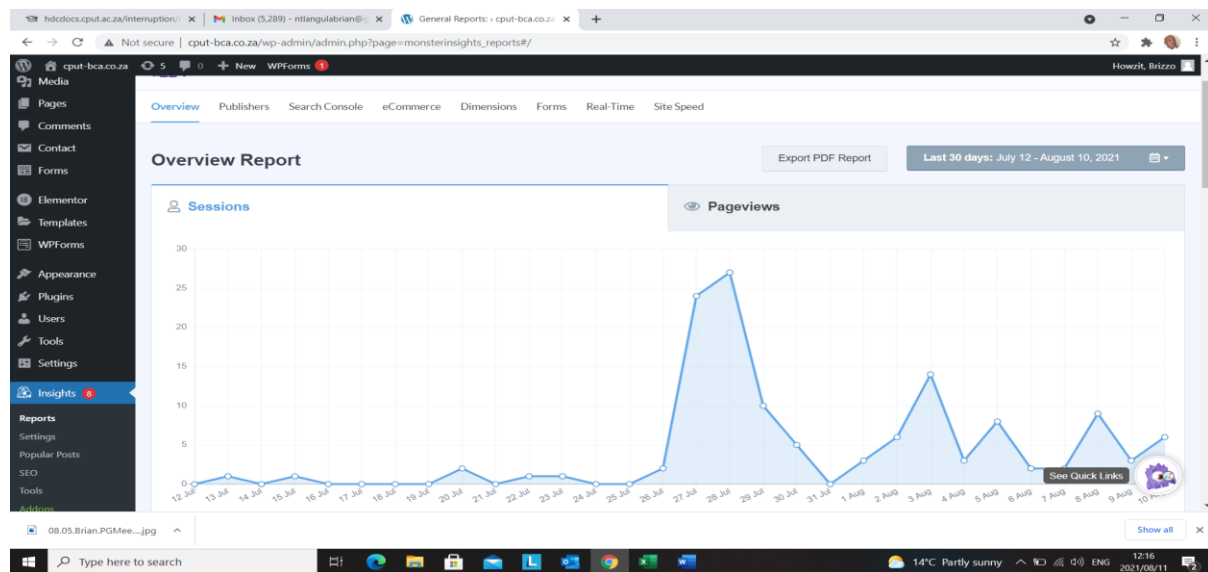


Figure 4.1: Website usage (12 July–10 August 2021)

Figure 4.1 shows that during the period of 12 July–10 August 2021, the website’s usage fluctuated following minor changes that were made, while there was high usage spike between 25 and 31 July 2021. This is the period when several changes were made on the website.

Table 4.1 presents the web metrics statistics during the period of 12 July–10 August.

Sessions	130
Pageviews	480
Average session duration	1 minute 35 seconds
Bounce rate	45,38%

Table 4.1: Web metrics (12 July–10 August 2021)

Table 4.1 shows that there were 130 interactions on the website during the said period. The pages were viewed 480 times during the same period with users spending 1 minute 35 seconds per page, on average. A bounce rate of 45,38% was recorded, which falls within the average, according to the GA experts.

29 July–27 August 2021

The website's colours were changed from blue and black to black and white during the period of 10–15 August, while new content was added to the website on the 16th of August.

The web metrics show that users accessed the website more during the period of 16–18 August, when they had to download items from the website. There was a decline in usage after the 19th, although they still accessed the website.

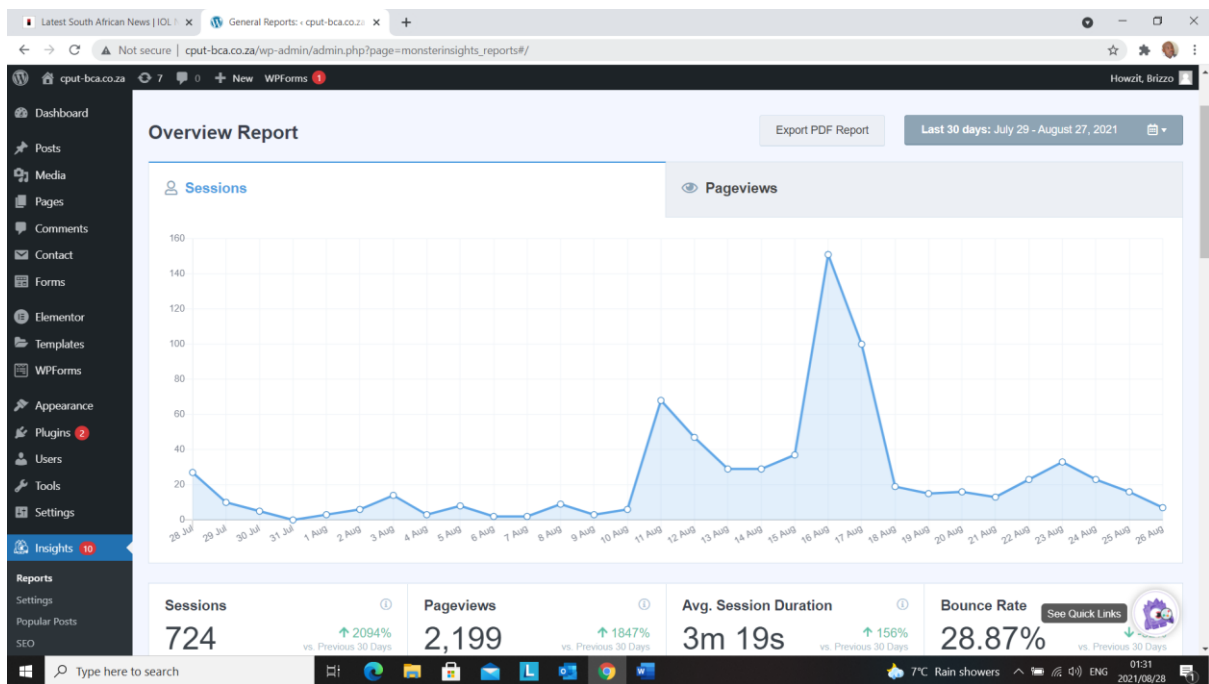


Figure 4.2: Web usage (29th July – 27th August 2021)

Figure 4.2 shows the website's usage between 29 July and 27 August 2021.

Table 4.2 shows the web metrics during this period.

Sessions	724
Pageviews	2199
Average. session duration	3 minutes 19 seconds
Bounce rate	28,87%

Table 4.2: Web metrics (29 July–27 August 2021)

Table 4.2 shows that 724 interactions were measured on the website during the said period. The website's pages were viewed 2199 times during the same period, with users spending 3 minutes 19 seconds per page, on average. A low bounce rate of 28,87% was recorded.

Certain changes were made to the website from 12 September – 11 October. A new logo was uploaded on 12 September 2021. New announcements were added, as well as new reading content. According to the web metrics, notable usage was measured on the following dates:

12–16 September - change of logo and content with different font colours, new pictures;

20–23 September - new announcements were added;

26–29 September - files (notes), new reading content and new sub-menus were added to enhance navigation; and

04 –08 October - this is the period when web usage was highest, when timetable and activity files were added to the site for users to download.



Figure 4.3: Web metrics (12 September–11 October 2021)

Figure 4.3 shows the website's usage from the period of 12 September to 11 October 2021, following changes, as noted.

Unique page views	651
Pageviews	883
Average duration per session	1 minute 15 seconds
Bounce rate	20,83%

Table 4.3: Web metrics (12 September–11 October 2021)

Table 4.3 shows the web metrics from the period of 12 September to 11 October 2021, after changes were made. A total of 651 unique page views were recorded on the website during the said period. The pages were viewed 883 times during the same period, with users spending 1 minute 15 seconds per web page, on average. A low bounce rate of 20,83% was recorded.

During 2022 there were fewer users who accessed the website as the intended users were introduced late to the website owing to other university activities.

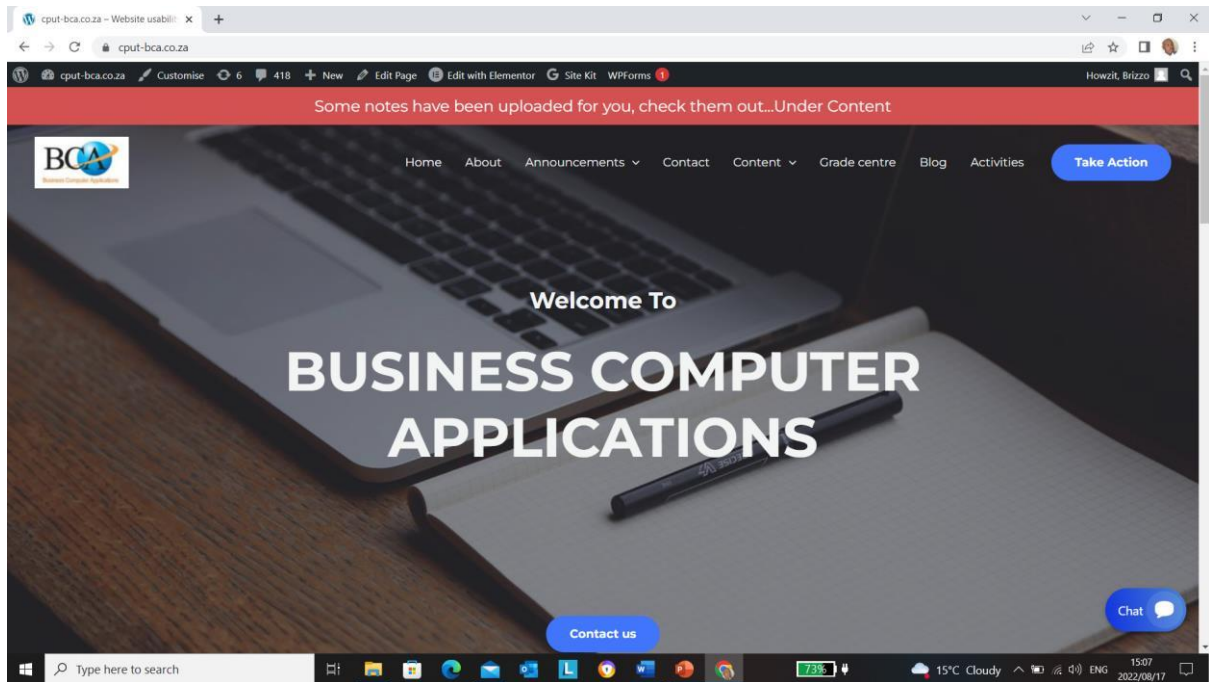


Figure 4.4: Test website home page after changes

Figure 4.4 shows changes that were made to the website, specifically those made to the home page and menu design, while unnecessary pages were removed. Before these changes, users were uncertain what to expect if they clicked on certain pages. The menus were re-arranged, starting with the home page, which provides content about the BCA course. The page includes a welcome message for users, introducing them to Business Computer Applications, the subject, which is part of their university course. The colours were changed, slightly though simply, to black and white, with a background picture relevant to the subject.

Figure 4.5 shows the web metrics statistics and the website's usage between 2 July and 1 August 2022, following changes.

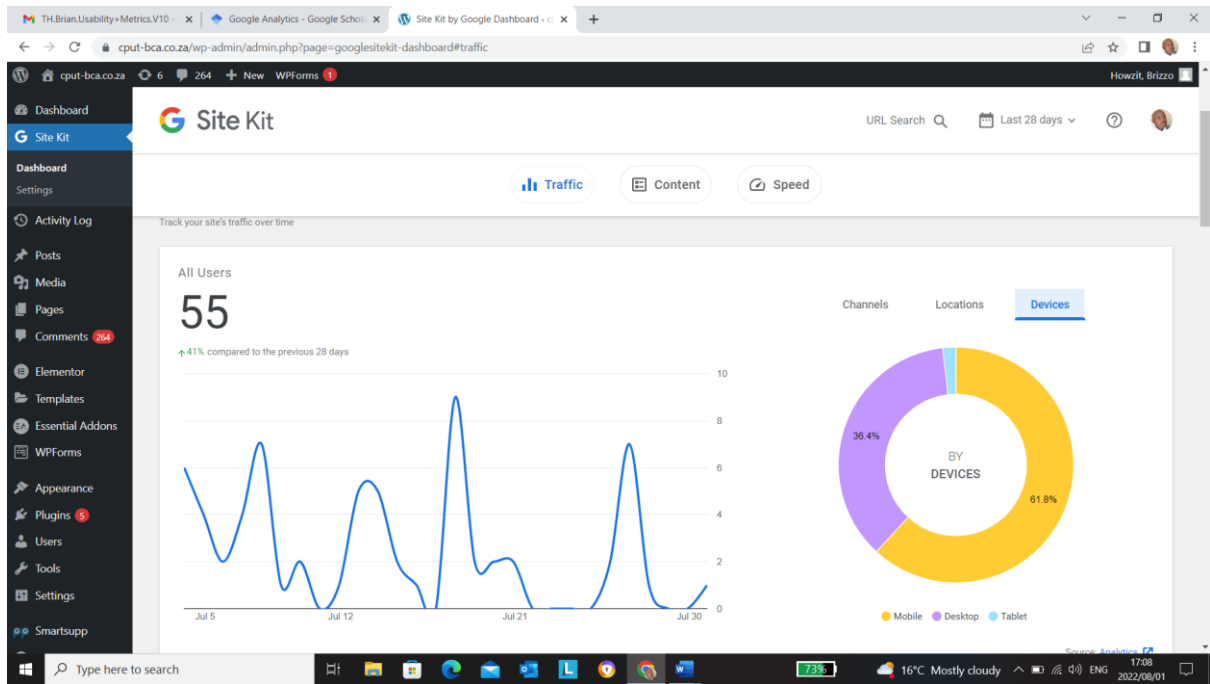


Figure 4.5: Web metrics (2 July–1 August, 2022)

Table 4.4 illustrates changes that were made to the website, as well as metrics that were collected.

The website’s homepage was changed, introducing new content, a background and different colours, while the menus were redesigned for improved navigation.

Page views	80
Unique page views	56
Bounce rate	33,93%
Average session duration	1 minute 43 seconds

Table 4.4: Web metrics (2 July–1 August 2022)

Table 4.4 shows the web metrics statistics, following changes to the website’s homepage, content and colours. The pages were viewed 80 times during the said period, with 56 unique views collected. A bounce rate of 33,93% was recorded, with users spending 3 minutes 19 seconds per page, on average.

More content and announcements were added to the pages for users and the metrics that were collected are shown in Table 4.5.

Page views	184
Unique page views	150
Bounce rate	52,5%
Average session duration	00:00:49 seconds

Table 4.5: Web metrics (22 July–16 August 2022)

Table 4.5 shows the web metrics statistics once more content was added to the website's pages. When users found information that was not relevant to them, they tended to leave without reading the full range of content, resulting in a low session duration and a high bounce rate.

New files with downloadable links were added to the website, allowing users to engage the feature, while metrics were collected for this, as shown in Table 4.6.

Page views	168
Unique page views	117
Bounce rate	26,9
Average session duration	2 minutes 11 seconds

Table 4.6: Web metrics (9 September–4 October 2022)

Table 4.6 shows the web metrics statistics after files were added to the website as downloadable links. A much better average session duration reveals that users spent more time exploring the new content that was added to the links.

The menus were changed, while different names were used for some menus and others were removed. A new logo was added to replace the old one.

Unique pageviews	49
Pageviews	7
Average session duration	1 minute 41 seconds
Bounce rate	26,53%

Table 4.7: Web metrics (30 September–6 October 2022)

Table 4.7 shows the web metrics statistics, following changes to the menus and logo. Although not many users visited the website during this period, those who visited stayed longer owing to the perceived changes, whilst exploring the new items.

Unique pageviews	172
Pageviews	208
Average session duration	00:00:42 seconds
Bounce rate	39,47%

Table 4.8: Web metrics (6 October–13 October)

Table 4.8 shows the web metrics statistics for the period of 6 to 13 October. During this period no changes were made to the website, but the users still visited the site and clicked on different pages. The average session duration shows that they did not spend much time on each web page.

4.4.1: First populated screen of the website, June 2021

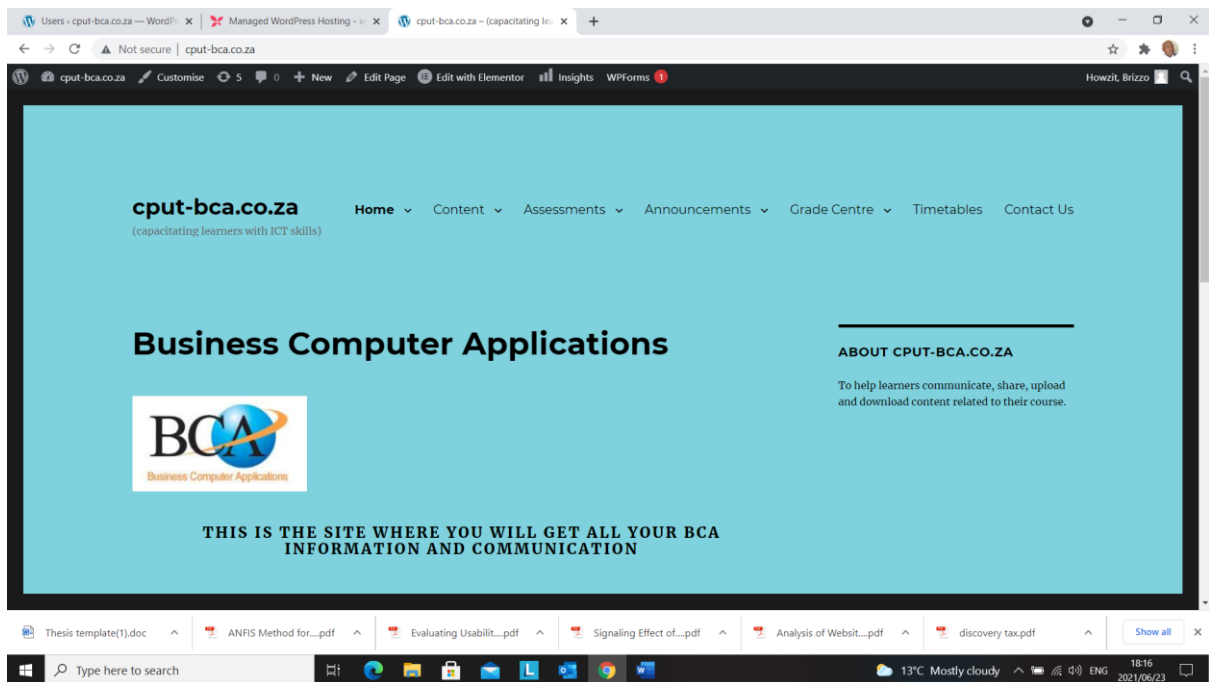


Figure 4.6: First homepage screen

Figure 4.6 shows the website's first populated screen, which was created as the homepage, alongside the website's first selected logo. This gave users an idea of the website's content in terms of its aesthetics and pages that they could access.

4.4.2. First page with information

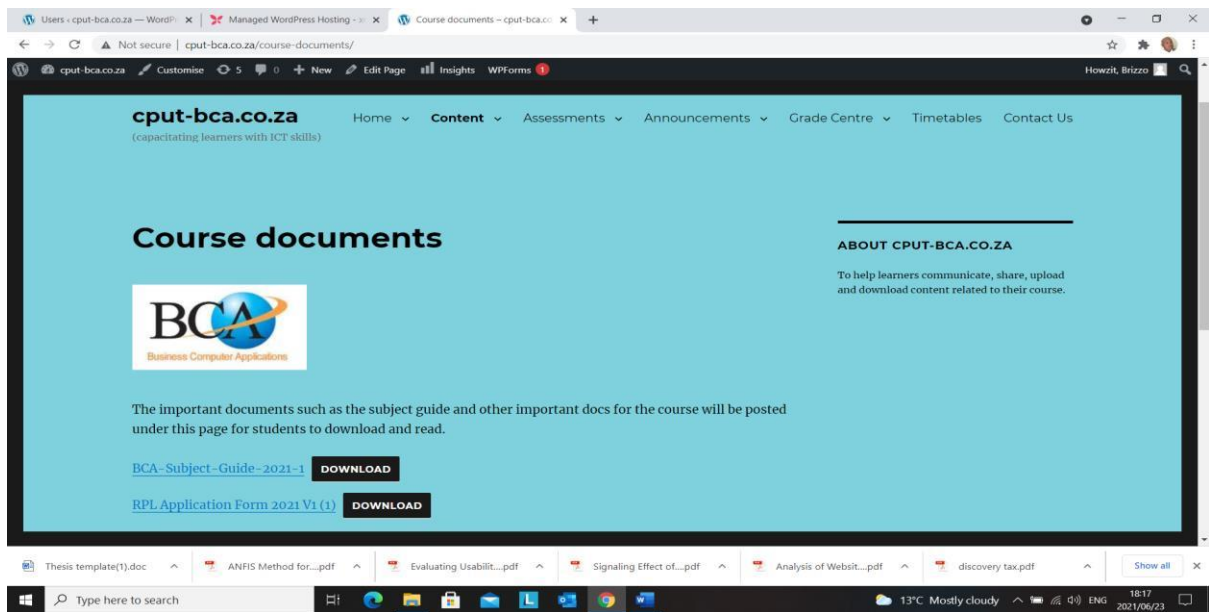


Figure 4.7: Course documents page under Content

Figure 4.7 shows content that was uploaded as course documents in the sub-menu, namely Content. The documents were created as downloadable links to make it easy for users to download the documents. Creating downloadable links is one of the elements of usability, which is important for users.

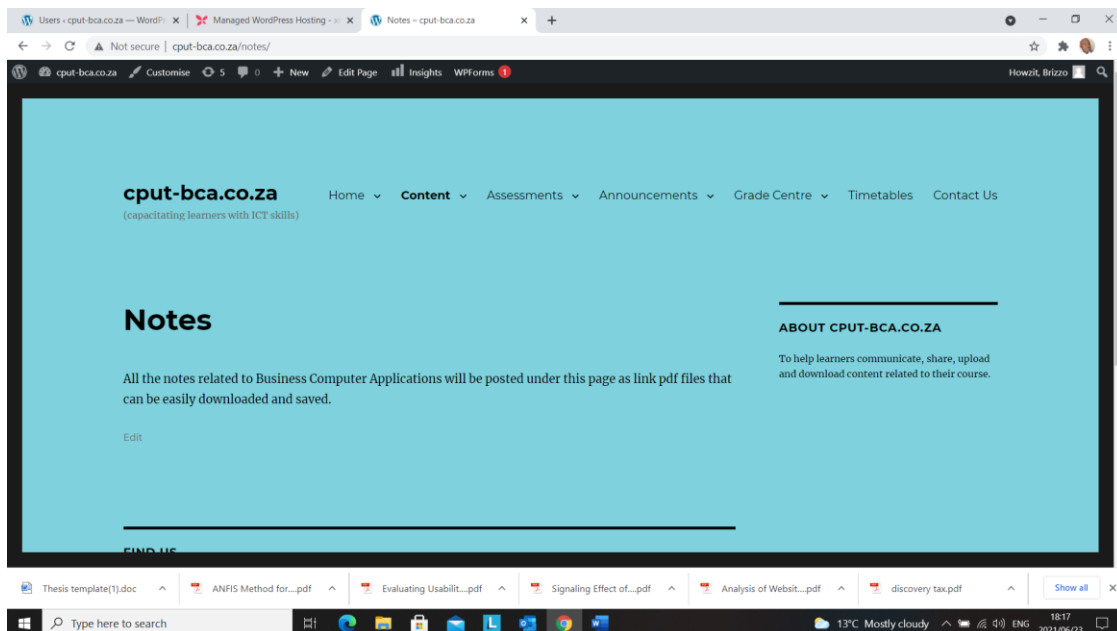


Figure 4.8: Notes page under Content

Figure 4.8 shows a notes page, placed in the Content sub-menu, which is where users' notes are uploaded.

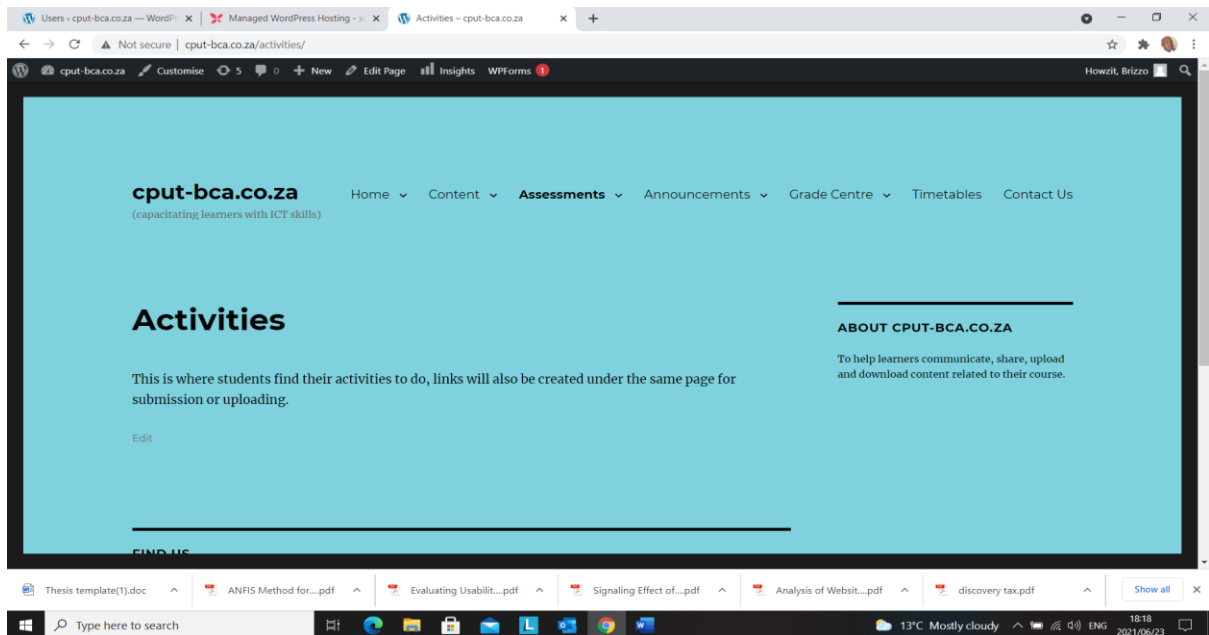


Figure 4.9: Activities page under Assessments

Figure 4.9 shows the activities page, a sub-menu of Assessments, used to upload Class activities that the users complete.

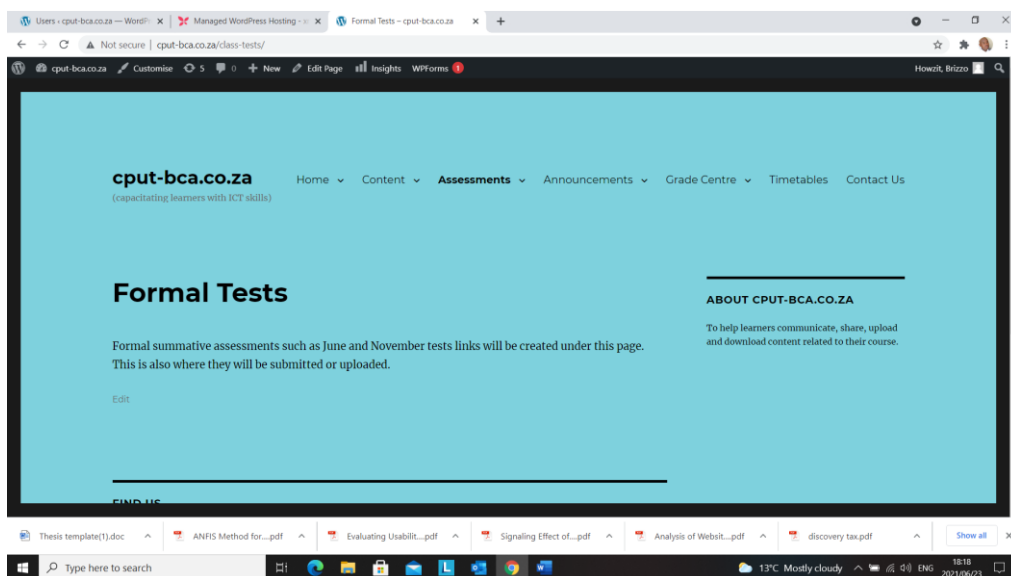


Figure 4.10: Formal tests page under Assessments

Figure 4.10 shows the Formal tests page, a sub-menu of Assessments, which is the page intended for the users' assessment files.

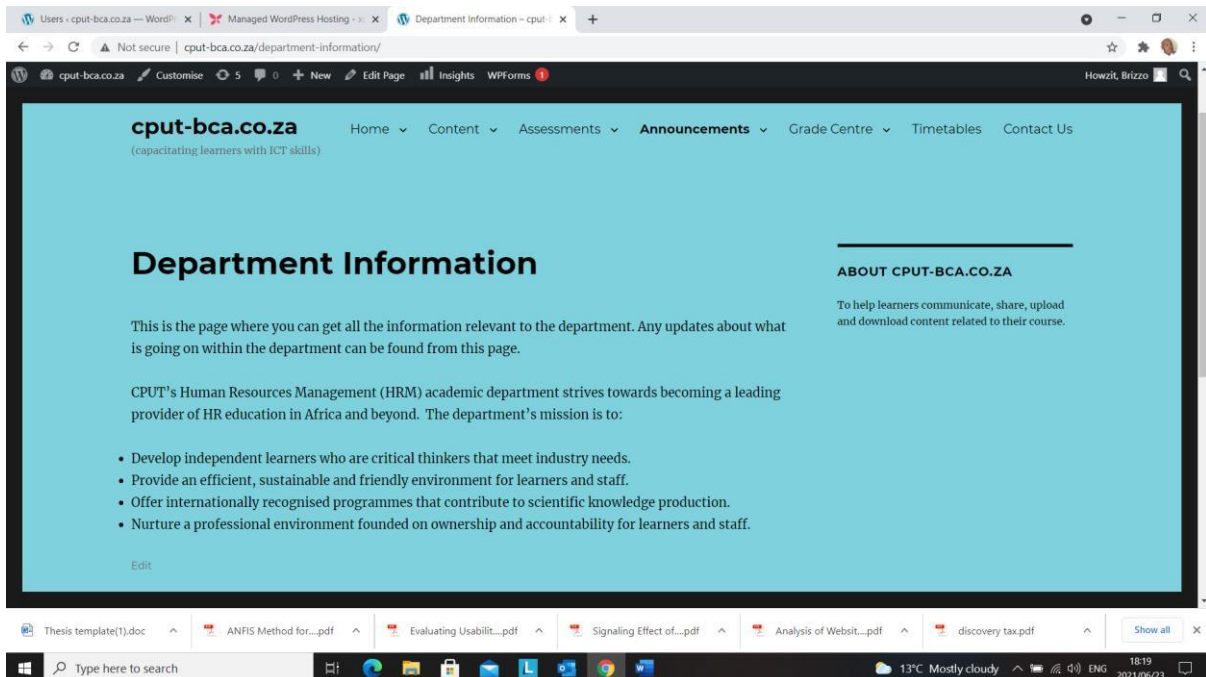


Figure 4.11: Department information page under Announcements

Figure 4.11 shows the Department's information page, a sub-menu of Announcements, where relevant information is posted for students.

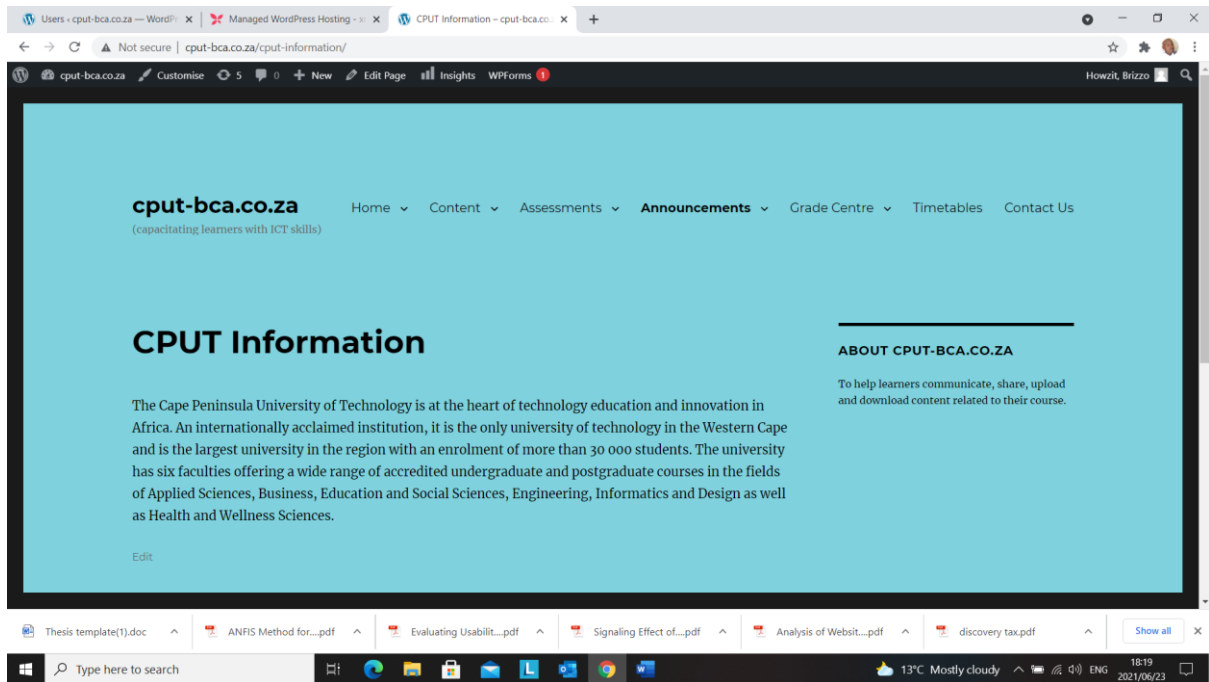


Figure 4.12: CPUT information page under Announcements

Figure 4.12 shows the CPUT information page, which is also a sub-menu of Announcements and is meant to provide relevant information about CPUT to the users.

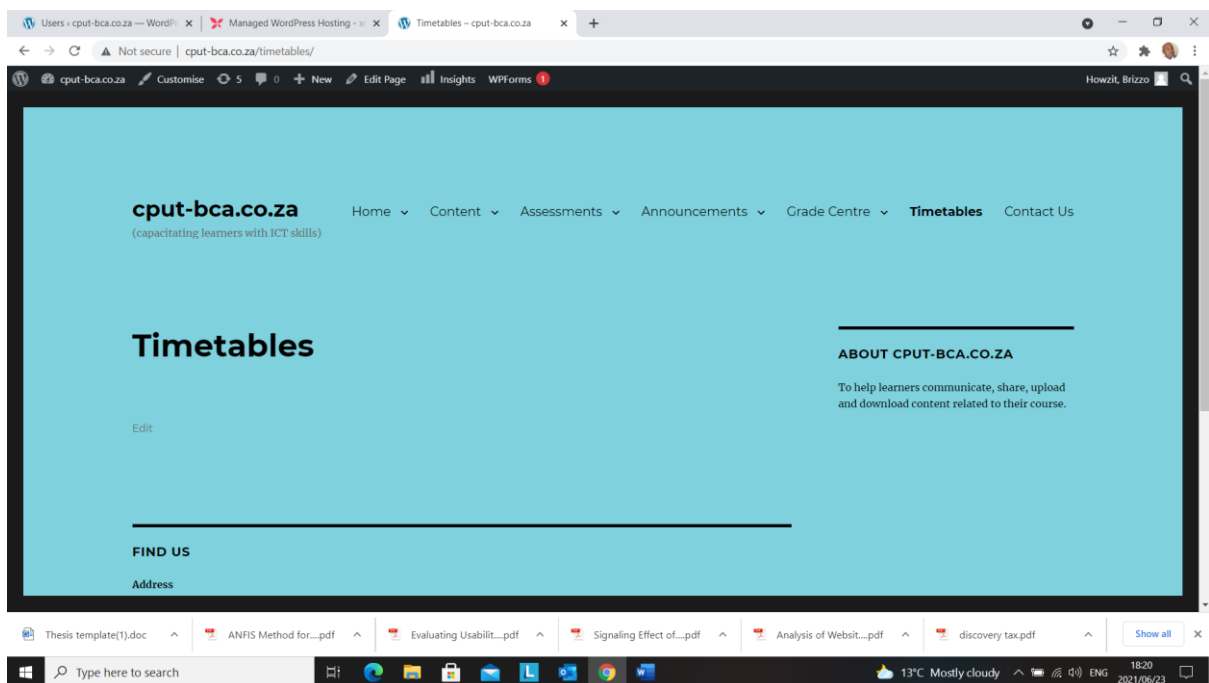


Figure 4.13: Timetable page

Figure 4.13 shows the Timetable page, detailing students' timetable for the semester or year. Users check this menu occasionally for any changes that may be made to the timetable.

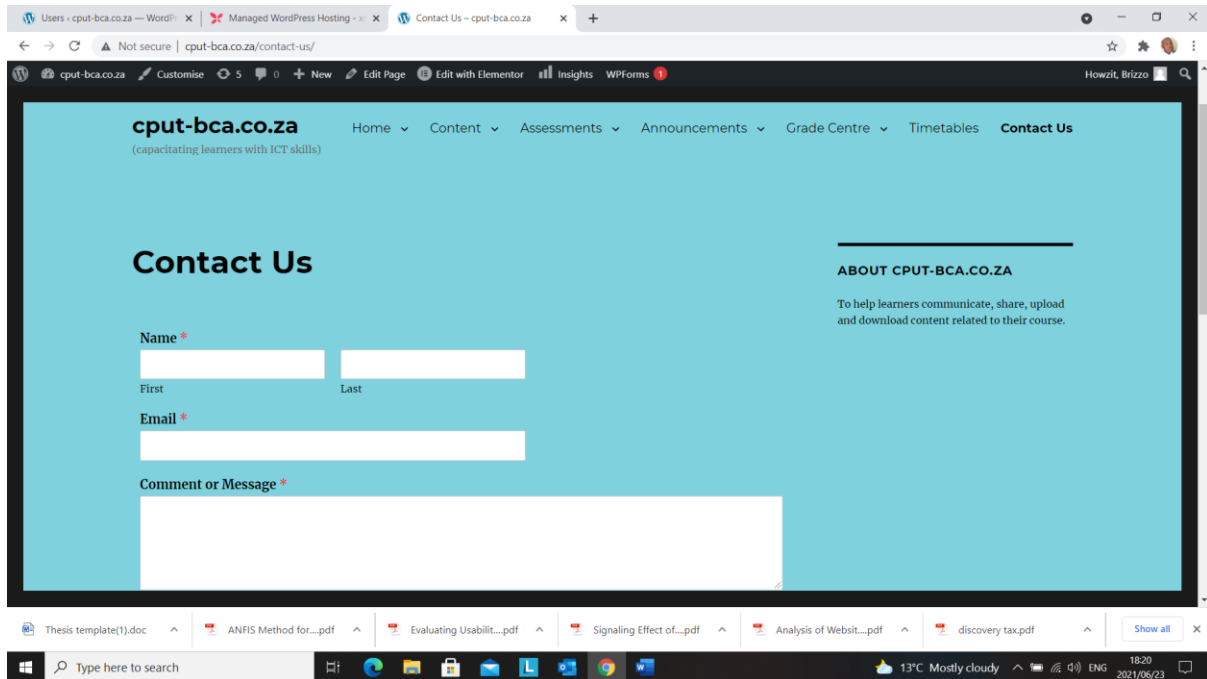


Figure 4.14: Contact page

Figure 4.14 shows the contact page, which provides the website administrator's contact details, allowing students to contact him, should the need arise.

4.4. Changes made after GA installation

Semerádová *et al.* (2020) mention that user-friendly websites, which provide the highest level of user experience, are a necessity nowadays for anyone who does business online. The authors further state that the user's experience can be bad and subjective since the number of users typically tends to be low. This section shows and discusses data that was collected from the designed website, using GA. It features web metrics that were used as indicators in terms of how the users interacted with the website.

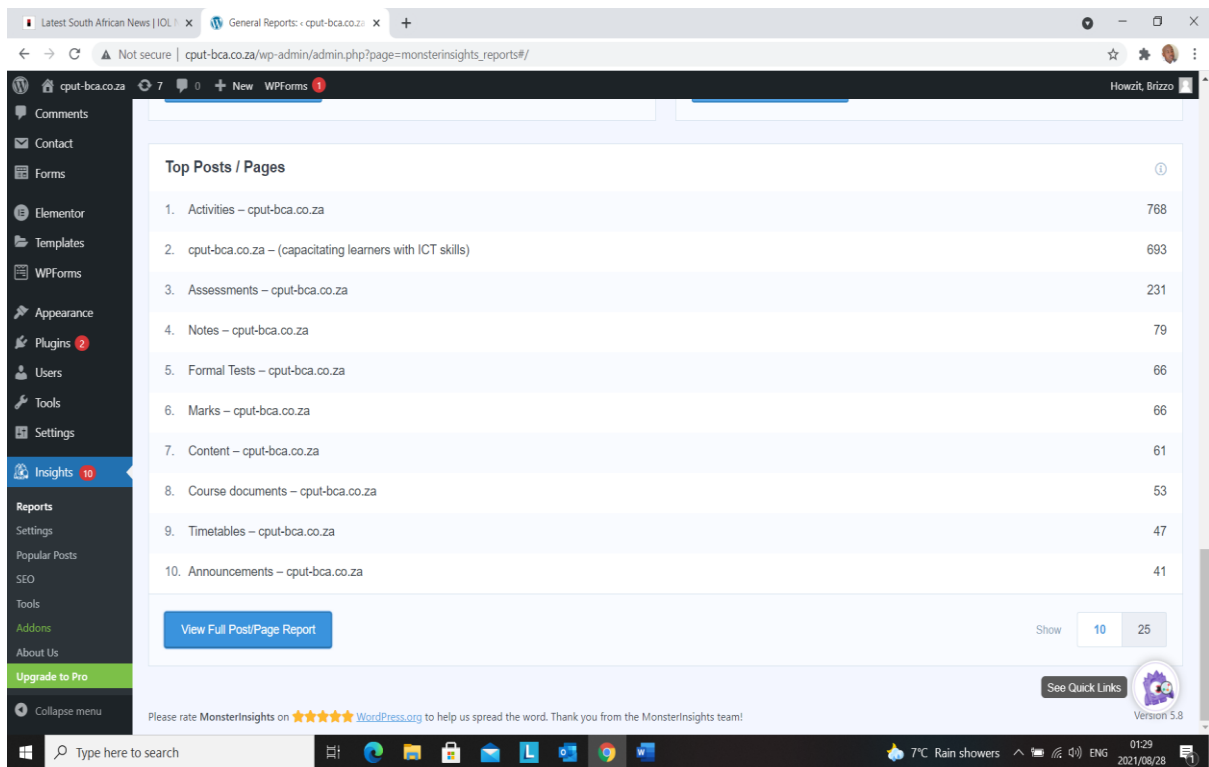


Figure 4.15: Screen showing visits on every page for 28th August 2021

Figure 4.15 shows a screenshot taken from the website, which details the pageviews for each of the website's pages. The screen shows the number of views per page, and shows that the number of views increased when information was added to the website, with the activities page receiving the greatest number of views. This was because to users perceived the page's content to be important. Certain activities that were easy to find owing to the menu's design, were also uploaded to the page.

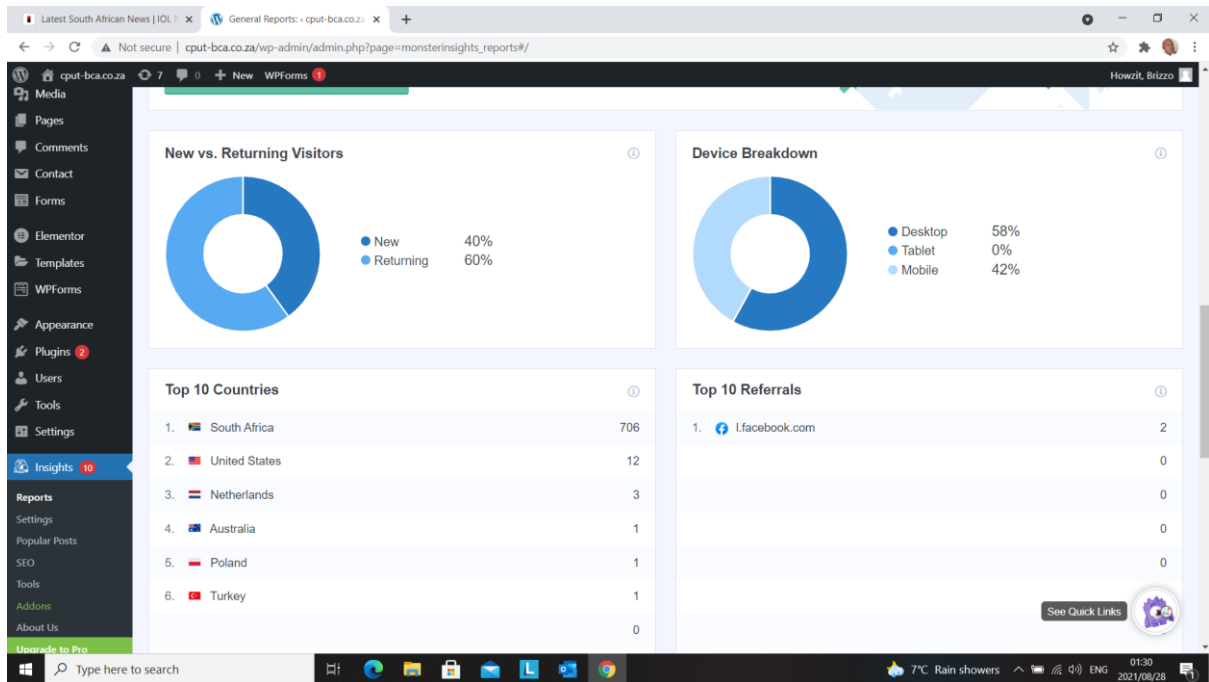


Figure 4.16: Screen showing visitors from different countries

Figure 4.16 shows visitors according to the countries from which they accessed the website. It also shows new visitors compared to those who were not visiting the website for the first time. A breakdown of the type of device that was used to access the website, is also indicated in Figure 4.16.

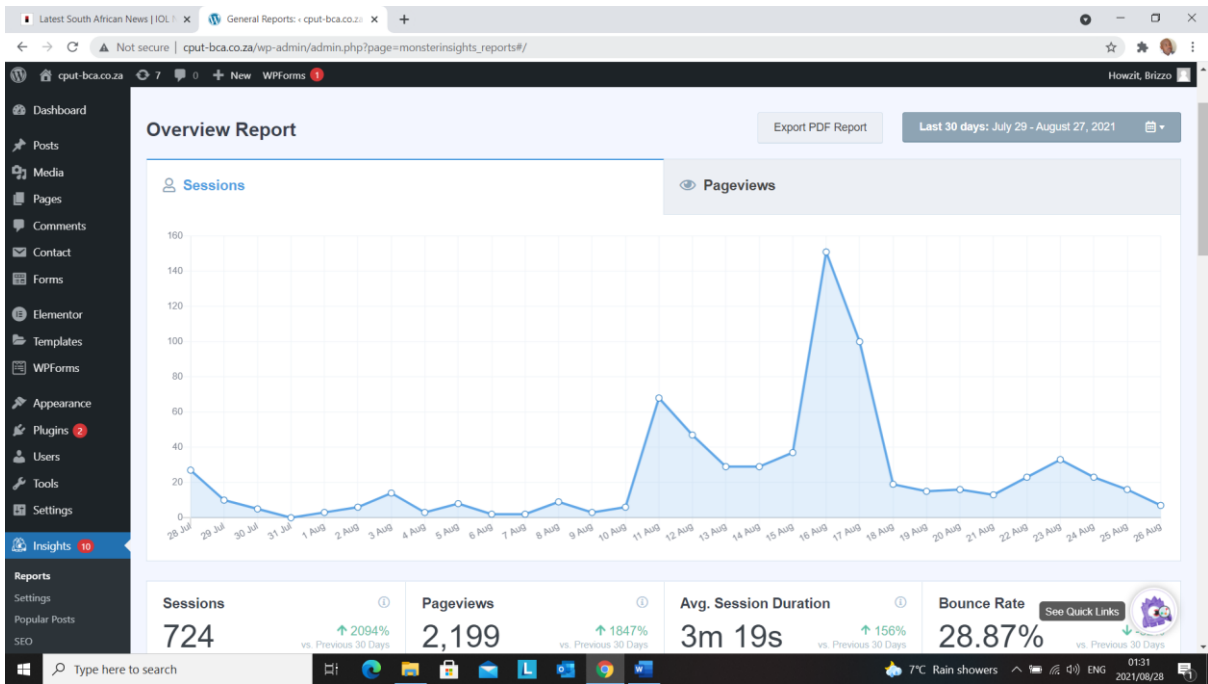


Figure 4.17: Web usage (28th August 2021)

Figure 4.17 indicates web usage during the period 29 July to 27 August 2021.

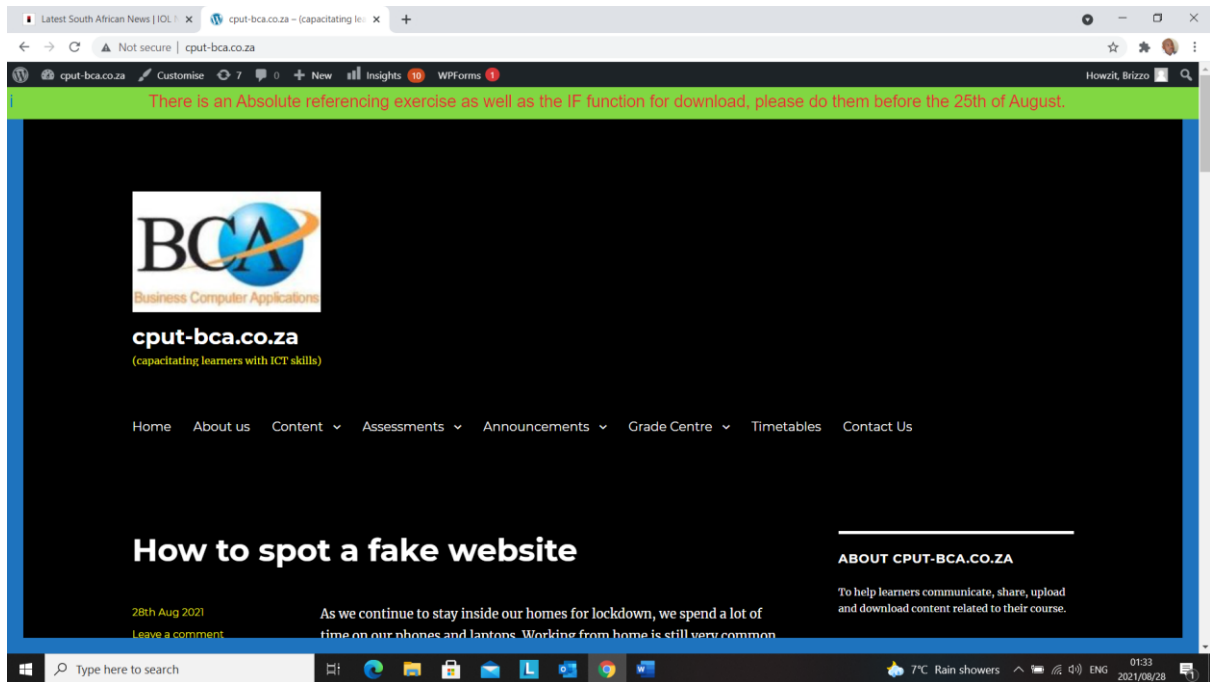


Figure 4.18: A new post was added

Figure 4.18 shows a screenshot from the website with a post conveying an important message for users.

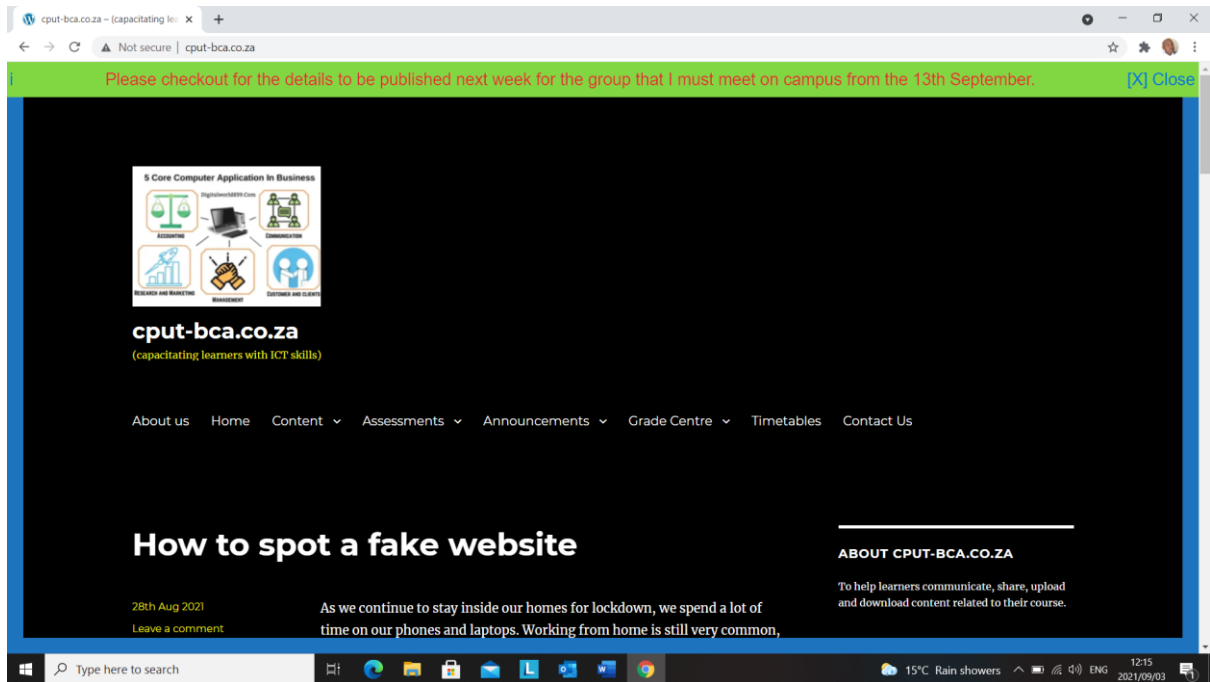


Figure 4.19: Changed logo with a new post and new announcement

Figure 4.19 shows a screenshot of the website's new logo.

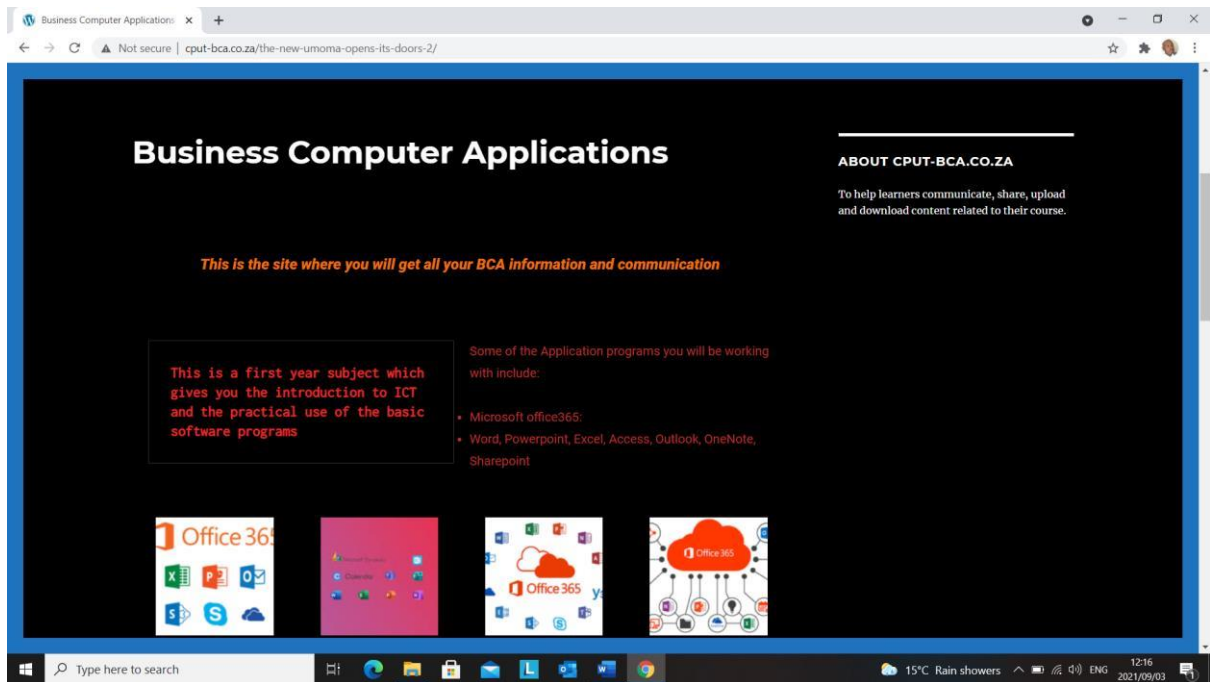


Figure 4.20: Homepage with new BCA content

Figure 4.20 illustrates the website's homepage, with new content that was added.

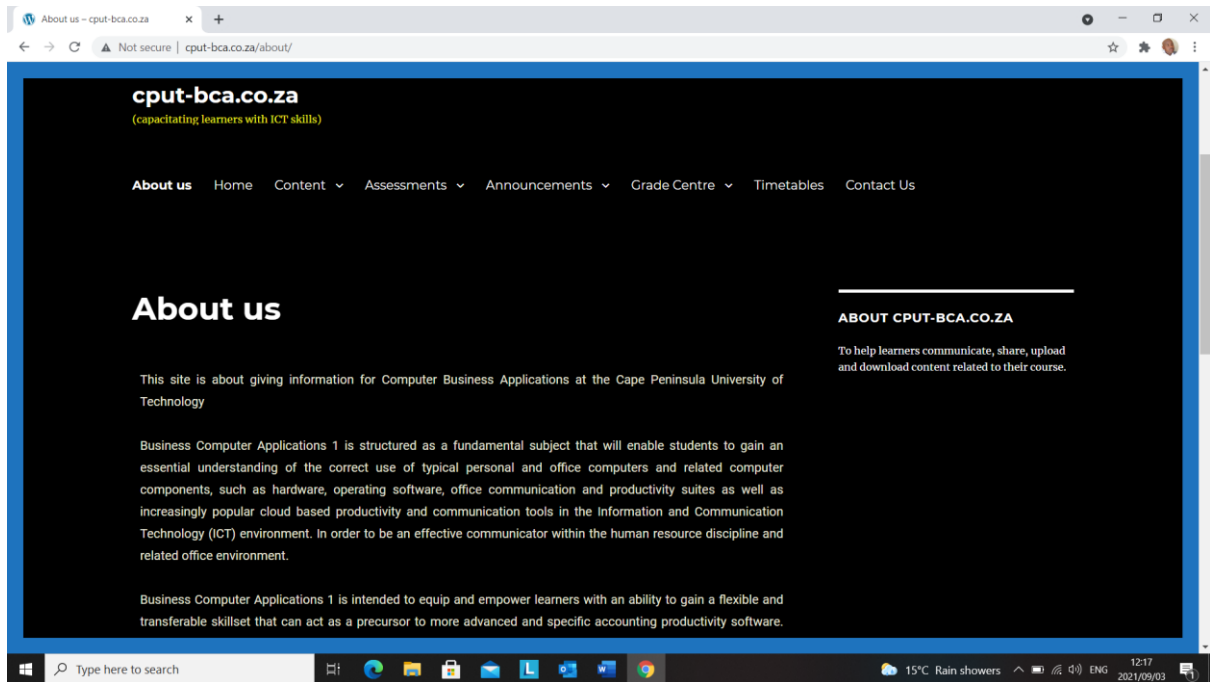


Figure 4.21: About Us page

Figure 4.21 shows the About Us screen, explaining the BCA subject to students, which included new content.

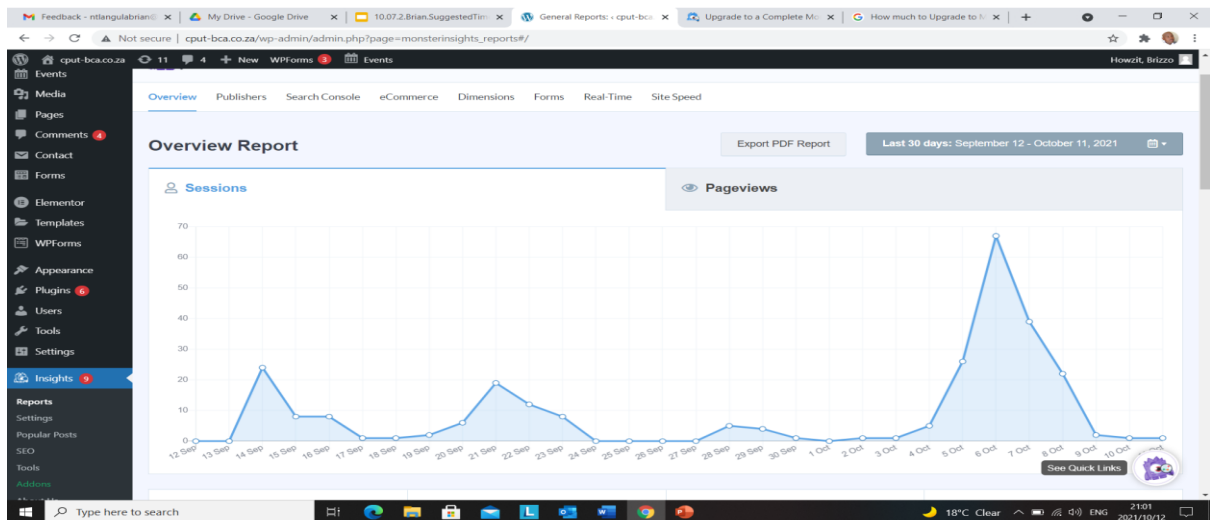


Figure 4.22: Website usage 12 September–12 October 2021

Figure 4.22 shows the website’s usage from 12 September to 12 October 2021, following usability changes that were implemented in October.

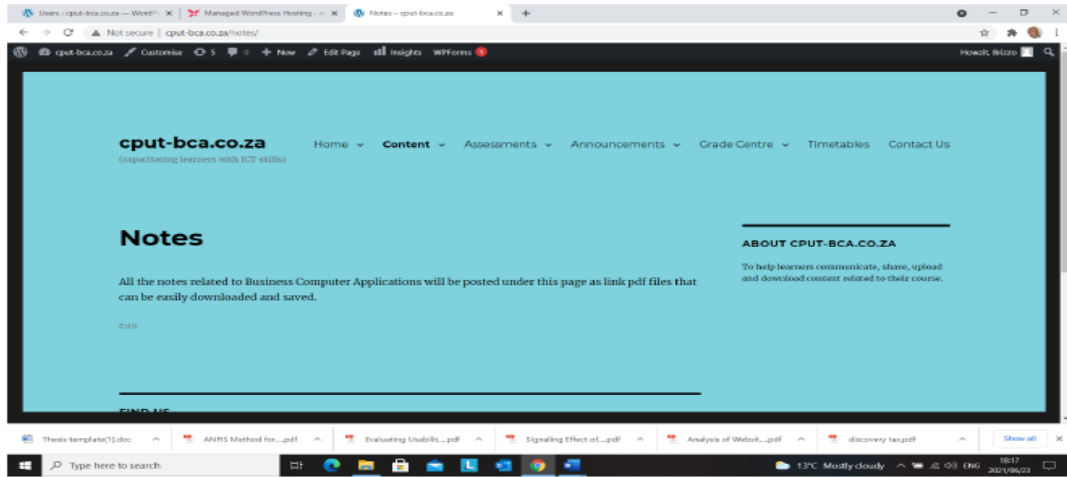


Figure 4.23: Home screen before changes

Figure 4.23 illustrates the website's home page screen before changes were made, and new content was added.

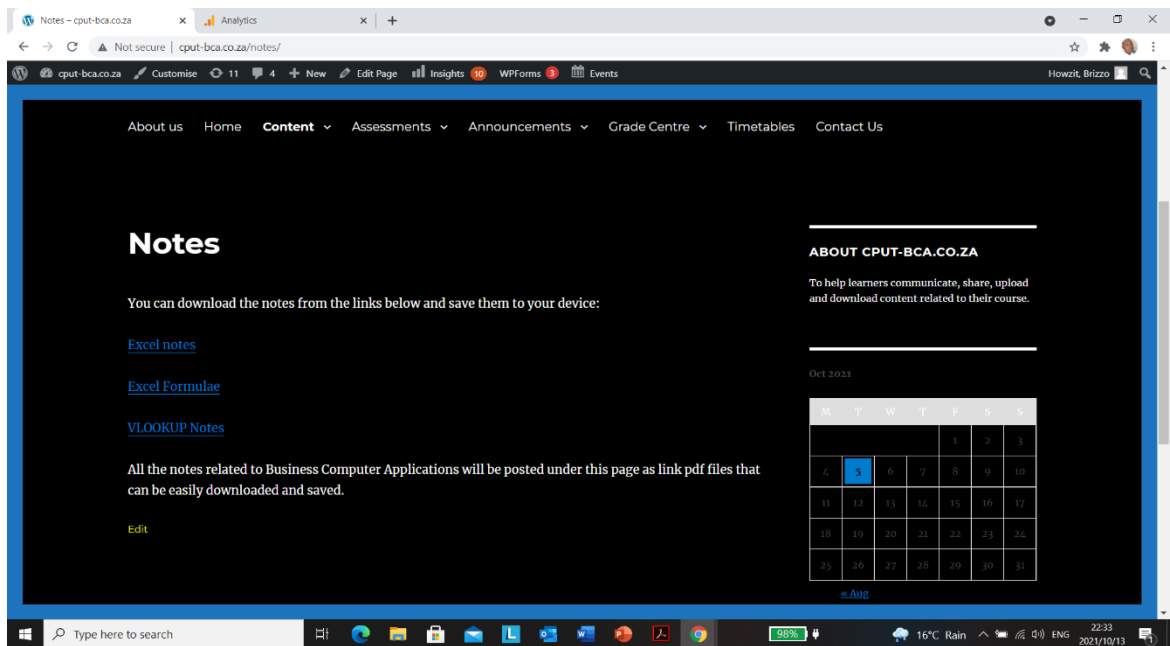


Figure 4.24: Home page after changes

Figure 4.24 shows the homepage following the changes, which include those made to the website's colour theme, as well as content.

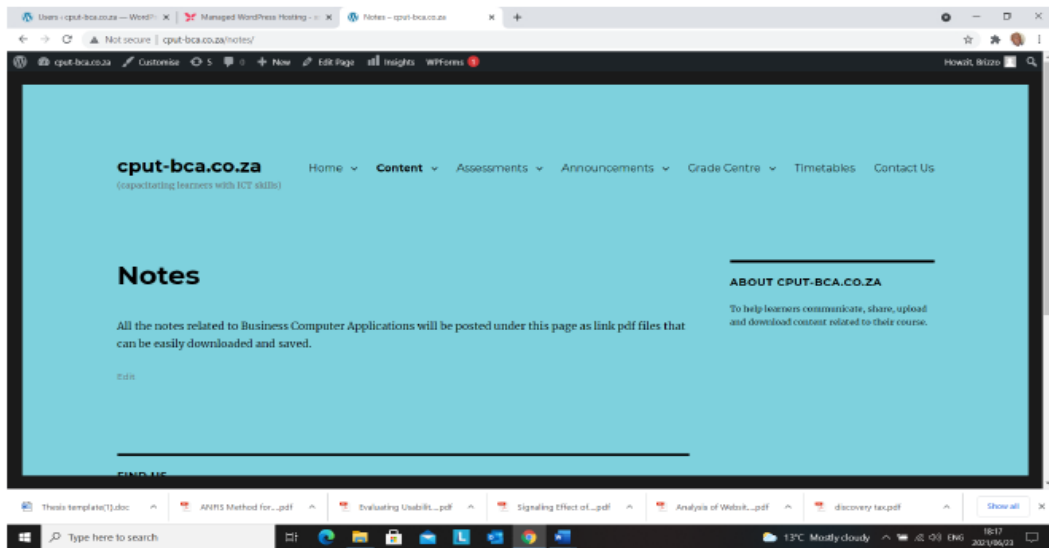


Figure 4.25: Notes page before changes

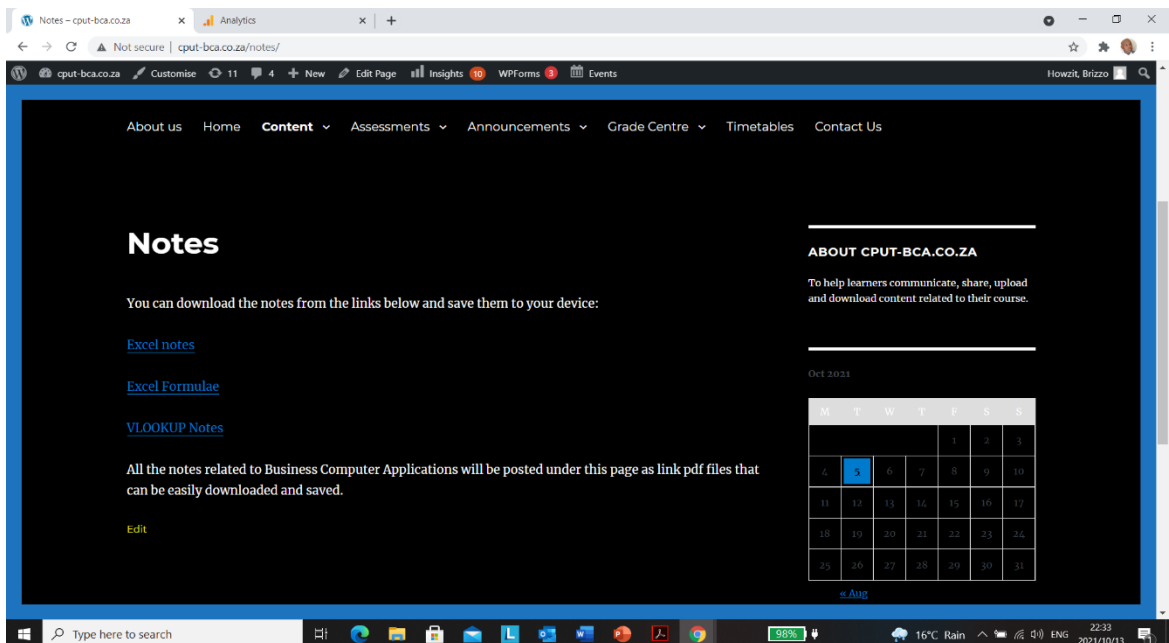


Figure 4.26: Notes page after changes

Figures 4.25 and 4.26 show two screenshots of the notes page before and after changes that were made to these.

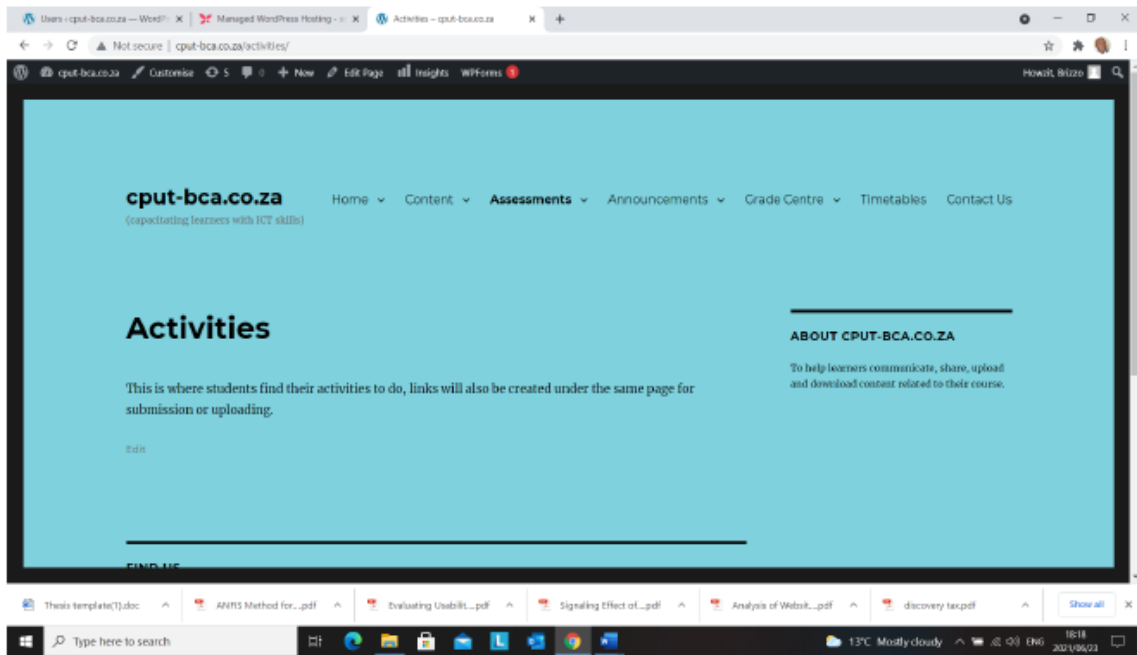


Figure 4.27: Activities page before changes

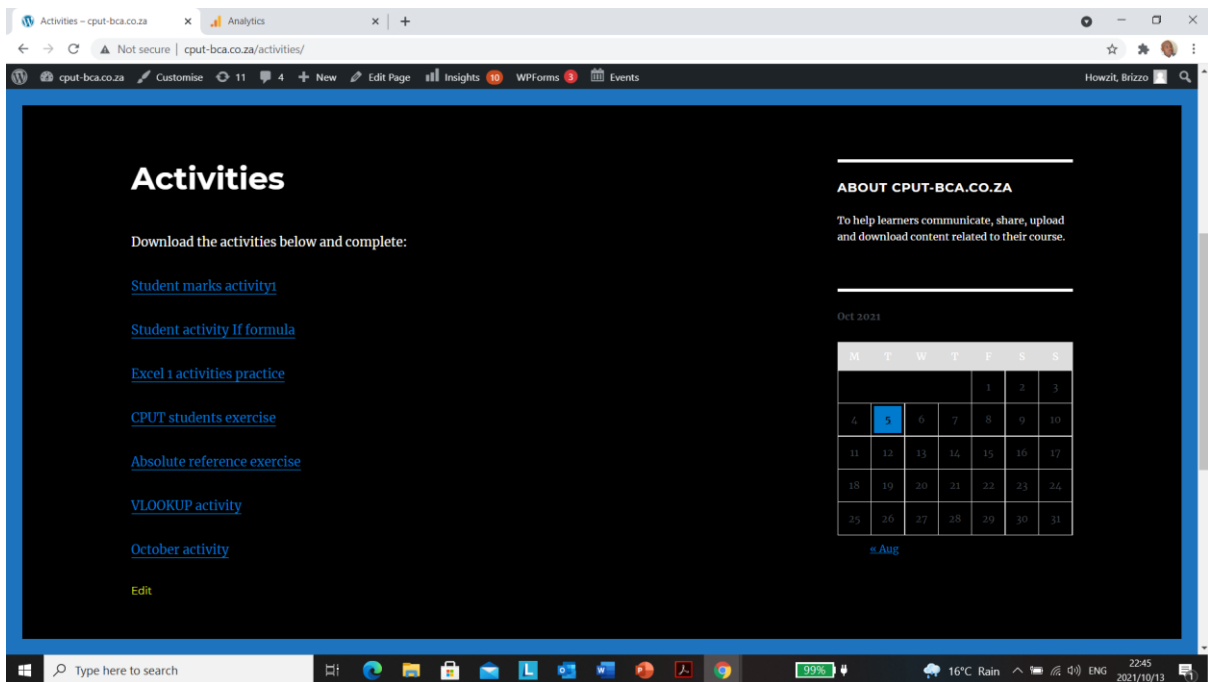


Figure 4.28: Activities page after changes

Figures 4.27 and 4.28 show the two screenshots of the activities page before and after the changes that were made to the site.

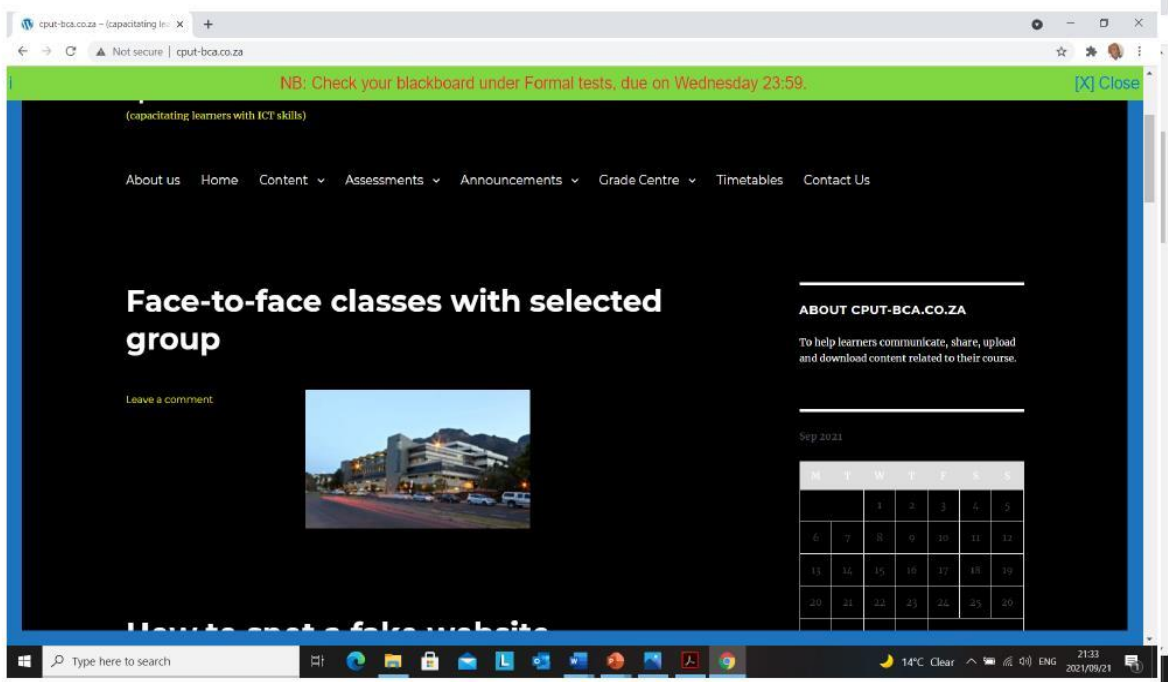


Figure 4.29: Blog post

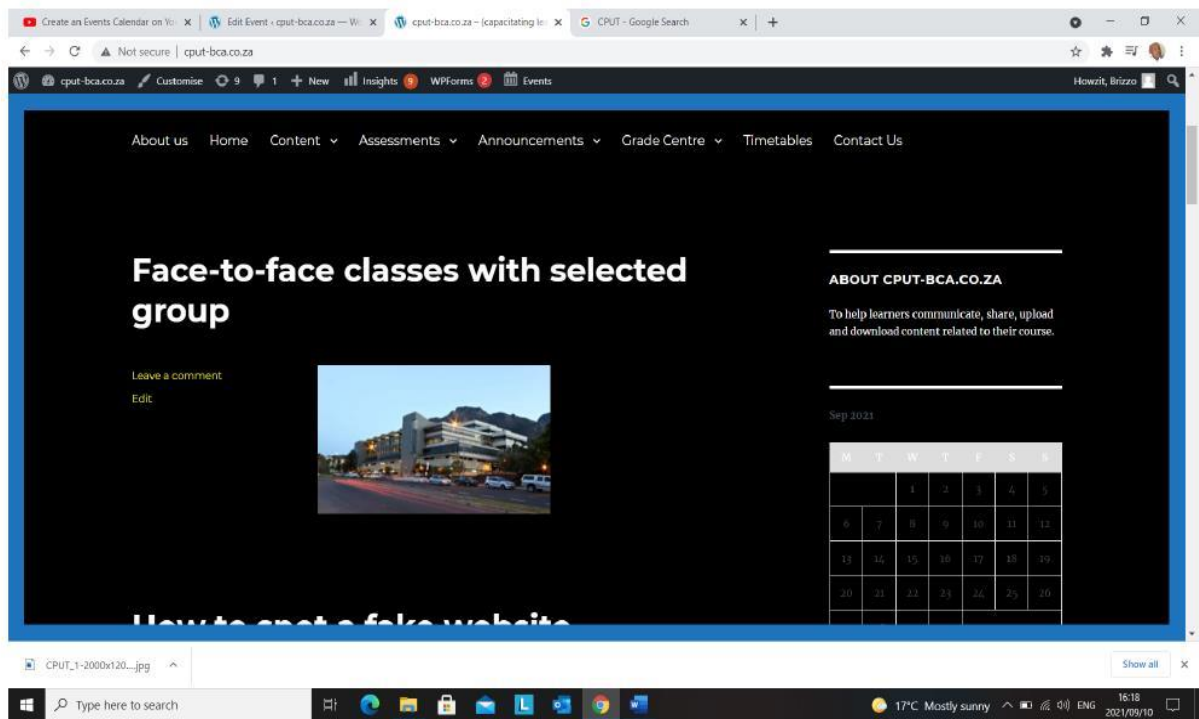


Figure 4.30: Blog post

Figures 4.29 and 4.30 show the blog posts that were created for the website's users.

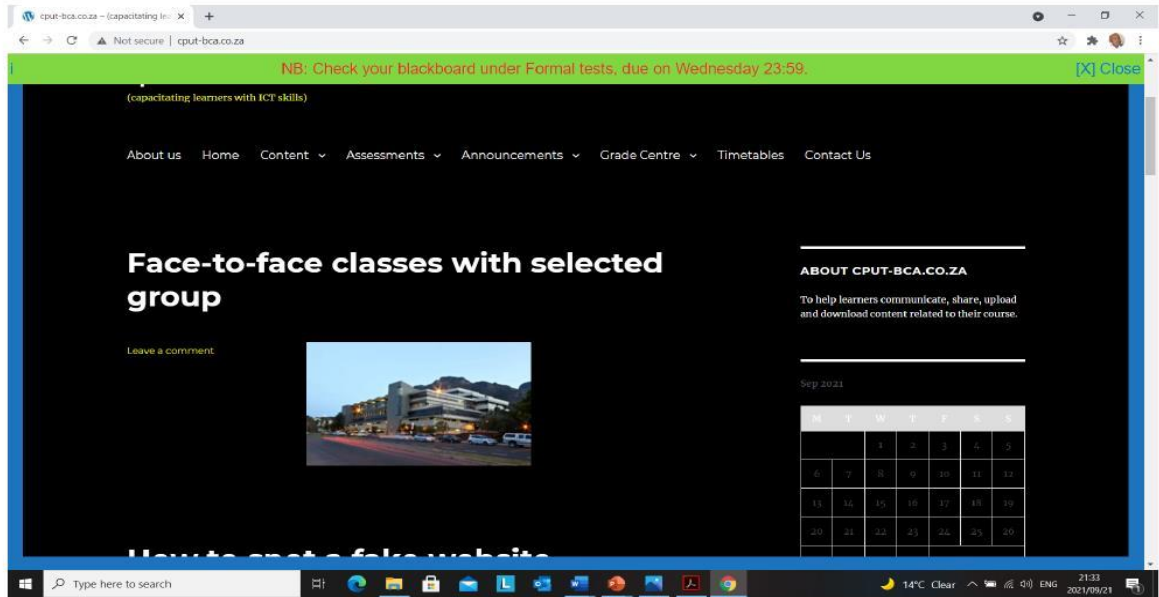


Figure 4.31: Landing page with notice to the students

Figure 4.30 illustrates a screenshot, using an orbisius (the notice on top), which can be placed on the home page or on all the pages for the users' attention. This notice captures the users' attention in respect of any new uploaded content to the website.

4.5 DISCUSSION OF THE RESULTS

This section provides an overview of the web metrics statistics for equivalence to the usability of the website. The selected web metrics included bounce rate, pageviews, unique pageviews and sessions. The changes were observed over a period for monitoring the website usage and web metrics statistics. The following changes were made on the website: Content; new content was constantly added on the website over the usage period of the website where web metrics were tracked. There were changes on web metrics statistics as it showed users accessed the website although they did not stay long.

For the period 26-30 July, sub-menus and downloadable files were added on the and the web metrics statistics showed an increase in website usage as reflected in Figure 4.1. A bounce rate of 45,38% was recorded with 480 pageviews and an increased average session duration of 1 minute 35 seconds in 130 sessions.

For period 29-27 August, the website pages were viewed with users spending 3 minutes 19 seconds on average and a bounce rate of 28,87% was recorded as reflected on Table 4.2 and Figure 4.2.

For the period 12 September-11 October, A logo, new colours, pictures, announcements, reading content, new sub-menus to enhance navigation were added. After these changes, for the period 04-08 October, the website usage was at the highest as reflected in Figure 4.3. The lowest bounce rate was recorded at the same period although users were spending less time per page, 1 minute 5 seconds on average. The changes that were made on the website constantly showed some relationship on the usability of the website and web metrics. When the content or changes were made on hidden pages or areas where users could not find them, the rate of the usage of the website dropped. When changes to menus and content were made on areas that are easily accessible to the users, the usage rate increased. It was easy to identify which webpages were accessed the most after changes through web metrics. The web metrics gave an indication through pageviews, sessions, bounce rates of how usable the website as their statistics changed after usability changes as reflected on the tables and figures of chapter 4. These results support the literature from various usability authors that a website should be designed to be easy to use so that users can find what they are looking for without any obstacles. The usability changes and web metrics gathered from the designed website showed that the two indicators (**usability and web metrics**) can be used to predict the success of an educational website. Therefore, proving that there is some degree of relationship between usability and web metrics.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This chapter provides a summary of the research and ends with a conclusion and recommendations. The conclusion is based on the study's findings, gathered throughout the research by means of the literature review and web data collected from the developed test website through web metrics, using GA. The researcher's own interpretation, based on the website's usage throughout the study period, was also included in this regard.

5.2. Findings

Website usability (which is an indicator predicting the success of a website) is known to be difficult to measure as it is qualitative. Conversely, web metrics, which could also be used to predict website success, are relatively easy to measure, as this is done by using numbers (quantitative). The purpose of the study was, therefore, to find if there is a link between the two indicators that were used to predict website success, as it is unknown if there is one that can be used to predict the other.

5.2.1. Research objective 1 (see Table 3.1): To determine why users like to use certain websites.

The reviewed literature revealed that websites should be designed to be easy to use so that users can find what they are looking for without any obstacles (Nielsen 2000). According to the collected data, users stayed away from the website when there was nothing to find. The collected data, through GA, showed a decrease in website usage, less time spent on the website's pages, fewer sessions, and a higher bounce rate for the individual pages when there was nothing to find on the test website. Visits to the website increased whenever improvements or changes were made, whether in respect of the colour theme, changes to navigation or the introduction of new content. However, it was observed from the web metrics' average session duration, that users would visit the website and spend more time when there was content for them to browse. The bounce rate dropped whenever new content was uploaded to the website. The same web metrics showed that the same users did not spend much time when they could not find what they were looking for, with a lower average session duration and a higher bounce rate. The pageviews and unique pageviews showed the relevance of making changes to the website as the numbers

increased whenever changes were made and decreased when the website was stagnant in terms of no new content or changes.

Therefore, the conclusion for objective 1 is that users do not like to use websites that do not have content that appeal to them, or when they find it difficult to access information they want (navigation). This also reflects on GA through the web metrics such as the numbers of pageviews, sessions, and bounce rate.

5.2.2. Objective 2 (see Table 3.1): To measure the website's usability.

The reviewed literature confirmed that usability is difficult to measure (user testing sessions are required). For this objective, an observation of the website's usage was conducted, using GA. Although it was difficult to point out what the users really liked, there was always an increase in numbers (pageviews) whenever positive usability changes were made to the website such as adding download buttons, a change in colour theme and navigation. These changes are characterised as usability attributes such as efficiency, satisfaction, and memorability, as defined by usability experts.

This showed how usable the website was as it indicated the length of time that the users stayed on the pages or navigating from them, without any engagement. Therefore, as the literature confirms, it was difficult to measure usability on the website, but this research has proven that there were indicators in web metrics that could be used to predict website success.

5.2.3. Objective 3 (see Table 3.1): To measure and collect metrics of a website.

The reviewed literature that covered GA confirmed that web metrics are indicators that can be used to measure website success because they are quantitative in nature. This study collected web metrics such as the numbers of sessions, bounce rate, average session length, pageviews and unique pageviews. These were measured to discover their importance in the developed website and provided a clear view of how the website was being used through numbers.

5.2.4. Objective 4 (see Table 3.1): To determine the best measures for the success of an educational website.

The purpose of this study was to find a correlation between two measures, which can be used as indicators of website success, namely usability and web metrics. An educational website was developed for this purpose. This would allow the measurement of attributes of an educational website used by students. This meant that the pages that were created on the website were relevant to those of an educational website, together with the content. The users, all students, were instructed to visit the website to find information that is relevant to their educational needs. From the data that was collected through GA, it showed that students had indeed visited the website. It was easy to monitor the number of visitors to the website, as well as which pages they viewed and how much time they spent on the site. With changes made to the website, including new content, upgraded menus, and new colours and a logo, it was evident that whenever these changes were made, the users' visitation statistics increased. Therefore, concentrating on the usability of an educational website does draw the attention of users to go and check what is new on the site. At the same time, the statistics that were collected from the web metrics indicate whether the users visited the website, which pages they visited and how long they stayed. For usability changes made on the website, web metrics statistics changed, thus showing that the correlation between web metrics and usability can best be used to determine the website's success.

5.2.5. Objective 5 (see Table 3.1): To determine the nature of the relationship.

The reviewed literature and the study's collected data reveal that although usability is difficult to measure while web metrics are easy to measure, they could both be used to predict the website's success. This would allow users to easily find what they want in less time whilst recalling how to navigate to obtain the information again if they visited the site for a second time. Website owners may not know why exactly users are visiting their websites. Hence, to understand this, it would serve them best to use GA to collect web metrics statistics, which provide a clear understanding of whether usability changes that have been added are attracting visitors to the website.

Therefore, the nature of the relationship between usability and web metrics is that web metrics can be used to predict if usability can enhance the website.

5.3. RECOMMENDATIONS

Further studies should be conducted on the use of metrics coupled with usability. Courses should be designed to make website owners aware of the importance of the use of web metrics to monitor the usability of their websites. This will help them to understand what changes they need to make on their websites, and they should pay more attention to what their visitors want. Many organisations that own websites do not even know how they can increase their clientele through their websites. Some have access to visitor user statistics but may not necessarily know why users keep leaving their websites as they do not understand the link between the web metrics that give them statistics and their site's usability.

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