

# Exploring the Diffusion of Big Data Analytics within Accounting Education

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## ABSTRACT

Universities need to ensure that future accountants are well prepared for employment in the Big Data era by incorporating Big Data Analytics (BDA) within their accounting curriculum. The incorporation of BDA into accounting curricula is an innovation that will diffuse over time. By investigating the diffusion of BDA among universities, valuable insights can be gained that can help universities prepare future accountants. However, studies on BDA in accounting education and its diffusion are still limited. Hence, this study aims to explore the diffusion of BDA in accounting education among selected universities in Malaysia. Semi-structured interviews with professors from public and private universities are the main method of gathering data, with document reviews as supplement. A total of eleven educators were interviewed, consisting of eight interviewees from public universities, while the remaining were from private universities. Based on Diffusion Theory of Innovation, the thematic analysis indicates that all selected public universities have progressed in their diffusion stages, while private universities experience little or no diffusion. The insights gained have important implications for policymakers, administrators, and academicians.

**Keywords:** Diffusion of Innovation, Industrial Revolution 4.0, Big Data Analytics, accounting education

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## **INTRODUCTION**

In recent years, the field of accounting has been undergoing a profound transformation due to the rapid advancement of technology. Among the most prominent innovations is the integration of Big Data Analytics (BDA) into accounting practices (Gamage, 2016). BDA encompasses the collection, processing, and analysis of vast datasets to extract valuable insights, thus significantly enhancing decision-making processes. The accounting profession, traditionally known for its reliance on structured financial data, is now facing a paradigm shift, with the incorporation of unstructured and non-traditional data sources, such as social media data and customer reviews, into the accounting curriculum. This shift in the accounting landscape necessitates a critical examination of how BDA is diffused into accounting education and its impact on preparing future accountants for the evolving demands of the profession.

The Industrial Revolution (IR) 4.0 has changed how we live, work, and communicate that are changing business models and employment trends. Traditional analysis tools are no longer applicable in today's environment due to drastic change in business organizations (Yassine et al., 2019) including the availability of Big Data. According to the World Economic Forum, Future of Jobs Report 2023, BDA is one of the biggest drivers of job growth. This is because there is a significant growth in the volume of data being created, captured, copied, and consumed worldwide. Global data creation is projected to grow rapidly reaching 180 zettabytes in 2025 (Taylor, 2022; Younis, 2022).

Chaurasia and Rosin (2017) defined BDA as the process of analysing data to uncover patterns using computational algorithms, programming and statistical modelling techniques to find valuable and timely correlations. BDA can facilitate business decision making and realisation of business objectives through analysing current problems and future trends, creating predictive models to forecast future threats and opportunities, and optimizing business processes based on historical or current data to enhance organizational performance (Sun et al., 2015). The use of BDA opens an opportunity for all accounting and finance professions in shaping its role in the near future (Gamage, 2016). With BDA, accountants should be able to use it to increase operating efficiencies, assess risks and identify advantages and weaknesses through analysis.

In line with the development in BDA, the accounting education structure needs to be upgraded by changing its syllabus, its style of teaching and most important is the access of knowledge to be received by the students (Rezaee & Wang, 2019). However, BDA is still an unexploited opportunity for higher education institutions (Chaurasia et al., 2018), including in the accounting curriculum. Content and delivery changes in accounting education are necessary to ensure graduates have a workplace with relevant knowledge and need to keep up to date with global accreditation standards and professional qualifications (Al-Htaybat et al., 2018) especially on BDA skills. Thus, by gaining BDA skills accounting graduates would possess an edge in the job market for the foreseeable future. Similarly, Tarmidi et al. (2018) suggested that universities need to equip the students with at least basic knowledge and technical skills in managing and operating data mining systems. Relevant educational content-related information and a better teaching assessment related to Big Data era is also needed (Tawafak et al., 2018). Despite the growing recognition of the importance of BDA in the accounting profession, there is a significant gap in our understanding of how these technologies are being incorporated into accounting education. The rapid evolution of BDA tools and techniques, coupled with the ever-changing demands of the accounting profession, presents a complex challenge. Accounting educators and institutions face critical decisions about what, when, and how to integrate BDA into their curricula.

Serdyukov (2017) suggested that innovation in education is critical to tackle the difficulties of a rapidly changing and unpredictable global environment. The incorporation of BDA can be viewed as an innovation in accounting education that will diffuse over time. An innovation can be defined as “an instrument of necessary and positive change” (Serdyukov, 2017; p.5). The Diffusion Theory of Innovation is a widely recognized concept that explains how new ideas, products, or technologies spread and are adopted by individuals or groups within a society. Proposed by Everett Rogers in 1962, the Theory suggests that the adoption of innovations follows a predictable pattern and can be categorized into distinct stages. In this study, the diffusion of BDA within accounting education was examined using Roger’s Theory of Diffusion. This theory provides a valuable framework for understanding the adoption and incorporation of new technologies in various fields including accounting education. While there is a growing body of literature on the integration of technology in education, there is a dearth

of research focusing specifically on the diffusion of BD A in accounting education.

Hence, the objective of this study was to explore the diffusion of BDA in accounting education by investigating the current status of integration of BDA into the accounting curriculum offered by selected universities. Through this research, we aimed to contribute to a deeper understanding of the dynamics surrounding the integration of B DA in accounting education, ultimately paving the way for informed decisions and meaningful advancements in the field.

## **LITERATURE REVIEW**

### **Big Data**

The term “Big Data” refers to vast quantities of structured and unstructured data that goes beyond the processing capabilities of conventional database and software technologies (Bharany et al., 2023). Various definitions of Big Data are found in the literature. Some of the definitions are: (1) Big Data as digital convergence of structured data found inside database, and unstructured data collected from various forms (Perry, 2017); (2) Big Data is the hi-tech, high speed, high-volume, complex and multivariate data to capture, store, distribute, manage and analyse the information (Popovič et al., 2018); and (3) Big Data are new generation technologies and architectures which were designed to extract value from multivariate high volume datasets efficiently by providing high speed capturing, discovering and analysing (Gantz & Reinsel, 2012).

Big Data has multiple characteristics; three of the common characteristics are volume, velocity, and variety (Sagiroglu & Sinanc, 2013). However, later veracity and value were added to the previously defined aspects of the data (Hashem et al., 2015). More recently, these characteristics of Big Data have been expanded to consist of seven Vs, which include variety, volume, variability, value, visualisation, veracity, and velocity (Munawar et al., 2020). These seven Vs along with the hierarchy, integrity, and correlation can help integrate the functions of smart real estate including safe, economical, and more intelligent operation, to help the customers make

better and more informed decisions (Pan et al., 2016). These dimensions commonly known as seven Vs underlying the complexities of Big Data are shown in Figure 1.

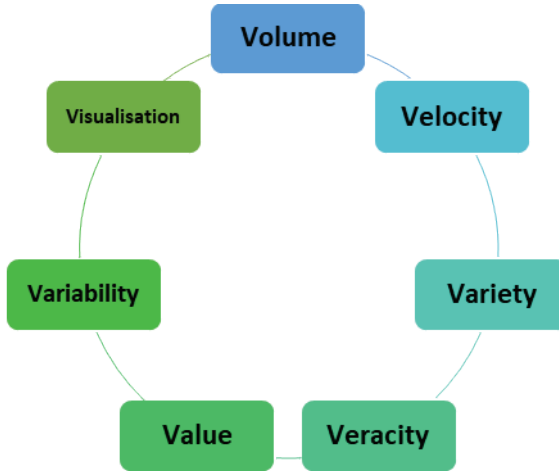


Figure 1: The Seven Vs of Big Data  
Source: Author

## Big Data Analytics Within Accounting Education

Accounting graduates are expected to become familiar with these new technologies in line with the emergence of Big Data and the development in BDA (McBride & Philippou, 2020). Accounting graduates need to be able to use these digital skills in their future work which benefits the economy in general. These relatively new technologies of new era business intelligence and analytics research drive demand for analytically skilled knowledge workers. Organisations are increasingly turning to Big Data and analytics to provide unique insight and prescriptive understanding of data (McLeod et al., 2016).

The accounting profession can be further enhanced by leveraging on BDA. For example, in the field of financial reporting, Zraaqat (2020) suggested that BDA has the potential to improve the quality of financial reports. This is because BDA enables access to a wide range of unorganised data, which could not be possible without the use of big data technologies. Further uses of BDA in auditing and management accounting were also noted. For example, Tang and Karim (2019) found that the use of BDA into

brainstorming meetings may solve concerns such as low-quality debates and production stifling, as well as increase the overall efficacy of fraud identification during auditing. Meanwhile, from the management accounting perspective, BDA can be used to enhance organisation's capability for forecasting, strengthen decision-making capabilities, improve the efficiency of operation and management as well as develop effective corporate performance evaluations (Li & Zhao, 2018). BDA also offers advantages for taxation field. The use of big data in tax collection and administration enables comprehensive surveillance of tax sources, effective counteraction against tax evasion and avoidance, and substantial enhancement of corporate tax compliance via the proficient analysis of extensive financial and tax data and the application of big data technologies (Deng & Yang, 2022).

Teaching the traditional accounting subjects will no longer be sufficient to make graduates qualified for the current job positions that are available. Accounting students' education should take a much broader approach and go beyond conceptual and technical accounting knowledge. Future accountants must be aware of the importance of Big Data through increasing their ability and skills to interpret and analyse Big Data to add value to business organisations (Younis, 2020). Results on a survey by Jackling and De Lange (2009) on 650 accounting graduates as well as 28 professionals showed that both groups agreed on the importance of technical skills. Therefore, universities need to ensure that the graduates they produce have required skills for the industries especially in accounting. At present, professional accounting bodies and universities have already taken the incentive to incorporate BDA. For example, CGMA added a new topic on Big Data in the syllabus for 2015 (CGMA, 2013). Also, universities in the U.S have already implemented Big Data and data analytics into their courses (Gamage, 2016).

In Malaysia, universities play a role to provide students with the latest knowledge and technical skills in managing and operating data mining systems (Tarmidi et al., 2018). In a study on Malaysian public universities, Tarmidi et.al. (2018) noted that it is important to utilize BDA within the Accounting and Finance courses offered and the respective syllabus. The Malaysia Institute of Accountants (MIA) has also recognized the impact of Big Data on the accounting profession. During BDA Conference 2015 organized by MIA, it was revealed that the top three uses of BDA by

businesses are consumer analytics (48%), operational analytics (21%) and fraud and compliance (21%). Hence, accountants would easily relate to these uses given their skills and knowledge in increasing revenue, reducing costs and improving cash flow.

## **Big Data Analytics in Accounting Education as an Innovation**

The incorporation of BDA in education can be viewed as educational innovation (Zhang, 2018; Tian, 2016). The Oslo Manual by Organisation for Economic Co-operation and Development in 2005 defined innovation as the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations (OECD, 2009). In the context of education providers such as universities, OECD (2016) suggest that among others, innovations typically include the introduction of new products and services, such as a new syllabus, textbooks or educational resources.

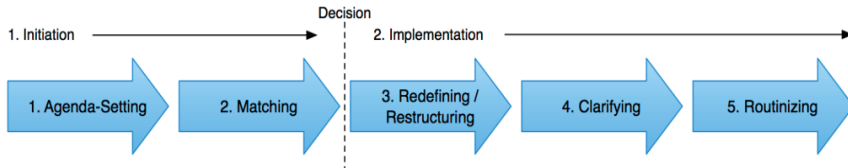
Rogers (2003) defined diffusion as a process by which an innovation is communicated through certain channels over time to the members of a social system. It is important to examine the diffusion of BDA within the accounting curriculum. This is because knowledge on diffusion can improve accounting educational practices. By understanding how innovations are diffused and what factors influence or hinders the success of their adoption, higher education providers and universities can develop strategies to improve the quality of education and better prepare students for the future. Efforts to increase the diffusion of BDA can help to ensure that benefits are realized by the universities in preparing accounting graduates. Hence, the Diffusion Theory of Innovation by Rogers, (2003) was used as the theoretical framework that acted as a guide in explaining the diffusion of BDA within the accounting curriculum.

## **Theoretical Framework for The Diffusion of Big Data Analytics Within Accounting Education**

Diffusion of innovations is a theory introduced by Everett Rogers in 1962 that seeks to explain how, why, and at what rate new ideas and technology spread. Rogers (2003) views innovation adoption as a decision of

full use of an innovation as the best course of action available and rejection is a decision not to adopt an innovation. Rogers defined diffusion as the process in which an innovation is communicated through certain channels over time among the members of a social system.

The purpose of this study was to investigate the incorporation of BDA within accounting curriculum among Malaysian universities using the organizational model of Diffusion Theory of Innovations. According to Rogers (2003), once the adoption decision of an innovation has been made the diffusion will take place and it consists of the following steps as shown in Figure 2.



**Figure 2: The Diffusion of Innovation Process**

Source: Rogers (2003)

The innovation process in an organisation is broadly divided into two parts: initiation and implementation phases (Figure 3). The initiation sub-process is divided into two stages. The agenda-setting stage occurs when a general organizational problem is identified that creates a perceived need for an innovation. The term ‘performance gap’ is used in describing this kind of problem and it is defined as the discrepancy between an organisation’s expectations and its actual performance. In the matching stage the organisation identifies a problem and opts for an innovation to solve it. Redefining/restructuring occurs when the innovation is re-invented for the needs of the organisation and it prepares for the innovation. In the clarifying stage the meaning of the new idea gradually becomes clearer to the organisation’s stakeholders. Finally, routinising the innovation ensures that it becomes part of regular activities in the organisation. This Theory was used to explain the diffusion process of the BDA within accounting education. The theory was chosen since it will allow the researcher to examine the incorporation of BDA processes within the accounting curriculum in a structured and systematic manner. In particular, five main processes were examined consisting of agenda setting, matching, redefining, clarifying, and routinising.



## **Agenda Setting**

Agenda setting in curriculum planning refers to the process of deciding which topics or subjects will be included in the curriculum, and how much emphasis will be placed on each one. It is a critical aspect of the curriculum planning process, as it determines what knowledge, skills, and values students will acquire during their education. Agenda setting can be influenced by a variety of factors, such as societal needs, cultural norms, political interests, and educational goals. Curriculum planners must consider a variety of factors, such as the needs and interests of students, the expertise and availability of teachers, and the goals and objectives of the educational institution or system.

## **Matching**

According to Rogers (2003), the matching stage is a stage that describes the extent to which an innovation is perceived to meet the specific needs and circumstances of the individual or organisation considering its adoption. In this stage, the individual or organisation evaluates the innovation based on its compatibility with their values, needs, and resources. According to Rogers, the matching stage involves four sub-stages: awareness of need, knowledge of options, evaluation of options and adoption. The matching stage is important because it helps to ensure that the innovation is well-suited to the needs and circumstances of the individual or organisation considering its adoption. In BDA diffusion, the matching stage involves matching the problem identified in the agenda-setting stage with problems faced by the universities. Hence, matching is typically conducted during curriculum reviews. Curriculum review is the process of evaluating and assessing an educational program to determine its effectiveness in meeting the needs of learners and achieving desired learning outcomes.

## **Redefining / Restructuring**

The redefining or restructuring is a stage in the adoption process where an individual or organisation modifies and adapts the innovation to fit their specific needs and circumstances (Rogers, 2003). In this stage, the adopter may make changes to the innovation in order to make it more compatible with their existing systems, values, or resources. Redefining or restructuring is an important stage in the adoption process because it allows adopters to

make the innovation more relevant and useful to their specific needs and circumstances. Rogers notes that the process of redefining or restructuring can involve several different strategies, including; (1) complementing by adding new features or components to the innovation to make it more useful or effective; (2) supplementing by using the innovation in combination with other tools or systems to enhance its functionality; (3) substituting on replacing certain components or features of the innovation with other tools or systems to make it more compatible with existing systems and (4) modifying by making changes to the innovation itself to improve its effectiveness or make it more compatible with existing systems (Rogers, 2003).

## **Clarifying**

The process of clarifying in the context of BDA diffusion entails ensuring comprehensive understanding among all individuals about the fundamental principles and methodologies associated with the innovation. It is important to ensure that all stakeholders, including both educators and learners, possess a comprehensive understanding of the novel pedagogical approach, its overarching objectives, and its operational mechanisms. Clarifying is important to gain a better understanding of educational data and to identify patterns, trends, and insights that might not be immediately apparent through other means. This might involve using sophisticated statistical techniques to analyse data, creating visualizations to make complex data more accessible, or developing predictive models to forecast future outcomes. The aim of redefining or restructuring in this study referred to stage of clarifying the idea of the incorporation of BDA within accounting curriculum to the university members so that they are aware of the innovation implementation.

## **Routinising**

Routinising in education innovation refers to the process of integrating innovative practices or approaches into the routine practices of education. This means taking new ideas or methods and making them a regular part of the educational process, rather than just using them as a one-time or occasional intervention. This might involve training teachers on the new approach, developing new materials and assessments to align with it, and making it a regular part of the teaching and learning process. Routinising

innovation in education helps to make the adoption of new practices more efficient, as they become integrated into existing routines and structures. In the routinising stage, it is expected that BDA would be fully incorporated within the accounting curriculum.

## **METHODOLOGY**

This study used the qualitative methodology of research in addressing research questions. According to Nassaji (2020), qualitative research is considered as a naturalist paradigm since rich data is derived from a natural setting obtained using a flexible research design, rigorous methods of analysis and interpretations. The present study chose this methodology since studies on the diffusion of BDA in accounting curriculum were still limited in Malaysia and thus an understanding of the key issues would still need an investigation of the field rather than through hypothesis testing.

The sampling method used in this study was purposive sampling which is a non-probability sampling technique commonly used in qualitative research (Thomas, 2022). It involves deliberately selecting participants who possess certain characteristics, experiences, or perspectives that are considered important to the research. This sampling strategy allows the researcher to choose cases that illustrate some features or processes of interest in a single setting (Silverman, 2019). In this study, a total of five universities were selected as the research sites consisting of three public universities and two private universities in Malaysia. These universities offer accounting programmes at the undergraduate and postgraduate levels. However, this study focused on the accounting curriculum at the undergraduate level. The inclusion of both public and private universities in this study was due to the expectation that each type of university possesses unique characteristics. As such, it was also expected that the diffusion of BDA in these universities would be different and thus could enable a comparative analysis to be made in this study. Such differences, among others, could offer valuable insights as to how the diffusion processes are managed and facilitate meaningful inter-university comparison to be conducted which in turn supports the revelatory opportunity of the findings. Participants in this study were university lecturers who were selected based on their teaching experience in Big Data, accounting information systems

and similar courses. Some of the participants were also selected due to their knowledge of curriculum review and experience in academic management.

## **Data Collection Methods**

The research questions posed in this study were addressed using data collected through semi-structured interviews and document reviews. According to Leavy (2022), a face-to-face interview has the advantages of providing the opportunity to build rapport, pick up on visual cues, and use gestures. However, during the data collection stage of this study, the online meeting platform was chosen. The reason was because there was a restriction on face-to-face interaction due to the COVID-19 pandemic. Saarijarvi and Bratt (2021) recommended new techniques to carry out interviews through video, telephone, and online applications as solutions to the problem brought about by the pandemic. Al Balushi (2016) discussed the limitations of online interviews by noting that online ones can be challenging for researchers since all the visual and non-verbal cues such as facial expressions and body language are lost. Nevertheless, this study had to utilise the online communication medium due to mandatory restrictions from the government. Interviews were held on prior appointments with the relevant interviewees.

The data collection process was facilitated by an interview protocol. The protocol consisted of introductory script to introduce the researcher and the topic of the interview, brief explanation on participant consent, a list of interview questions, and a closing remark as field notes. This interview guide served as a benchmark to assure consistency in the phrasing of questions and consequent credibility of the interview and its questions. The interview questions were formulated based on the literature review and the theoretical framework. This study also used the questions to ask the same information in different ways to achieve triangulation, depth, and completeness. Probing questions were included to allow for asking deeper meanings from the participants. The period of data collection was approximately 6 months which involved interviews which on average lasting around 40 minutes to 1 hour and 30 minutes. The interview communication was conducted in both English and Bahasa Malaysia and all data was transcribed in both languages initially. Upon completion of the transcription, each transcript was carefully reviewed and translated fully into English for reporting purposes.

Document review was another method of data collection utilised in this study. Specifically, a review of university websites to gain comprehensive insights into the accounting curriculum offered by a selected group of institutions was conducted. This approach enabled access to a rich source of publicly available information, including course descriptions, program structures, learning objectives, and any additional details related to accounting education. By examining these online resources, data triangulation and cross-reference data was achieved, thus providing a solid foundation for subsequent analysis.

## **Data Analysis**

The process of qualitative data analysis is a non-mathematical procedure that involves examining, categorizing, tabulating, testing or otherwise recombining both quantitative and qualitative evidence to address the initial propositions (Yin, 2012). In this study, a thematic analysis was used to analyse classifications and present themes (patterns) that relate to the data (Alhojailan, 2012). The procedures to conduct thematic analysis were based on Creswell and Poth (2016), Bloomberg and Volpe (2008) and Miles and Huberman (1994).

## **RESULTS AND DISCUSSION**

### **Profile of Interviewees**

The research issues of this study were addressed mainly using semi-structured interviews. A total of eleven educators were interviewed whereby eight of them were public university lecturers while the remaining were from private universities in Malaysia. The interviewees represented three public universities which are in northern, central and southern Malaysia and two private universities which are located in the central region of Malaysia. The list of interviewees included two lecturers in the computer science faculty. The selection of these lecturers was important to gain information on the technical aspects of Big Data and BDA and how both aspects can be incorporated into the accounting programme. Table 1 provides a brief profile of each interviewee.

**Table 1: List of Interviewees**

Interviewees	<sup>1</sup> Name of university	Positions	Faculty	Interview hours
01	Public University 1	Lecturer	Accountancy	40 minutes
02	Public University 2	Senior Lecturer	Accountancy	1 hour 30 minutes
03	Public University 2	Lecturer	Computer Science	45 minutes
04	Public University 3	Senior Lecturer	Accountancy	1 hour
05	Private University 1	Lecturer	Accountancy	45 minutes
06	Public University 2	Lecturer	Computer Science	1 hour 30 minutes
07	Public University 2	Senior Lecturer	Accountancy	1 hour 30 minutes
08	Public University 2	Senior Lecturer	Accountancy	1 hour 30 minutes
09	Public University 2	Senior Lecturer	Accountancy	40 minutes
10	Private University 2	Lecturer	Accountancy	40 minutes
11	Private University 2	Lecturer	Accountancy	40 minutes

## Findings -Diffusion of Big Data Analytics within Accounting Curriculum

The following sections present the findings which are presented sequentially according to the five stages of Rogers (1995) innovation process in an organisation. These stages are: (a) agenda-setting, (b) matching, (c) redefining/restructuring, (d) clarifying, and (e) routinising. A summary of the major findings is presented in Table 2.

**Table 2: Stages of Diffusion on BDA among Selected Malaysia**

University	Stage 1 Agenda Setting	Stage 2 Matching	Stage 3 Redefining/ Restructuring	Stage 4 Clarifying	Stage 5 Routinising
Public University 1	P	P	P	P	X
Public University 2	P	P	P	P	X
Public University 3	P	P	P	X	X
Private University 1	P	P	X	X	X
Private University 2	P	X	X	X	X

Source: Author

Note:

P Denotes stage already achieved.

X Denotes stage not yet achieved

1 The names of the university are kept anonymous for confidentiality purposes.

## Agenda Setting

Consistent with Rogers (2003), one of the starting points for the universities to introduce BDA as a solution is to explore potential remedies in the form of new ideas or innovation. In introducing BDA for accounting programmes, agenda setting entails actively gathering information, conceptualising, and planning for adoption.

The importance of equipping future graduates with technological skills in Public University 1 is reflected in the university's broad mission and vision. It is clearly stated that the university supports continuous professional development and keeping abreast with technology, which includes IR4.0 and BDA. The agenda setting of BDA within Accounting programmes in Public University 1 has taken place which involved discussions at the curriculum planning stage on why it is important to introduce BDA for their accounting graduate. Among others, the university acknowledged that the demand for accountants with data analytics skills is growing rapidly. Failure to address this concern may mean that the university will not be providing their accounting graduates with successful career opportunities. Hence, the management decided that to prepare for the future, students and accounting professionals must acquire data analytics skills. Other than that, there was also a pressure for the university to implement data analytics into accounting programs since they offered double-accredited schools. As stated by IV01:

*“The demand for accountants with data analytics skills is growing rapidly, providing for exceptional career opportunities. To prepare for this future, students and accounting professionals must acquire data analytics skills. The pressure to implement data analytics into accounting programs is higher for double-accredited schools.”*

Similarly, in Public University 2, the agenda setting took place within academic management meeting that discusses the importance to introduce BDA for their accounting graduates. Public University 2 recognises that BDA is very important because nowadays, being an accounting graduates is no longer seen as wholly focusing on the accounting subject matter. More importantly, in the present day many accounting functions are facilitated by the use of technology. Interviewees noted that technology has greatly

impacted the accounting profession, and it has opened up new opportunities for accountants to work more efficiently and effectively. For example, IV02 stated that:

*“Nowadays, accounting is seen as inter-related with technology. For example, now this accounting job not only to prepare financial statements but they also will be involved in a system development.”*

Within the curriculum planning of this university, an emphasis was made on the need to innovate accounting education. The aim was to ensure that their accounting syllabus is in line with the latest technological development so that their accounting program will stay relevant in the future. As stated by IV02:

*“So, whatever it is, (our) accounting (program) still needs to take into account the latest development in technology. Meaning that if you look at our faculty, we keep doing changes to the syllabus to suit the needs of industry.”*

The agenda setting stage was also the stage where it is important for the university to start examining the existing constraints such as instructor expertise, computer facilities and financial resources. Universities may not have the necessary expertise or technology infrastructure to teach BDA effectively or may not have the financial resources to invest in the necessary resources. There may be challenges in assessing the effectiveness of BDA in accounting education, particularly in terms of evaluating the impact of these skills on students' career readiness and long-term success in the accounting profession. There may be a need for new assessment methods and tools to measure the effectiveness of BDA in accounting education.

The curriculum planning in Public University 3 to introduce BDA for their accounting students has been conducted. This agenda setting stage resulted in the university informally incorporating minor elements of BDA into their existing accounting curriculum. For example, IV04 stated that:

*“We already have some Big Data Analytics related topics being taught in our current courses. For example, we have data base,*



*system analysis and design chapters. But to include Big Data Analytics as a core subject, it will take some time. We are in the process of doing that...we plan to do that after we conduct a proper syllabus review. Most probably, it will be implemented next year (2023)."*

The top management of Private University 1 recognises the need to prepare the graduates to new challenges including IR4.0. This is because, the university emphasises that their graduates need to be able to enter the society, either as an industrious professional working in the employment field or as an entrepreneur competing in the business sector. From the perspective on the accounting graduates, this aspiration has been translated into planning to introduce BDA in their curriculum. For example, the universities offer knowledge of BDA in the undergraduates Level for Bachelor of Accounting as a subtopic in Accounting Information System course. A brief introduction and exposure about data analysis has already been taught in the course. As IV05 said that:

*"We offer for undergraduate level. Bachelor of accountancy so far. In AIS subject. Including all the topics of security. We include brief or surface exposure of students on four topics of Data Analytics."*

During the agenda setting stage, several issues were discussed, particularly on how the introduction on BDA will affect their current environment. For instance, adding BDA subject may become a concern to the lecturers to include it in the current course in the universities. If graduates need to add a BDA course to their already packed accounting syllabus, they may face some difficulties. Adding a BDA course may increase the workload and time needed for studying, which can make it difficult to manage other courses and extracurricular activities. Also, BDA can be a challenging subject, and adding it to an already packed accounting syllabus may make it more difficult for graduates to absorb and apply the concepts effectively. Graduates may also face financial difficulties in pursuing an additional course. Pursuing BDA can be expensive, requiring additional fees for software and tools, and may also require additional books, materials, and equipment. As IV05 said that:

*“We include brief or surface exposure of students on four topics of Data Analytics. The challenges that we need to face in implementing Big Data Analytics is that we need more training like analytical application using software in the future. All syllabus is already pack with other subjects. Big Data Analytics is a plus new topic for them and it difficult for us to teach and for students to digest everything.”*

In Private University 2, the agenda setting stage of introducing BDA accounting students was still in its initial stage. Currently, they offer BDA as an elective course, but it is limited to the Master of Business Administration (MBA) program. However, they have a plan to update their accounting syllabus with BDA in the future. It is still very early for this university to introduce BDA. As a private university, it is very important for them to offer accounting programs that will be sustainable in the future since they are profit-making universities. As such, the need for introducing BDA is still viewed as important.

### **Matching**

In the context of education innovation using BDA, matching refers to the process of using data to identify the best match between students and educational resources. This might involve using data to identify students who are likely to benefit most from a particular type of instruction or who are best suited to a specific educational program. Contrary to the Theory, the matching stage in Public University 1 was conducted informally with no evidence of data formally collected to justify the need to implement BDA within the Accounting program. Nevertheless, a discussion on the need for “hybrid talent” among accounting graduates was emphasised. Additionally, Public University 1 university recognised that accounting graduates need to be more pro-active in their profession. As stated by IV01:

*“Business Analytics mines data and drives future business planning as it converts big data into actionable intelligence. It helps to answer, “What happens next?” (predictive) and “What should we do?” (prescriptive) by using statistical and quantitative methods, computational tools, and predictive models in providing data-driven decisions.”*

The matching stage in Public University 2 was conducted more systematically through frequent syllabus reviews. It is during these reviews that the university collects information from panel experts and resource persons to justify their decisions. This public university's process for reviewing its curricula begins with holding meetings to discuss all pertinent aspects of each existing programme: whether new material should be added, what should be removed from the curriculum, and which curricula should be kept in place. The next stage was to engage professional organisations as consultants to offer their advice. The third step was to change the curriculum in light of the conversation and propose it to upper management. Once the new syllabus based on the curriculum review has been approved by the top management, it is time to put it into practise.

From the data analysed, it is evident that Public University 3, Private University 1 and Private University 2 were still at the early stage of introducing BDA within the accounting programme. As such, the matching process did not materialise either formally or informally.

### **Redefining / Restructuring**

In relation to the incorporation of BDA in accounting programmes, the redefining/restructuring stage was interpreted as the process where the university customizes BDA according to its own structure, culture, and needs. Public University 1 was viewed as one of the early adopters of BDA in accounting programme. By offering BDA as an elective course, public university 1 aimed to attract accounting students who are open to new ideas and willing to explore the applications of BDA in their future careers. These are students who may be motivated by the potential career opportunities and want to gain a competitive edge by acquiring skills in data analysis. As stated by IV01:

*“Big Data Analytics subject as an elective course that has been taught to undergraduate accounting courses. In addition, the school also offers online courses on Professional Certificate in Business Analytics from September 2020.”*

These elective courses covered topics such as machine learning for business application, data preparation and data visualisation, applied

business analytics project, accounting and finance analytics, applied analytics and programming for business analytics. Exposing the students to BDA via elective courses, will help to transform students into analytics professionals in the accounting field.

In Public University 2, the redefining / restructuring stage of BDA implementation involved the university offering it at the undergraduate level as one of the core courses. As commented by IV02:

*“Our university already teaches Big Data Analytics since 2019 for undergraduate’s final year paper for accounting information system. It is as a core courses.”*

To enhance the redefining / restructuring stage, this university ensured their lecturers to possess adequate knowledge in BDA. This was crucial for facilitating the teaching and learning process. When lecturers are well-versed in BDA, they can effectively complex concepts to students. Moreover, this university already had quite a few lecturers who can teach BDA. Additionally, BDA courses in this university emphasised on information reporting and data visualisation. This was important because accounting graduates need to be able to tell a story using the data. Accounting students must practise data cleaning methods. It taught them how to arrange charts and use them as a dashboard in addition to reporting. If the process of data cleaning was not properly done, the data can become dangerous as false information may be produced, rendering it no longer valid.

In public university 3, the redefining / restructuring stage involved within subchapter accounting subject whereby students were given an initial exposure on BDA. Apart from that, the university also organised seminars on BDA. As stated by an interviewee IV0“:

*“There will be specific sub-chapters within certain subjects where students will be exposed to Big Data Analytics. But at the same time, we also organise seminars related to Big Data, which we may hold once or twice per semester.”*

Another form of restructuring done by university was by inviting BDA experts from local as well as international organisations and universities. These lecture series aimed to provide awareness to their students on the current issues involving BDA to their accounting students. This was

particularly done for general BDA knowledge not currently included in the syllabus. This university already planned to implement formal BDA courses within their syllabus in the future.

From the interviews, it was evident that Private University 1 and Private University 2 had not decided to implement BDA within their accounting programmes. As such, the redefining / restructuring process did not occur.

## Clarifying

Clarifying is the fourth stage in the Rogers innovation process model (2003). It marks a period of refinement between the innovation and the organisation after implementation has begun. In Public University 1, it was important as an educator to be trained on BDA for keeping up with industry trends. As BDA is a rapidly evolving field, and it is important for instructors to keep up with the latest developments to ensure that they are providing their students with the most relevant and up-to-date information. As stated by IV01:

*“We attend training & lots of training not only in house but also with the expert training providers. I’ve recently been enrolled for a training in Applied Analytics Using SAS Enterprise Miner for a week. Since it was during this pandemic season, it was conducted online.”*

Also, by ensuring quality instruction through educators and instructors who are knowledgeable about BDA can provide better quality instruction to their students, as they have a deeper understanding of the subject matter and can provide real-world examples and practical applications. As stated by IV01:

*“Additionally, due to the evolving nature of data analytics tools, having the right training available when it is needed is important. In this sense, educators need to keep abreast with the recent technological changes to cater the academic needs.”*

The clarifying stage was important for developing new course content as evident in Public University 2. Instructors who are trained on BDA can more effectively develop new course content and update existing courses to ensure that they are relevant and effective. As stated by IV02:

*“Previously we will attend workshop about related system that potentially used in the industry. Previously, two workshop on excel advance level in year 2019 was successfully attended. We enhance knowledge from intermediate level to advance level up to preparing dashboard as a complete system. And it is a success... I hope that for Big Data Analytics will also provide a complete training for our educators.”*

A diverse perspective by collaborative teaching can bring together students from diverse backgrounds and experiences, providing them with a broader range of perspectives on accounting and BDA. This can help accounting graduates develop a more nuanced understanding of accounting practices and their applications in different contexts. As stated by IV08:

*“Yes, we did a collaborative teaching, as we use that to invite people from industry to come to our class to explain and share about the experience on new technology and use on accounting. Previously, we had Accounting Global Week. We invite speakers from Dubai that are experts on Big Data Analytics. The reasons to invite him is to spark the idea and needs to our students. And from the responds, I know they slowly sees the important of big data. We inspired them by telling what will happen if you do not move now you will suffer. We bring real case from outside.”*

The clarifying stage in Public University 3 involved attending training to provide better support for their students by answering questions, providing guidance, and offering feedback on projects and assignments related to BDA. Training instructors or educators on BDA is essential for ensuring that students receive high-quality instruction that prepares them for the demands of the workforce and the rapidly evolving field of data analytics. Further evidence showed that Private University 1 and Private University 2 had not specified their teaching lecturers need to have adequate knowledge on BDA within their accounting programmes. As such, the clarifying process did not occur.

## **Routinising**

Routinising is the blending of the innovation with the routine of the universities. During this final stage of the process, the innovation loses its singular identity and becomes institutionalized. Although the purpose of this study was to trace the innovation process and not to measure indicators of successful routinization, certain indicators were noted. Findings from the study indicated that none of the universities interviewed had implemented BDA as a core course in their accounting subject. This was because it was still in its infancy stage. The biggest challenges were lack of expert training providers involved in BDA.

## **DISCUSSION**

As shown in Table 2, all universities selected in this study had reached the agenda setting stage. This implied that all universities had made the decision to incorporate BDA within their accounting curriculum although with a different degree of implementation. This study found a notable difference between public and private universities. Public universities had advanced to the clarifying level, indicating significant BDA integration and comprehension in their accounting teaching programmes. This advancement suggested a proactive response to the changing accounting sector by successfully incorporating this novel method into their curricula. Private universities, in comparison, appeared to be lingering in the agenda defining stage, indicating a more cautious approach to BDA. The apparent diffusion progress difference between these two groups of institutions suggested that their training systems may incorporate this key component of modern accounting at different rates and depths.

During the agenda setting stage, public and private universities showed clear differences. In the case of public universities, a proactive approach had been taken, based on a commitment to continuous professional development and technological adaptation that includes both Industry 4.0 and BDA. During curriculum planning, public universities talked about how important it was to include BDA in their accounting programmes to make sure they would be useful in the future. This process of setting the agenda was made easier by academic management meetings, and it ended with BDA elements

being added informally to existing accounting classes. On the other hand, this process was just getting started for private universities. Concerns about the implementation of BDA were common, especially about how it might affect students' workloads and the education system as a whole. The financial effects of using BDA, such as the cost of tools and extra study materials, were also a big topic of conversation. These differences showed that there were different levels of proactive participation and institutional readiness for BDA integration. They also showed that there may be ways to work together, share resources, and come up with new ways to teach in order to solve problems that are unique to each type of university.

The matching stage of BDA in accounting education showed significant differences between public and private universities. This stage at public universities was methodical and driven by curriculum reviews. These studies gathered detailed information from panel experts and resource individuals to support BDA curriculum choices in accounting. This rigorous approach guaranteed that BDA is integrated according to industry needs and technology advances, creating a well-informed and purposeful plan. Public universities were earlier in the dissemination process, with the matching stage still to occur. The formal or informal matching procedure had not been developed, suggesting that BDA integration in the accounting programme was still in its infancy. Thus, private universities may struggle to adapt their accounting curriculum to industry trends and changing expectations. Private universities might start organised matching procedures and use industry experts and practitioners to integrate BDA into their accounting education programmes to close this gap. This comparative gap in the matching stage emphasised the need for institution-specific initiatives to integrate current analytics into accounting education.

During the redefining/restructuring stage, a clear difference appeared between public and private universities approaches to integrating BDA into accounting education. Public universities took a proactive approach by attracting students who are open to new ideas and keen to learn about the uses of BDA in their future accounting jobs. To improve students' competitiveness, these universities emphasised the learning of data analytic abilities. For efficient knowledge transmission, ensure educators experience in BDA. This is supported by Voithofer and Nelson, (2021) as technology must be integrated into teacher education, and educators' techno-



pedagogical skills must be developed. By including components of BDA into conventional accounting disciplines, public universities provide an immersive atmosphere that is enhanced by seminars and guest lectures from professionals in the sector. Private universities, on the other hand, seem to have yet to commit to implementing BDA into their accounting programmes, resulting in a lack of redefinition or restructuring currently. This disparity highlighted the need of private university considering the changing demands of the accounting profession and the possible advantages of incorporating current data-driven methodologies into their training frameworks.

The research indicated that in public universities, instructors who understand BDA were regarded as essential because they can provide higher-quality instruction by employing real-world examples and practical applications. They can also create new courses and update existing ones to ensure that students learn relevant and current information. Students can gain a broader understanding of accounting and BDA through collaborative instruction that incorporates a variety of perspectives. In addition, these educators can support students more effectively by responding to queries and providing useful advice. In contrast, private universities mentioned in the study have not focused on ensuring their accounting programme instructors are knowledgeable about BDA. We refer to this distinction between how public and private universities approach teaching BDA as the clarifying stage difference.

In relation to the stage of routinization, it was notable that both public and private universities have not yet included BDA as a fundamental component inside their accounting curricula. This observation highlighted a similarity between the two types of institutions. This common trait may be ascribed to the relatively early stage of development in the sector, suggesting that the process of adoption is currently undergoing changes and advancements. This finding is consistent with Serdyukov (2017) which noted that the actual pace of educational innovations and their implementation is too slow. Both public and private universities had a shared challenge at this point, namely, the absence of readily available professional training providers with specialisation in the field of BDA. The difficulty presented a significant obstacle to the smooth incorporation of this novel technique into the field of accounting education.

## **CONCLUSION**

The investigation of the diffusion process of BDA within accounting education had revealed a distinct difference between public and private universities. This divergence in progression from the clarifying stage in public universities to the agenda-defining stage in private universities underscored the varying degrees of commitment and readiness for embracing this innovative approach to accounting education. Public universities were evidently taking proactive steps to include BDA comprehensively into their curriculum, signalling their recognition of the critical role data-driven insights play in modern accounting practice. In contrast, private universities appeared to be approaching this integration more cautiously, potentially reflecting their need for a deeper understanding of the benefits and challenges associated with this shift. These findings present an opportunity for further investigation into the underlying factors that contribute to this distinction, such as institutional culture, resources, and faculty expertise. Understanding these factors could guide the development of strategies to ensure that BDA becomes a universal and effective component across all types of educational institutions, ultimately preparing accounting graduates with the skills needed to excel in a big data-driven professional landscape.

This research has broad theoretical and practical implications. This study highlights key insights on how BDA is incorporated within accounting curriculum using the diffusion theory of innovation by Rogers (2003). This will contribute to the body of knowledge in the accounting field by understanding diffusion processes involved as suggested by the theory. More specifically, the implementation processes will be analysed and explained in a more structured way. In addition, the application of this theory in the education field represents a significant contribution since its application in education is limited. The difference between public and private universities in how BDA are used in accounting education has important effects for policymakers, administrators, and academicians. To close this gap, tailored support systems, collaborative projects, or relationships with the business world to make it easier to fully integrate BDA into accounting education in a variety of institutional settings may be used. By addressing these effects, universities can better match their programmes with the changing needs of the accounting field and help create a workforce that can handle the complexity of modern accounting practises.

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