Journal of Information Systems and Informatics
Vol. 5, No. 1, March 2023 e-ISSN: 2656-4882 p-ISSN: 2656-5935
DOI: 10.51519/journalisi.v5i1.385 Published By DRPM-UBD

An Evaluation Framework for The Adoption of Big Data Technologies in Higher Educational Institutions

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Abstract

The aim of this study is to develop a framework for the use of Big Data Technology in Higher Educational Institutions (HEIs). The research which employed a mixed method approach, is primarily based on relevant critical analysis and literature review of studies conducted within the Big Data Technology area in higher education institutions. It investigated the processes of monitoring student performance by Namibian HEIs. The challenges faced by Namibian HEIs on the use of BDT. The various methods of data collection by Namibian HEIs and determined the level of readiness to adopt BDT.in Namibian HEIs. The study further undertook quantitative surveys and qualitative interviews with staff of the three (3) higher institutions in Namibia. A sample of 345 participants from International University of Management (IUM), Namibia University of Science and Technology (NUST), and The University of Namibia comprising the study's population (UNAM) were selected for this study using the simple random sampling technique. The Unified Theory of Acceptance and Use of Technology (UTAUT) constructs model was used to analyse to collect and analyse the quantitative data collected in this study. Finally, the study developed a sustainable framework that will guide the use of Big Data Technology in Namibian Higher Educational Institutions (HEIs). The validity of the framework was ascertained by expert reviews to ensure that the framework developed is effective and appropriate in fulfilling the purpose of the study and its objectives.

Keywords: Framework, Education, Technology

1. INTRODUCTION

Big Data is formed from large quantities of knowledge consisting of various data types and accumulating at a rapid velocity (McAfee and Brynjolfsson, 2012; Provost and Fawcett, 2013). Big Data is one of the most well-liked Internet technologies which will allow businesses to control information round the physical environment for a more accurate analysis of company performance in response to today's fierce competition (Provost and Forest, 2013).

p-ISSN: **2656-5935** http://journal-isi.org/index.php/isi e-ISSN: **2656-4882**

Big Data Technologies (BDT) blossomed as a promising technology for analysing and managing the Big Data generated in the digital world (Alsheikh, 2019). BDT as a technology, seem to have been developed to handle the tremendous volume of various data produced by users or technology environments. Thus, Big Data could be referred to as the amount of data that eclipsed the processing abilities of current database systems. Big Data is generated by storing large quantities of data in one main storage facility that supports special transactions (Picciano, 2012).

Education across the globe today seems to have become a competition to the extent that institutions vie for the attention of prospective students in order to increase the number of prospective candidates seeking admissions. Rapid innovation in technology appears to have made it easier for schools and colleges to reach out to more candidates as the urge to market them intensifies. In order for advanced education institutions to receive the maximum number of accepted candidates, they are now adopting the ability to analyze, access, and manage vast volumes of data (Schmarzo, 2014). As a result, colleges seem to now have more complicated ways of collecting and reacting to data about students, and as a result are able to target students in more specific ways than ever.

The above is an indication of the multitude of opportunities for universities and colleges to make use of Big Data to improve student and academic staff satisfaction and performance. Notwithstanding the purported competition among universities in recruiting students, the possibility of all benefitting from shared data, it's analytics, and best practices in areas such as student performance effectiveness, student retention, teacher retention, and more, is still possible with BDT. In a world where education holds the greatest potential to drive quality-of-life improvements, there are countless opportunities for educational institutions to collaborate and raise the fortunes of students, teachers, and society at large (Schmarzo, 2014).

BDT appears to be beneficial to HEIs. Notwithstanding this, BDT use by various industries including HEIs, seem to of challenges. Rabella, (2016), argues that not all IT systems can process, organize, and present a large amount of data. There is also a problem of getting users to accept BDT due to the fact that most management find it difficult to adopt new processes since they feel that change management leads to major expenses (Daniel, 2014). Daniel and Butson (2013) further stated that aggregating administrative data, classroom, and online data pose a challenge as most of the institutional data systems are not interoperated.

Furthermore, lack of capacity and capability to handle Big Data within institutions and inadequate Information and Communication Technology (ICT) infrastructure has led to the inability to leverage or support IT and failing to make informed decisions (Daniel, 2014). According to Michael and Miller (2013), there is a rapid expansion of data that exceeds the organization's ability to design appropriate systems that can handle Big Data effectively and analyze it in order to make

meaningful decisions. Daniel (2014) believes that security and privacy issues pose additional challenges to the implementation of Big Data in higher education.

There are several universities operating in Namibia. Due to the high demand for the new students securing places in universities, the growth of educational data is rapidly increasing. High volumes of data need to be secured by using Big Data as it can help universities improve results, help identify students they want to enrol, and improve higher educational performance (Murumba and Micheni, 2017). Students' grading, student performance, and learning performance will be poorly performed if Big Data adoption is not implemented. In addition, there is no guiding technique and principles of how BDT can be integrated so as to enable HEIs in Namibia to benefit from data across boards. Studies on BDT have continuously been centered on student performance (Golding & Donalson, 2006; Saleh, 2020), achievement (Kotsiantis, & Pintelas, 2005), predictive analysis (Murumba & Micheni, 2017; Bill, 2014) and management (Orange-Roglá, Sergio, Chalmeta & Ricardo, 2019; Banica & Radulescu, (2015). This study departs from others to develop an integrated framework for adopting BDT in Higher Educational Institutions, Using the three top Universities in Namibia as case studies.

2. LITERATURE REVIEW

2.1 Big Data Technology Definition

Sin and Muthu (2015) refers to big data as structured and unstructured data sets that are too large and complex for traditional and conventional applications to process or handle. Big Data refers to the large volume of data generated because of the development of technology and the continuous actions and interactions of users in digital environments (Husan and Erik, 2018). Big Data Technologies (BDT) blossomed as a promising technology for analysing and managing the Big Data generated in the digital world (Alsheikh, 2019).

Kiran (2019) explains BDT as a utility software designed to analyze, process, and extract information from complex and larger data that traditional data software cannot deal with. BDT involves the two types of technologies of operational and analytical BDT, where operational BDT is about the day to day data that is generated (online transaction and social media), and analytical data technologies involve the real-time business operation such as weather forecast and the stock market. The most important top BDTs are; data storage, data mining, data analysis, and data visualization (Kiran, 2019). BDTs in education is implemented for several purposes such as Detection of learners dropping out risk rates, Performances prediction, Behaviours investigation, Absences tracking, Courses recommendations, Instant assisting and assess in HEIs, Visual analytics on learner's interaction with a discussion forum, Improvement of accessibility, Research and development,

Evaluation, and accountability, Identification of learners at-risk of failing, and at the course level (Bamiah, Brohi, & Rad, 2018).

2.2 Benefits of big data in Education (BDT)

Big Data provides an opportunity to educational institutions to use their Information Technology resources strategically to improve educational quality and guide students to higher rates of completion, and to improve student persistence and outcomes (Murumba and Mitcheni, 2017). Cen, Ruta and Ng (2015) agree that big data introduces opportunities of improving the efficiency and effectiveness of students' learning and maximising their knowledge retention.

BDT plays an essential role in optimizing education intelligence by facilitating institutions, management, educators, and learners improved quality of education, enhanced learning experience, predictive teaching and assessing strategy, effective decision-making and better market analysis. Moreover, BDTs are used to analyze, detect and predict learners' behaviours, risk failures and results to improve their learning outcomes and to ensure that the academic programmers undertaken are of high-quality standards (Bamiah, Brohiand and Bashari, 2018).

2.3 Challenges of BDT.

There are several challenges that HEIs are experiencing nowadays because of BD. These challenges are lack of framework for the adoption of BDT in HEIs, Data Storage/Lack of infrastructure, Information Security and Privacy, Lack of professionals, no Guiding Techniques and principles. Non-availability of BDT in Higher educational Institutions

2.1 Factors that enhances BDT adoption

Factors related to the success of adopting Big Data include cost-effective/efficient, management supporting, infrastructure, communication, skilled team/staff, political stability, social and culture, citizen involvement, organization maturity, privacy and security, and realistic plan/objective (Zulkarnain, Meyliana, Hidayanto and Prabowo, 2019). Additional factors to the adoption and success of BDT include performance expectancy, social influence, facilitating conditions, effort expectancy and resistance to use, among others.

3. METHODS

The study employed the mixed method as its research approach. "Mixed methods create paradoxes and conflicts that bring about new information" (Greene, 2007). Thus qualitative (interviews) and quantitative (questionnaires) responses helped to give a voice to study participants and ensure that the study's findings are grounded in participants' experience

The population of this study was made up of administrative staff and lecturers of the IUM, NUST and UNAM. According to Tjivukwa (2016), NUST has over 300 academic staff and other non-academic staff spread over the regions of Namibia while UNAM has over 2500 staff spread over the regions of Namibia (UNAM) All staff of the three universities could not be selected, hence for the purpose of this study, a fraction of the population was selected for data collection.

The study sample was selected from IUM, UNAM and NUST's administrative staff and lecturers. The study gave an equal chance to the participants of being selected. Hence, a sample of 100 academic staff, and 9 administrative staff within the examination department, 6 IT personnel were selected from each university through simple random sampling, giving a total of 345 respondents.

Theoretical Foundations in BDT Adoption Research

The adoption and use of technology in developing countries' education institutions have been planned to support students in classroom teaching and improve the quality of education. In this study, the researcher used concepts from the Unified Theory of Acceptance and Use of Technology (UTAUT) model to explore the factors on the adoption and use of BDT in Namibian top three universities. The theory also helped in the development of the research instruments which lead to the development of a framework for the adopting and integration of use of BDT.

The UTAUT is a technology acceptance model articulated by Venkatesh et al. (2003) to explain user intentions to use an information system and subsequent usage behaviours. Venkatesh et al. (2003) reviewed related studies and conducted an empirical study where they synthesised several elements of the eight behavioural intention models used in previous technology acceptance contexts. The UTAUT model consists of four main direct determinants of behavioural intention (BI) and usage behaviour (USE) are Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC). Meanwhile, gender, age, experience, and willingness to use technology are the moderators that affect usage of technology (see Figure 3).

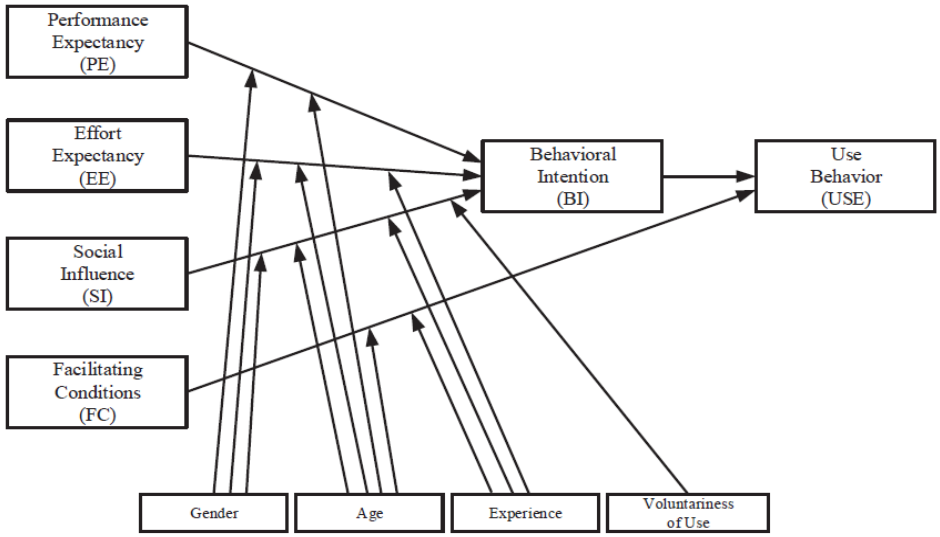

Figure 1. UTAUT Model suggested by Venkatesh et al. (2003)

In this study, graphs and tables were used to analyse quantitative data from the survey questionnaire.

3. RESULTS AND DISCUSSION

The study's goal is to develop a framework for the adoption of big data technology in Higher Educational institutions (HEIs). Therefore, the main research objective is answered by the findings presented here. Respondents included administration staff with the examination department, academic staff and IT personnel from IUM, NUST and UNAM.

Table 1. sample of the study

Staff Type	Questionnaires Distributed	Questionnaires Returned
Administration Staff	9 (IUM) 9 (NUST) 9 (UNAM)	8 (IUM) 7 (NUST) 8 (UNAM)
Academic Staffs	100 (IUM) 100(NUST) 100 (UNAM)	87 (IUM) 72 (NUST) 66 (UNAM)
IT Personnel	6 (IUM) 6 (NUST) 6 UNAM	6 (IUM) 5 (NUST) 5 (UNAM)

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3.1 Findings

This section provides a detailed analysis of data gathered to form an opinion about the adoption of big data technology in Namibian HEIs.

3.2. General Knowledge

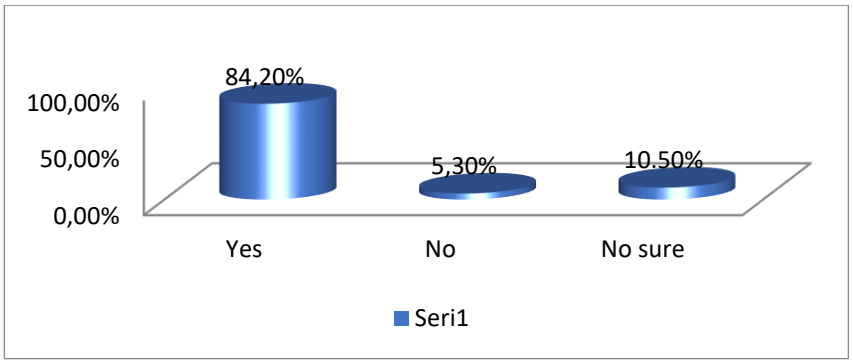

Figure 2. computer literacy

Figure 2 results indicate that 84.2% of the respondents were computer literate and 5.3% are not, while 10.5% were not sure of the skills they have. The results point to the fact that a majority of the staff are already computer literate. This means that they have enough knowledge to use information technology. However, those who have little or no knowledge in the subject matter should also be taken into consideration.

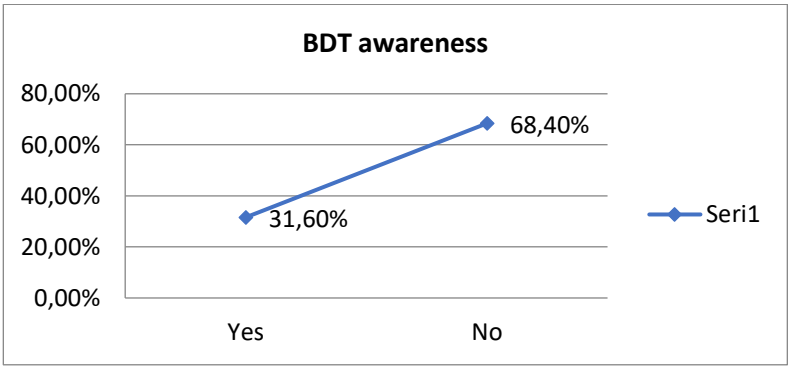

Figure 3. BDT awareness

The results presented in Figure 3 shows that 68.4% of respondents agreed that they have heard about Big Data Technology and 31.6% indicated that they have not. This means that more awareness is needed in this aspect if BDT is to be used in the universities.

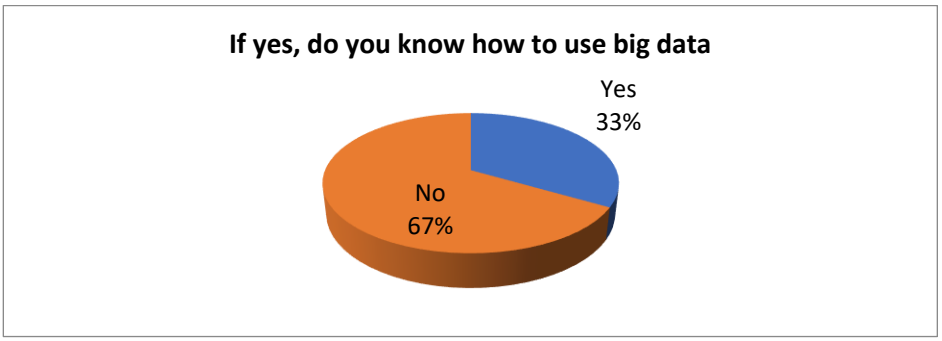

Figure 4. Do you know how to use big data

According to the results presented above in Figure 4, it shows that a majority (63.2%) of respondents indicated that they do not know how to use Big Data Technology, while 31.6% of the respondent noted that they can use the technology. Not minding the fact that a majority of the respondents (84.2%) indicated in figure 6.5 noted that they are computer literate, only 31.6% of them indicated that they know how to use Big Data Technology. This means that a lot still needs to be done to bring all staff up to date as this will enhance the use of BDT in the universities.

3.3. How do you monitor student's performance in your university?

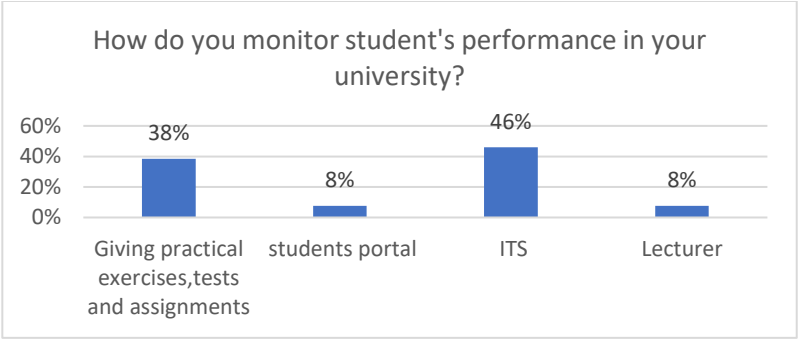

Figure 5. How do you monitor student's performance in your university

Bhatia, (2019), refers to monitoring as the continuous collection and analysis of data to assess the effectiveness of a program. Bhatia (2019), also stated that there are numerous advantages to continuously monitoring student progress in the classroom such as providing teachers with useful information about their students' progress and achievements and allowing teachers to reflect on their own teaching and evaluate the impact of the instructional strategies they use. According to Renerd (2018), there are several ways on how you can monitor students' performance; automatic graded quizzes, test, observation, evaluation, and assessments. Figure 5

indicates that, a majority of respondents (38%) used practical exercises, tests, and assignments to monitor student performance at the university, while 8% used the students' portal, 46% ITS, and 8% Lectures respectively. This finding will go a long way to assisting the researcher when developing the framework since the results will determine ways in which students' performance can be enhanced.

3.4 What tool do you use to monitor students' performance in your university?

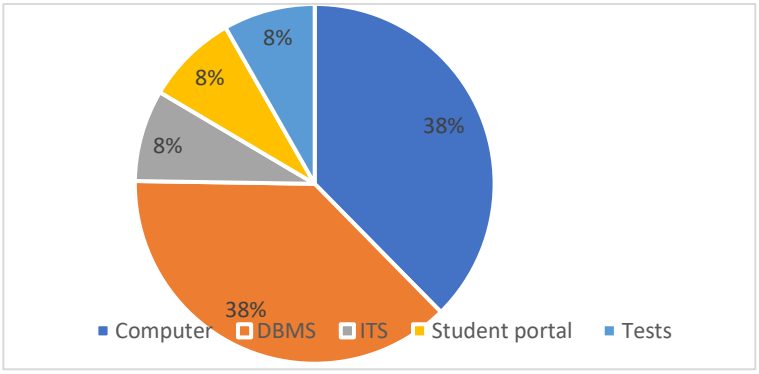

Figure 6. Tool used to monitor students' performance.

Student progress monitoring is a practice that enables teachers to use student performance data to continuously assess the effectiveness of their instruction and make more informed instructional decisions (Bhatia, 2019). Learning Management Systems (LMS) have been shown to be effective in distance and hybrid teaching models, and they are one of the tools used to track student performance. Antunes, Oliveira, Gusmão, Lucena, Nozawa, Brodbeck (2016). Figure 6 shows that 38% of respondents used DBMS and 38% used a computer tool to monitor students' performance in their university while 8% used ITS, 8% student portal and 8% tests. This data is useful in determining the monitoring component that will be in the framework.

3.4 How often should a student's performance be monitored?

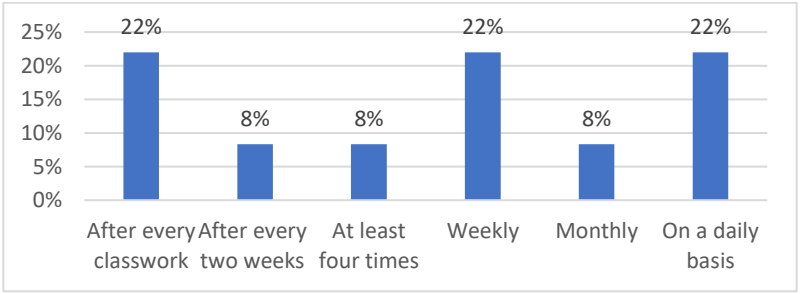

Figure 7. how often should student's performance be monitored

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According to Brenda Weaver (n.d), students should be tested as frequently as a teacher needs to evaluate their learning in order to provide more effective instruction. All areas are typically serviced at least once every ten weeks. However, she further explained that in some areas, such as oral fluency, the teacher will want to assess more frequently. As indicated in Figure 7, 22% of respondents noted that performance should be monitored after every classwork, 22%, weekly and 22% on a daily basis, 8% said it should be monitored after every two weeks, 8% at least four times and 8% monthly.

3.5 What challenges are faced by your University on the use of big data technology?

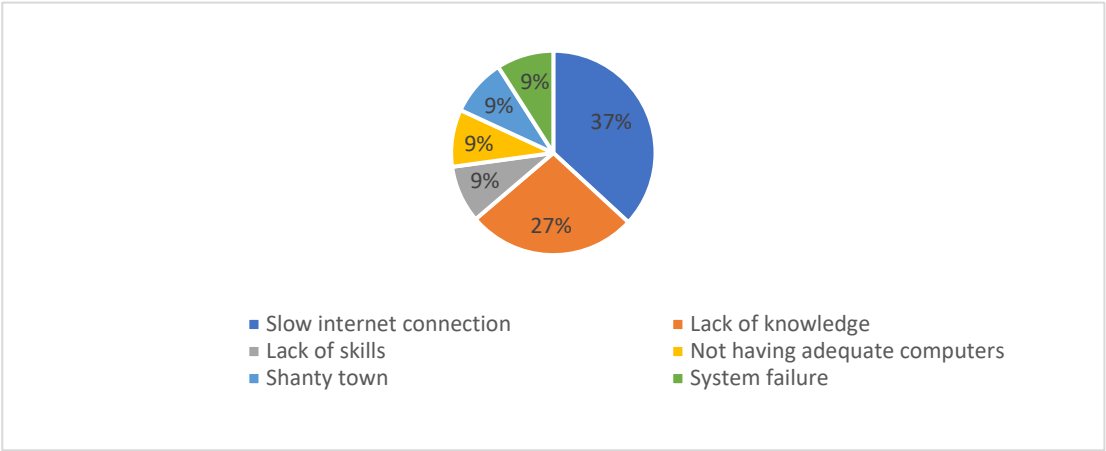

Figure 8. What challenges are faced by your university on the use of big data technology.

Every second, massive amount of data are generated from business transactions, sales figures, customer logs, and stakeholders; data is the fuel that drives businesses, and this data accumulates in a massive data set known as Big Data (Sharma, 2021). There are several challenges that HEIs experiencing nowadays because of BDT, these challenges are as follows; lack of infrastructure (Rabella, 2016), no guiding techniques (Shu, 2016), information security and privacy (Daniel, 2014), lack of qualified professionals (Boulton, 2015 and Bamiah et al, 2018).

There has been little progress in gathering the extremely rich data that flows through higher education systems in order to obtain usable information for students, instructors, administrators, and the general public (Mohsen & John & Derek. 2018). From the information presented in Figure 8, it shows that 37% of the respondents indicated that slow internet connection is one of the challenges faced by their university on the use of big data technology and 9% of them were of the view that lack of skills, Furthermore, 9% of the respondents subscribed to inadequate computers, 9% system failure while 27% went with lack knowledge. The responses

demonstrates that there are indeed challenges affecting the implementation of big data technology in Namibian HEIs.

3.6. Can the challenges affect student's performance in your university?

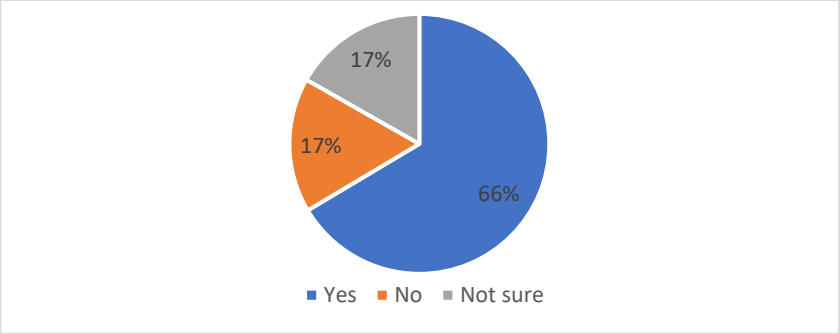

Figure 9. challenges affect student's performance in your university

Figure 9 presented above shows that of 66% of respondents agreed that the challenges can affect students' performance in their university and few (17%) of them said it cannot while 17% of the respondents were not sure. Be that as it may, it is wise to look for ways to tackle the challenges for better student performance.

3.7. To investigate the challenges faced by Namibian HEIs on the use of BDT

The challenges faced by the Namibian HEIs on the use of BDT were divided and analyzed in the following categories

a). Environmental challenges
b) Technological challenges
c) Organizational Challenges

3.7.1 Environmental challenges

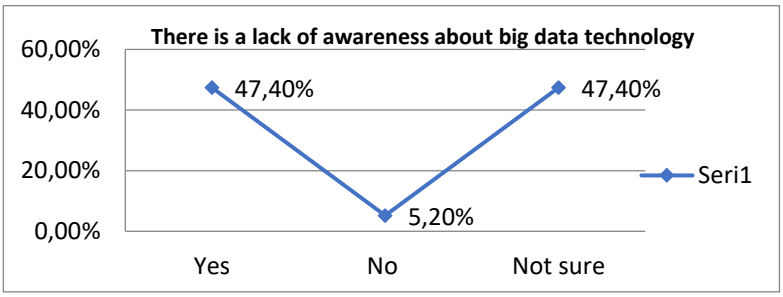

Figure 10. Lack of awareness about BDT

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It is worthy to note the awareness of technology counts greatly when it comes to its usage. If individuals are not aware that there exists a particular type of technology, there is the possibility that they would not have the knowledge of that particular technology. According to the results presented in Figure 10 above, it shows that 47.4% of the respondents agreed that they are aware of BDT while 47.4% were not sure and 5.2% further indicated that they are not aware of BDT. The gap between the respondents who are aware of BDT and those whose and not sure od=s too wide and may be a challenge. Therefore, it is suggested that something needs to be done in order to bridge the gap.

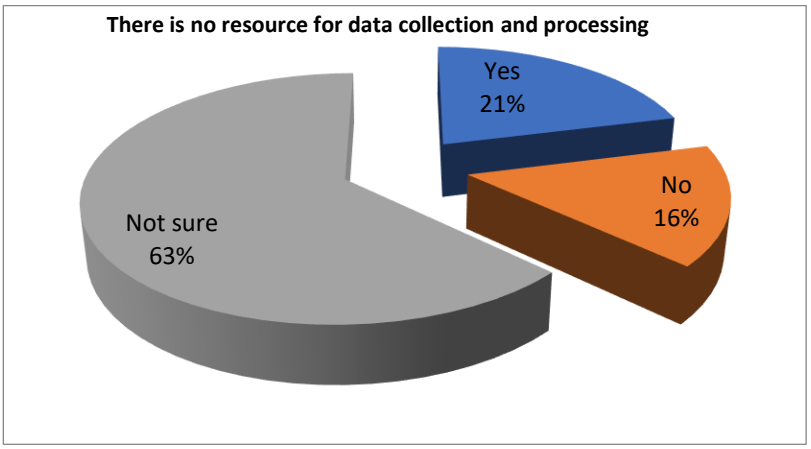

Figure 11. No resource for data collection and processing

Where there are no resources to carry out activities, there is every tendency that the particular activity may not be successful. According to Bloge (2019), When resources are available, activities are sped up and carried out to its logical conclusion. The results presented above in Figure 11 shows 63% of the respondents indicated that they were not sure if their university has enough resources for data collection and processing, while 21% responded noted that there are resources in their university for data collection and processing and only 16% of the respondents agreed that there are resources. Judging from the responses only few (16%) of the respondents indicated that there are resources for data collection in their universities. This is too small compared to the percentage of respondents who gave negative responses. Therefore, one can conclude that efforts should be made to provide resources for data collection and processing in these universities.

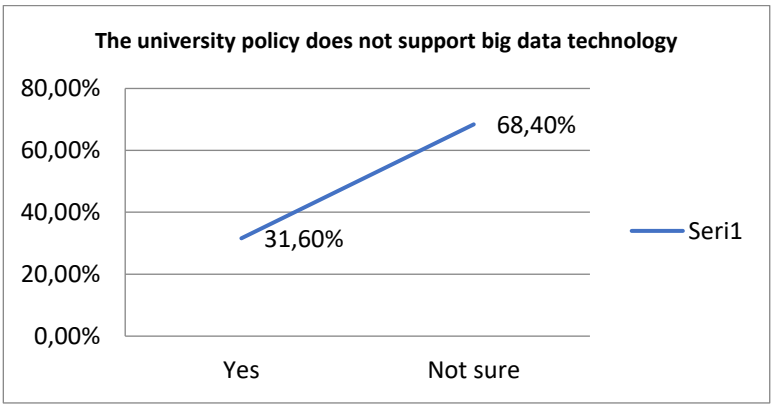

Figure 12. University policy does not support BDT

It is important to note that policies guide the day to day running of every organisation. Where there are no policies, it will be difficult to control and organise the various activities in an organisation. The result presented above in Figure 12 shows that 68.4% of respondents said they were not sure if the university policy that supports big data technology, while 31.6% said yes to that.

3.7.2. Technological Challenges

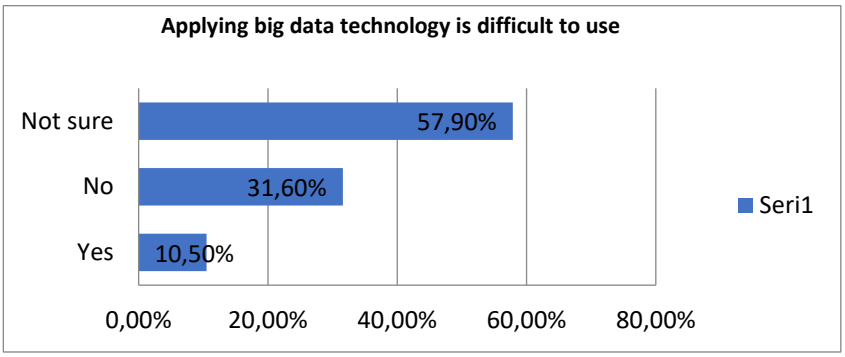

Figure 13. Applying BDT is difficult to use

According to the results presented above in Figure 13, 57.9% of the respondents were not sure if BDT will be difficult to use. This percentage of respondents could be part of those who indicated that they are not aware of BDT. This is because they may not have used it. On the other hand, 31.6% of the respondents indicated that applying BDT will not be difficult to use while 10.5% of the respondents are of the opinion that BDT will be difficult to use. This boils down to training. According to Osakwe et al, (2017) training increases the skills and the ability of individuals to use technology.

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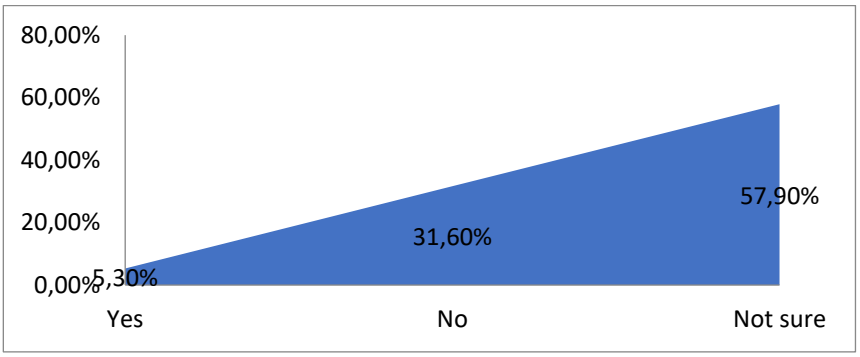

Figure 14. IT infrastructure not supporting BDT

For any institution to use BDT, the institution must as a matter of importance, have IT the relevant IT infrastructure that will power the innovative technology. Osakwe, et al (2017) noted that IT infrastructure is a necessity for any institution that wants to use technology for teaching and learning. The results presented in Figure 14 shows that the majority of the respondents (57.9%) are not sure if their institutions have IT infrastructure that will support BDT while 31.6% of the respondents noted that they are not and if their institution has IT infrastructure that will support BDT. Interestingly, only 5.3% of the respondents indicated that their institutions have enough IT infrastructure to support BDT. The percentage is very small compared to the responses from other respondents on the question. Therefore, there is a need to look at the area of providing adequate IT infrastructure to enhance the use of BDT in HEIs.

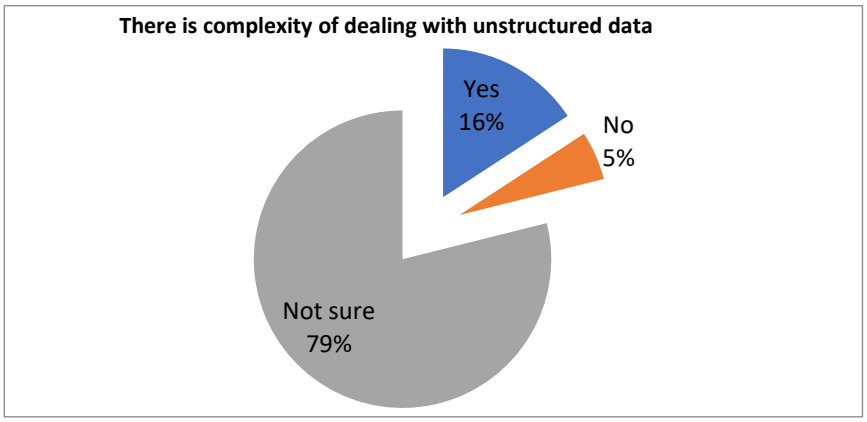

Figure 15. There is complexity of dealing with unstructured data

Structured data is highly organized and formatted in such a way that it can be easily searched in relational databases. Because there is no predefined format or organization for unstructured data, it is much more difficult to collect, process, and

analyse (Pickell, 2018). According to the results presented in Figure 15, it shows that 79% of respondents were not sure if their university can handle the complexity of unstructured data while 16% were positive. On the other hand 5% of the respondents indicated that their institutions can handle the complexity of unstructured data.

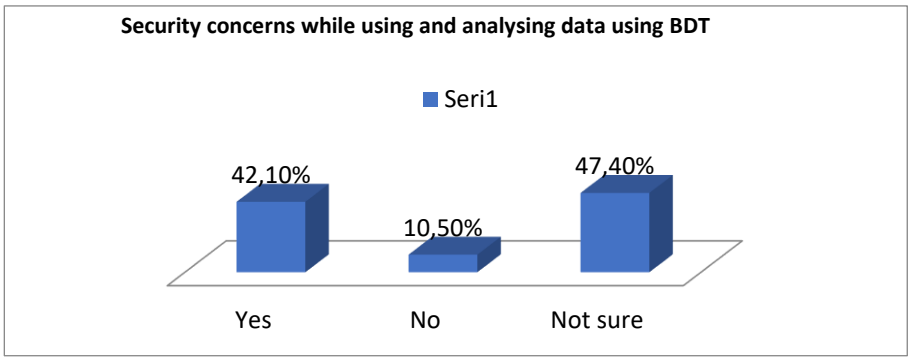

Figure 16. Security concerns while using and analysing data using BDT

Big Data security is the process of protecting data and analytics processes, both in the cloud and on premises, from a variety of threats that may jeopardize their confidentiality. Figure 16 presented above shows that 47.4% responded that they are not sure if there will be security concerns while using BDT, while 42.1% are of the view that there will be security concerns while using and analysing data using Big Data technology. On the other hand, 10.5% noted that there will be no security concerns.

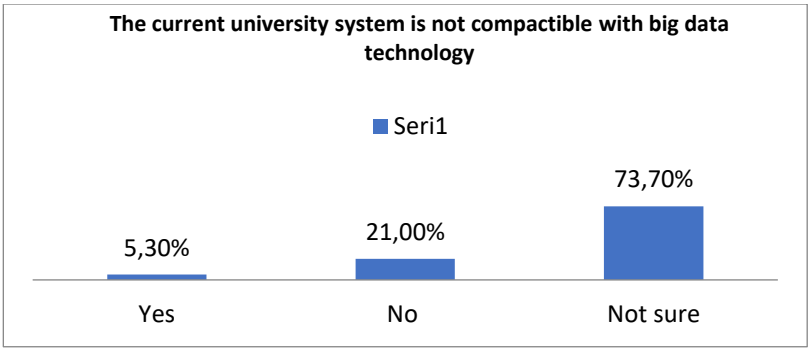

Figure 17. Current university system is not compatible with Big Bata Technology

According to the result produced above in Figure 17, it shows that 73.7% of respondents were not sure if the university system is compatible with BDT. This could be true judging from some of the responses of the respondents in the area of awareness and the universities not having enough IT infrastructure for. This also goes for the 5.3%% of the respondents who indicated that the current university

system is not compatible with big data technology. However, 21.1% noted that their current university system is compatible with BDT.

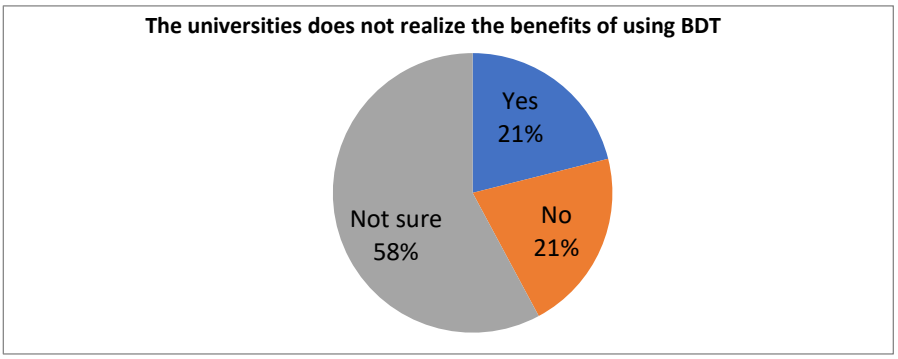

Figure 18. Universities does not realize the benefits of using BDT

With higher education institutions increasingly connecting with their students via the internet, opportunities for big data collection and use in university recruitment and pedagogical innovation are expanding. These are some of the ways in which big data technology can benefit the university: student recruitment, improved student performance, and teacher effectiveness (Baker & Baker, 2017). The result displayed above in Figure 18 shows that the majority of 57.9% of respondents were not sure if their university realised the benefit of using Big Data Technology. 21% were positive while 21% were negative.

3.7.3 Organizational Challenges

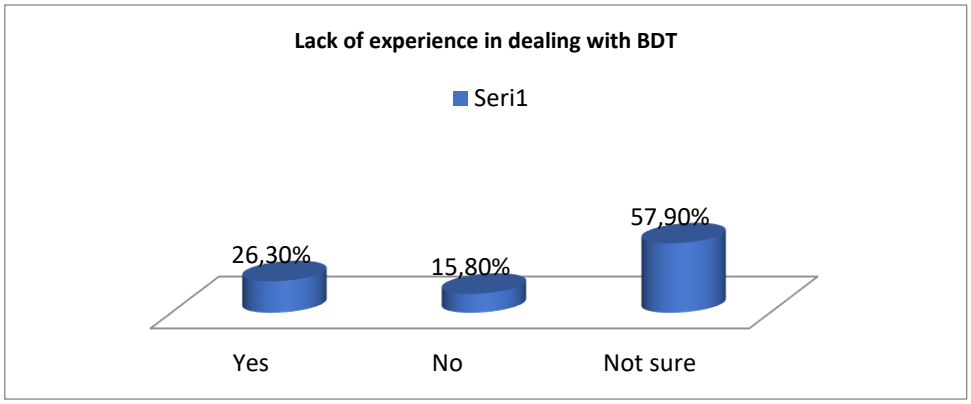

Figure 19. Lack of experience in dealing with BDT

According to the researcher, big data technology is one of the new technologies that has been recently used by developed countries. It is recommended that one needs to be qualified in order to use BDT. The results presented above in Figure 19 shows that 57.9% of respondents were not sure if they have the experience in dealing with

big data, while 26.3% indicated that they have the experience on the other hand 15.8% of the respondents do not have the experience in dealing with BDT.

3.8. Results from UTAUT question

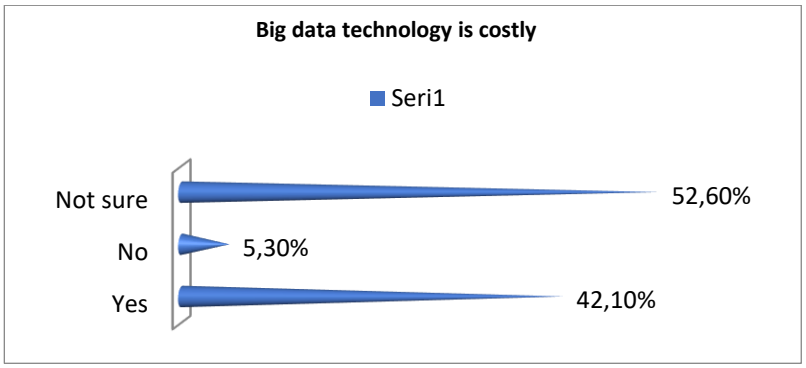

Figure 20. BDT is costly

Big data analytics refers to data sets that are excessively large in number, generated at a high rate, and come in a variety of formats. As a result, these data sets are referred to as "big data." Because of their poor algorithms, high costs, and other factors, they are difficult to manage using conventional methods and may be expensive to maintain (*Big data analytics*, 2018). From the results presented in Figure 20 above, it shows that 52.6% of respondents were not sure if BDT is costly. This could be because they are not too familiar with it and its operations as can be seen from their responses in previous sections. Furthermore, 42.1% noted that BDT is costly to implement, 5.3% disagreed.

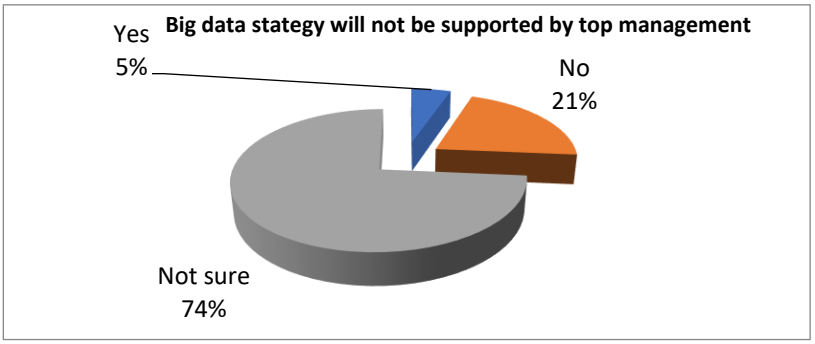

Figure 21. Big data strategy will not be supported by management.

Scholars in the area of strategic management have a unique opportunity to help create a better understanding of how the rise of big data is altering the competitive landscape (Mazzei, 2019). According to Mazzei (2019), despite recent developments in big data analytics, there is evidence that many organisations have struggled to

successfully convince management to implement BDT. The results above in Figure 21 shows that 74% of respondents were not sure if BDT strategy will be supported by management. 21% disagreed, while 5% are of the view that management will support BDT strategies.

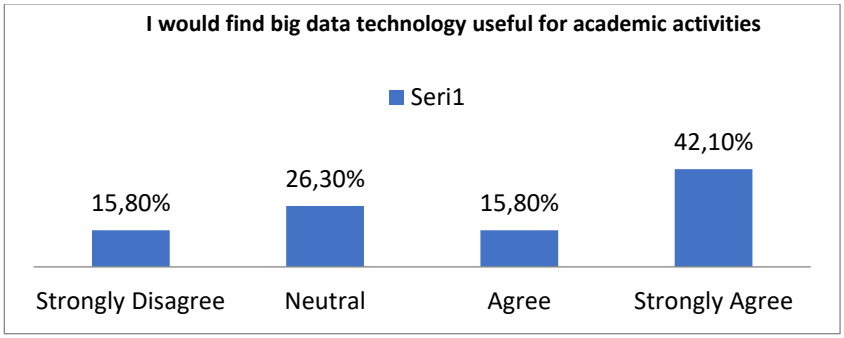

Figure 22. I would find BDT useful for academic activities

Big Data assists educators in tracking student performance. The analysis aids in understanding both individual and collective performance. Individual grade statistical analysis will assist educators in understanding students' areas of interest (Sharma, 2021). According to the results shown in Figure 22, 42.1% strongly agreed that the use of Big Data technology is useful for academic activities, while 15.8 percent strongly disagreed, 15.8 percent agreed, and 26.30 percent are neutral about using BDT for academic purposes. This means that a total of 57.9% of the respondents indicated that they would find BDT useful for academic activities.

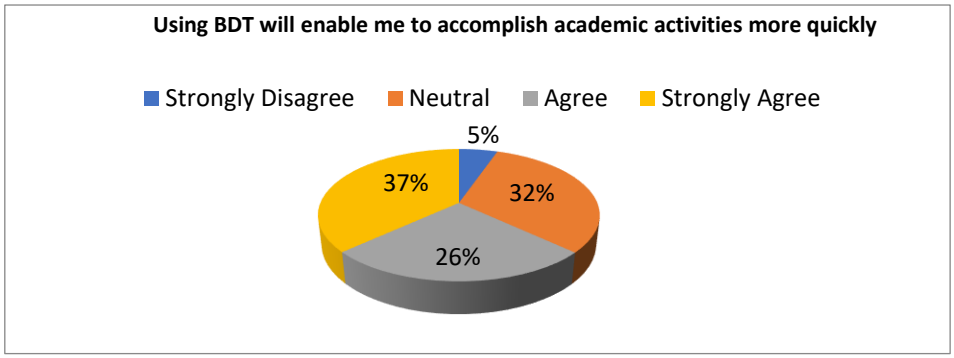

Figure 23. using BDT will enable me to accomplish academic activities more quickly.

The use of BDT will help enhance student results, better grading systems, gaining attention, customized programs, and reducing the number of dropouts. This has helped institutes all over the world to reduce the time spent on the selection process. Big Data is also being used while recruiting teachers (Sharma, 2021). The result

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displayed in Figure 23 shows that 37% of respondents strongly agreed that using BDT will enable them to accomplish academic activities more quickly, 26% agreed and while 32% are neutral and 5% strongly disagreed that using BDT will enable them to accomplish academic activities more quickly.

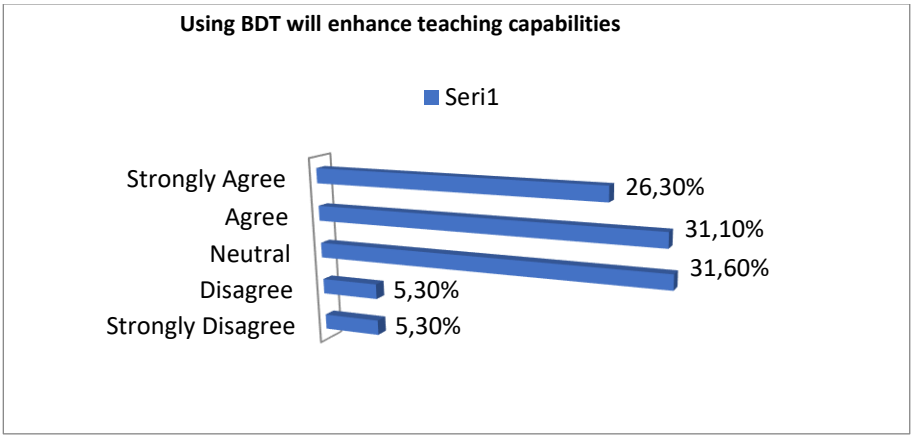

Figure 24. Using BDT will enhance my teaching capabilities.

Big Data develops an online learning platform solution based on Moodle's LMS. A course recommendation system based on machine learning techniques has been designed and implemented based on the analysis of learning traces to assist learners in selecting the most relevant learning resources based on their interests (Dahdouh, 2020). Figure 24 shows 31.6% are neutral, 31.60% agreed that using BDT will enhance their teaching capabilities while, 26.30% strongly agreed. On the other hand, 5.3% of the respondents disagreed that using BDT will enhancing teaching capabilities and minority, while 5.30% disagreed.

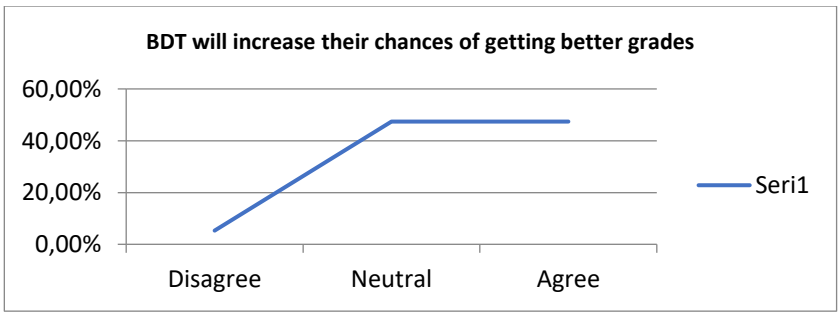

Figure 25. BDT will increase their chances of getting better grades.

The education sector is starting to use BDT to improve their services, including but not limited to gaining insights, improving learner performances, grades, and retention, and customizing learning, teaching, and assessment methods and

techniques based on the needs and capabilities of the learners within the constraints of limited resources (Mervat et al, 2018). The information displayed in Figure 6.46 shows that 47.4% of the respondents were neutral and some 47.35 agreed to Big Data technology increasing their chances of getting better grades and few 15.3% of them disagreed.

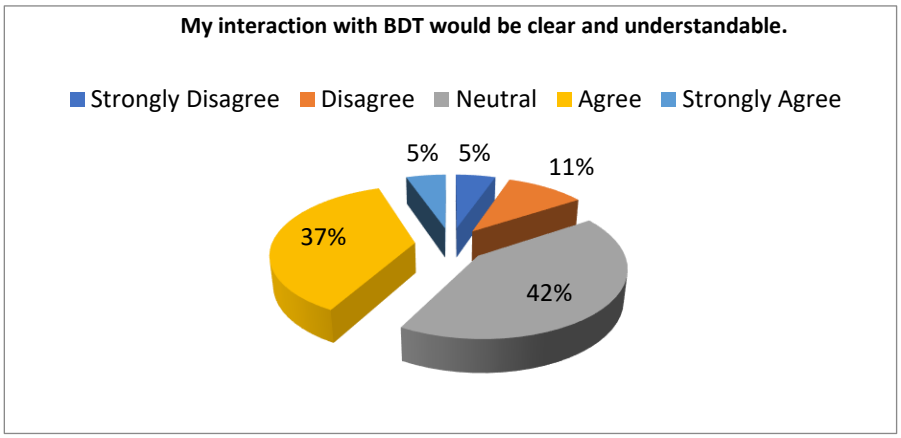

Figure 26. Interaction with BDT would be clear and understandable.

The information presented in Figure 26 shows that 42% of respondents were neutral, 37% agreed that their interaction with BDT would be clear and understandable, 5% of the respondents strongly disagreed and 11% disagreed to that.

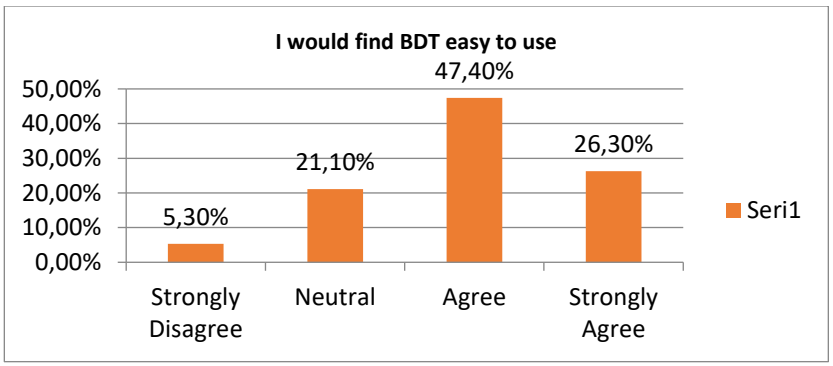

Figure 26. I would find BDT easy to use.

From the result presented, it is clear that a majority of the respondents in Figure 26 presented that 47.4% of respondents agreed, 26.3% strongly agreed to finding BDT easy to use, 5.3% strongly disagreed 21.1% were neutral.

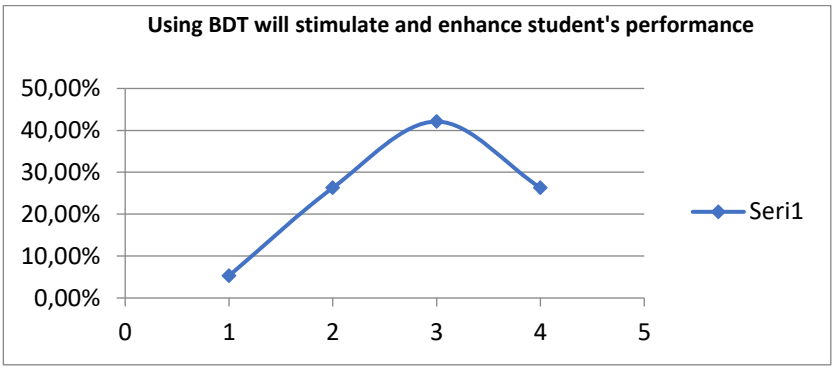

Figure 27. Using BDT will stimulate and enhance student's performance

The result displayed in Figure 27 shows that 42.1% of respondents agreed, 26.3% strongly disagreed to using Big Data technology stimulating and enhancing students' performance and 5.3% of them strongly disagreed while 26.3% were neutral.

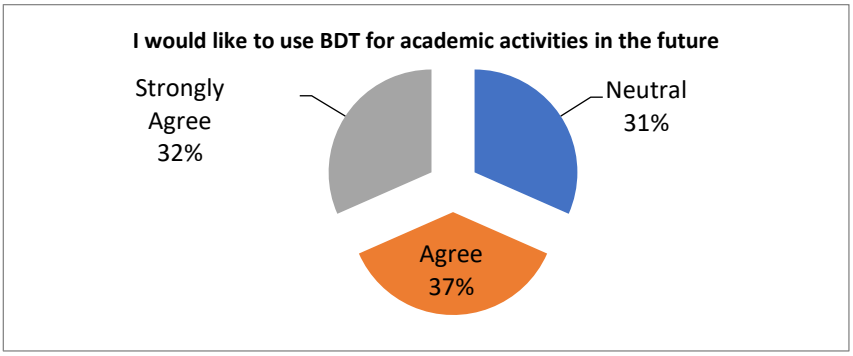

Figure 28. I would like to use BDT for academic activities in the future.

The results presented in *Figure 28.* shows that 36.8% of respondents agreed that they would like to use Big Data technology for academic activities and a minority 31.6% of them were neutral and 31.6% strongly agreed to that.

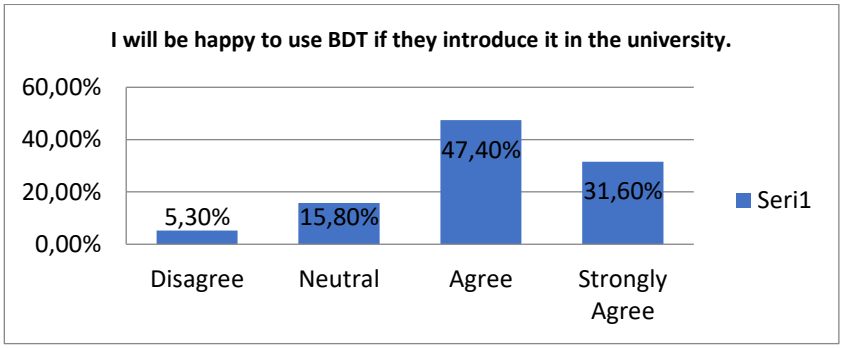

Figure 29. I will be happy to use BDT if they introduce it in the university

Figure 29 presented that 47.4% of the respondents agreed, 31.6% strongly agreed to be happy to use Big Data technology if they were introduced in the university and 5.3% of respondents disagreed while 15.8% were neutral to that.

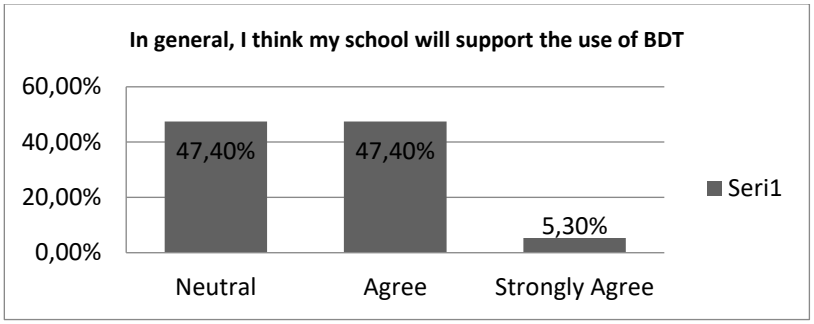

Figure 30. My school will support the use of BDT

The result displayed in Figure 30 shows that 47.4% of respondents were neutral and 47.4% agreed with them in general thinking their school will support the use of Big Data technology and 5.3% strongly agreed to that.

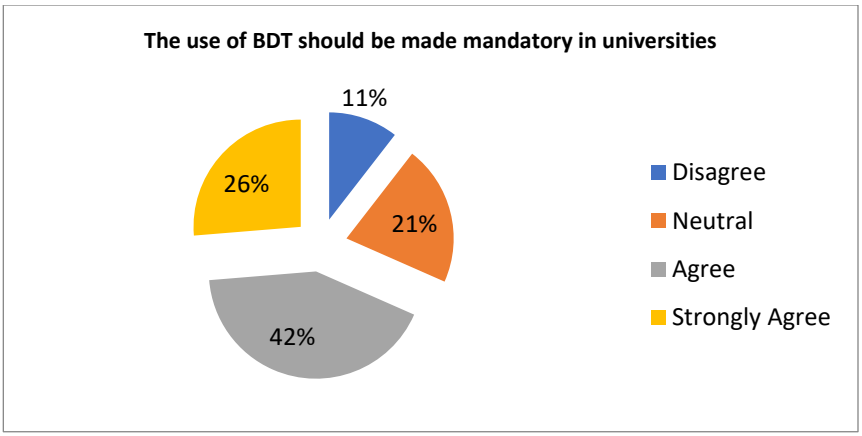

Figure 31. The use of BDT should be made mandatory in universities

Figure 31 shows that Majority 42.1% of respondents agreed, 26% agreed to the use of Big Data technology being made mandatory in universities and 21% were neutral while 11% of them disagreed with that .

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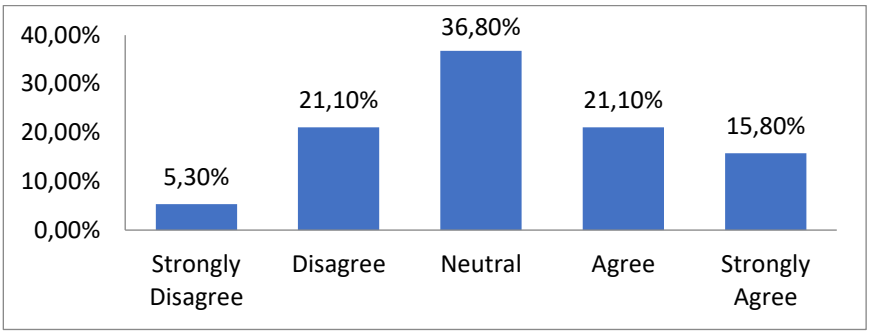

Figure 32. BDT enhances student performance

According to the results presented in Figure 32, it shows that 36.8% of respondents were neutral, 21.1% agreed and 15.8% strongly agreed that BDT will enhance performance and achievement of students in HEIs. 21.1% disagreed while a 5.3% of them strongly disagreed to that.

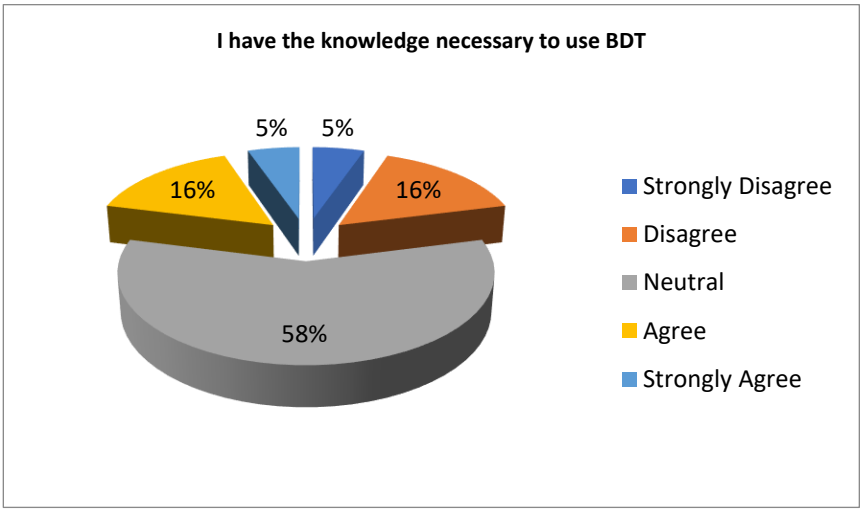

Figure 33. I have the knowledge necessary to use BDT

The result displayed in Figure 33 shows that the majority of 58% of respondents were neutral, 16% agreed and 5% strongly agreed about having the knowledge necessary to use Big Data technology and 5% of respondents strongly disagreed and 16% disagreed to that.

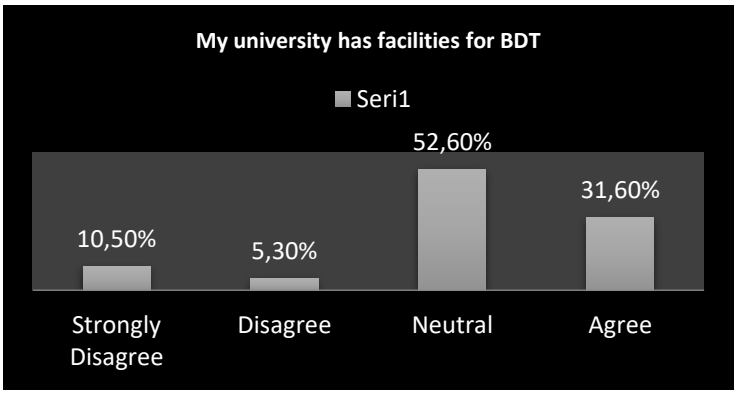

Figure 34. My university has facilities for BDT

The results above presented in Figure 34 shows that 47.4% of respondents were neutral, 31.6% agreed about their university having facilities for Big Data technology and 10.5% strongly disagreed and 5.3% disagreed to that.

3.2 Discussion

The result from the analysis indicates that a majority of the respondents (84.2%) are computer literate and they have knowledge of Information Technology. This will make it easy for them to adapt to technology use easily. There is also positive response to the question on awareness on Big Data Technology. Where 68.4% of the respondents indicated that they have heard about Big Data Technology. 63.2% of the respondents noted that they are competent on the application of Big Data Technology. However, efforts will still have to be put for more awareness on the usefulness of Big Data Technology in educational institutions.

It is also important to note that part of the benefits of Big Data Technology is monitoring of students' performance. Traditional database systems are usually used for this purpose. But due to storage and processing capacity, it will be difficult to use them to process enormous data. This makes it imperative to deploy Big Data Technology for this purpose. Furthermore, there are many ways of monitoring the performance of students in the university and a majority of the respondents affirmed they their universities use them. For instance, 38% of the respondents noted that their university use practical exercises, 8% of the respondent indicated that their Universities use ITS, while 38% of the respondents also noted that their University use DBMS. It was also noted by 54% of the respondents that lecturers are responsible for monitoring students' performance in their university. However, some of the respondents believed that the Dean's office or the Information and Communication Unit should be responsible for monitoring students' performance. Monitoring of students' performance, as noted by most respondents, should be done daily, weekly, or monthly.

To monitor student's performance, it is important to note that the university must have to put together relevant student data necessary for that activity. This data is usually enormous (Sharma 2021) and may by difficult to collect for analysis unless appropriate measures are taken which involves Big Data Technology. However, there are some challenges that universities need to tackle if Big Data Technology is to be used. For instance, the challenges of slow internet connection and inadequate infrastructure as noted by 46% of the respondents must be tackled. There is also the challenge of lack of technology skills, system failure and knowledge on the application of Big Data Technology. A majority of the respondents (64%) believed that these challenges will affect decision making.

Not minding these challenges, 82% of the respondents agreed that Big Data Technology in the university can make work easy for them while 9% noted that the use of Big Data Technology stimulate performance and knowledge acquisition. However, 18% of the respondents opined that Big Data Technology complicates data which may lead to loss of Data. It is also worthy to note that some of the respondents are of the view that resources should be made available and university policies should be made favourable for the adopted and implementation of Big Data Technology in the Universities.

As seen in the analysis, the respondents indicated that there are a lot of setbacks that can inhibit the implementation of Big Data Technology in HEIs. These ranges from environmental, technological to organisational challenges. On the environmental challenges, a majority of the respondents indicated that there is lack of awareness (47.4%), Not sure if there is enough resources for data collection and processing (63%) and not sure if the university policy supports Big Data Technology (68.4%). In the aspect of technological challenges, 57.9% of the respondents are not sure if the technology will be easy to use, while 31.6% of the respondents indicated that the technology will be difficult to use. Furthermore, 31.6% of the respondents indicated that their universities do not have enough infrastructure of Big Data Technology. Security concerns were also stated as part of their concerns if Big Data Technology is implemented. On the aspect of Organizational challenges, Lack of experience in dealing with Big Data Technology, cost of implementation and management support were among that challenges that may inhibit the implementation of Big Data Technology in HEIs.

Another area, as noted by the respondents are security concerns while using Big Data Technology. It is a known fact that data should be protected before during and after analysis. This will prevent series of threats that may jeopardise their confidentiality. 47.4% of the respondents are not sure if there will be security concerns while using Big Data Technology while 42.1% are of the view that there will be security concerns. On the other hand, 10.5% of the respondents noted that there will be no security concern. Other concerns include environmental concerns,

technological concerns, awareness, infrastructure etc. It is believed if these concerns are handled properly, Big Data Technology will have a place in HEIs.

Literature reviewed reveal that universities have a lot to benefit from Big Data Technology. A majority of the respondents (58%) indicated that they are not sure if universities realise the benefits of using Big Data Technology. 21% of the respondents noted that the universities realise the benefits of Using Big Data Technology while 21% of the respondents do not know if universities realise the benefits of using Big Data Technology. It is therefore important that the benefits of Big Data technology be made known to universities and work towards adopting and implementing it in the institutions.

Conclusively, data analysed revealed that Big Data Technology is essential for the enhancement of student performance through, observing and assessment of students academic performance. This can be seen in the quantitative and qualitative analysis carried out. Where respondents shared their views on the importance of Big Data Technology and why the innovative technology will be beneficial for HEIs. The results from the qualitative and quantitative data analysed contributed a lot to the development of the framework. Quantitative analysis involves the use of survey questionnaires with was guided by the already validated survey question from the UTAUT model and further analysed for descriptive statistics. On the other hand, literature reviewed in this study also contributed to the development of the framework. The literature covered the literature related to this study, critical analysis of empirical study and comparison of framework related to this study. Frameworks compared assist in a way of extracting gaps that were seen in the reviewed frameworks. The strategies mentioned above assisted the study to derive the components used in developing the framework.

3.3 Development of framework

The framework has been designed based on a review of the existing literature on Big Data Technology, critical analysis of literature, comparison of various frameworks on big data technology as well as the results obtained from data analysis.

3.4 The Components of the proposed framework

The components for the development of a framework which was developed are based on review and comparison of previous related frameworks and findings from previous related studies on big data technology and findings from analysis. According to the findings of related studies, one of the factors affecting the development of a framework for the adoption of big data technology in Namibian HEIs is a lack of infrastructure, lack of policies or guidelines, data privacy, and a lack of qualified professionals, to name a few.

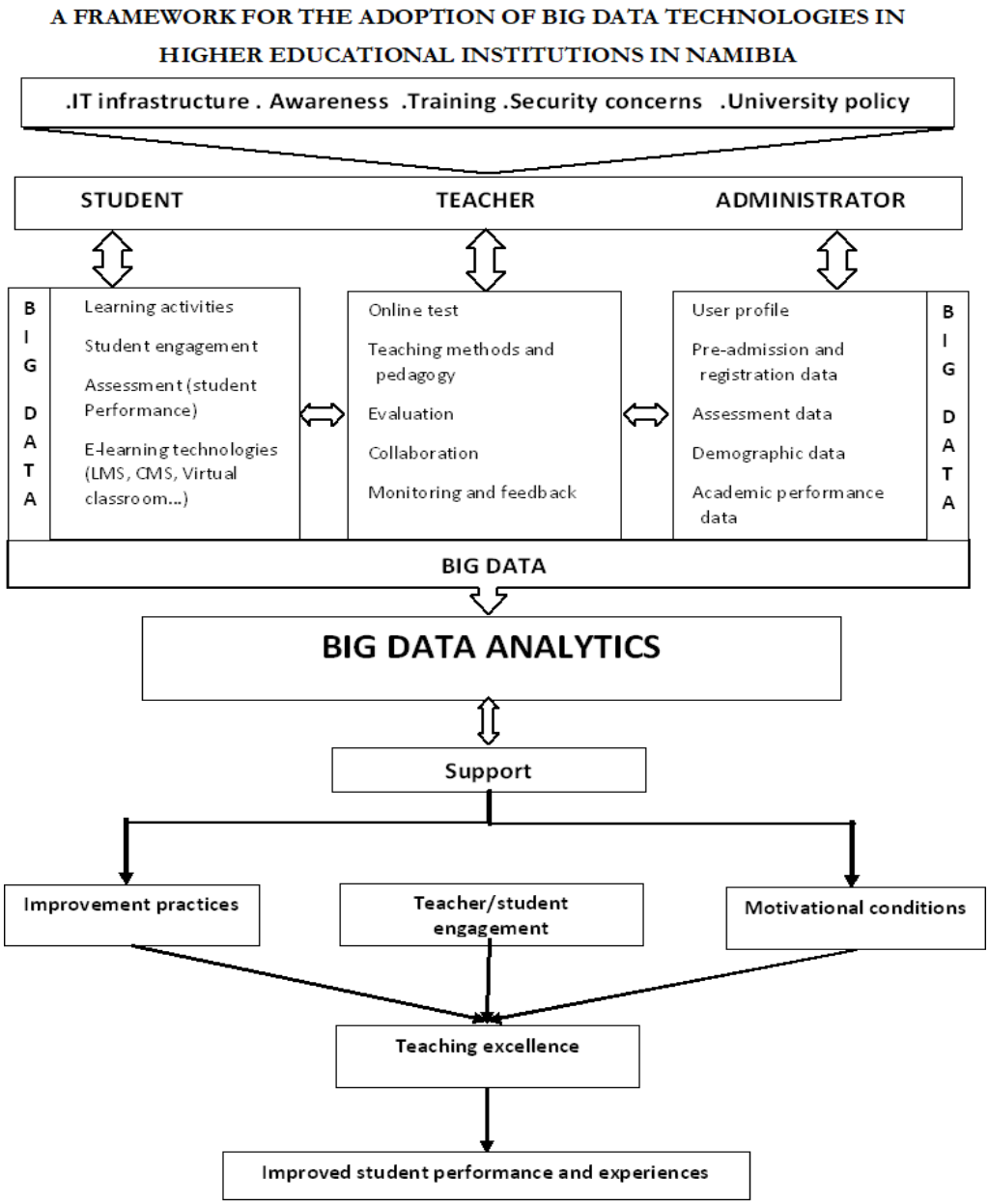

Figure 35 Framework for the adoption of BDT in Namibian HEIs.

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3.5 Stakeholders' contributions to framework

The above proposed framework is based on the stakeholders' contributions, survey data, focus groups, reviewed literature and data analysis, as it relies on existing literature. Based on the analysis of the results carried out, this developed framework will enable lecturers to evaluate student's performance. If lecturers correctly adopt these guidelines, it will facilitate easy teaching and learning, improve quality students' education and support lecturers within and outside of classroom.

It will enable students and lecturers' interaction which will lead to improved learning. Therefore, the development of this framework will be beneficial to various stakeholders as it is in line with existing literature and the study's objectives.

3.6 Limitations and Future Research

The researcher worked hard to make this study as comprehensive as possible, but there are some limitations. There are several limitations to the study that should be considered. These problems are related to time, context, methods used, and other factors. The study was limited to IT departments, ICT Units, and faculty members at three Namibian universities. As a result, the findings may not be generalizable to other countries where technology adoption and implementation differ. The number of survey participants was lower than expected; this reflects the university's policies and regulations. A strategy for distributing the questionnaire was implemented by submitting an approval letter to the department heads, asking for their assistance in distributing questionnaires; however, this was insufficient to encourage a higher response rate. The other limitation is the fact that Namibian universities had little understanding of Big Data concepts and how they can be applied in education. They tend to focus on the extracted information from structured data to enhance educational quality, whereas Big Data can also use unstructured data. The researcher makes some suggestions and recommendations for future research based on the study's findings.

- All universities considering using Big Data in the future should think about the technical plans for the coming years. How will they construct a data warehouse? What kinds of data will be collected? Mining for new data sources and real-time data analysis will be critical.
- Some universities are still looking for the best mining software and mining technologies to find new insights based on their goals and strategies, indicating the need for a more in-depth study of data mining technologies.

- Participants in the study included staff from IT departments and data centers, as well as faculty from a university's college of computer and information sciences, as stated in the study limitations. More research in other industries is required to learn more about the issues influencing the adoption of big data technology.
- The framework could be used as a starting point for further research, and it could be developed with the participation of other Namibian cities to measure the outcomes of Big Data technology adoption and implementation.

4. CONCLUSION

This study looked into the factors that influence Big Data adoption and implementation in Namibian higher education institutions. This chapter outlines the research's purpose and objectives by answering the research questions through data analysis from the survey and interviews. It was discovered that some of the factors identified in this study had previously been mentioned in the literature, confirming previous research and findings. Furthermore, new factors have emerged as a result of this research. Factors from previous literature and current research were incorporated into the research framework depicted in Figure 4 in the previous section. The study was carried out with great care, but some limitations remain. Furthermore, this research has made several new contributions to the context of Namibia education, as well as some recommendations.

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