Application of Big Data Analytics for Improving Learning Process in Technical Vocational Education and Training

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Abstract. The study identifies the application of big data analytics for improving learning process in Technical Vocational Educational and Training (TVET) in Nigeria. Two research questions were answered. The descriptive survey design was employed and the target population was made up of experts in TVET. A structured questionnaire titled "Big Data Analytics in Technical Vocational Education and Training" (BDATVET) is the tool used for data compilation. BDATVET was subjected to face and content validation by three experts, two in TVET and one in Education Technology. Cronbach Alpha was used to determine the reliability coefficient of the questionnaire and it was found to be 0.81. The data collected from the respondents were analyzed using mean and standard deviation. The findings on the problems of big data include among others security, availability and stability of internet network service. The Findings related to the prospects include among others, allows a teacher measuring, monitoring, and responding, in real-time to a student's understanding of the material. Based on the findings, it was recommended among others that the stakeholders in TVET need to uphold the fundamental security of their data and who may access information about their competencies.

Keywords: Big Data Analytics · Technical Vocational Education and Training · Problems and Prospects

1 Introduction

Technical Vocational Education and Training (TVET) is a field which persistently needs to be assessed to track the swift rate of development in the labour force. An essential component that has fundamentally changed the way TVET education is carried out is technology; such technologies include, among others, mobile gadgets (smartphones), remote access systems and teleconference [1]. These technologies are used in teaching and learning processes, however, in addition to practically echoing in the learning

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process in real setting generate an enormous amount of new data that are devastated as conventional learning methods are not capable of processing them. The interaction with these technologies produces large amounts of data that vary from an individual access log file to an institutional level activity [2]. Nevertheless, the educational systems are not hitherto completely geared up to muddle through with and take advantage of them for constant improvement use. Consequently, this call for the need to manage this problem within TVET and research into the latest applications of Big Data analytics for improving the learning process in TVET.

Big data refers to the large amount of data produced from the learning process of students [3]. The use of big data in teaching and learning process primarily is to apply, study forecast analysis, behaviour analysis and academic analysis of the learners' educational activities and the data can suggest for the instruction of schools teachers to have an apt and precise appraisal of the educational standing of learners and uncover prospective problems for students. The sources of the data produced are either in explicit or implicit behaviour [4]. The explicit behaviour is directly assessed as learning activities while the implicit behaviour is not, for instance, the implicit behaviour is the extracurricular activities, forum posting and online social activities. These behaviours are based on the learners and instructors adaptive learning system. From the perception of the learners, after understanding the standing point of the learner, the data generated and analyzed help to determine the pertinent problems and improves the learning process of the students to reach the idea of independent learning. From the viewpoint of instructors, the data generated and analyzed helps to review teaching curricula and develop methods for instructors to facilitate solving practical problems by the learner's [5]. These behaviours are based on the learners and instructors adaptive learning system.

Today, big data is the much-needed transformation driving force in the education sector particularly TVET because of its availability guarantee achievement for TVET students, staff and other related institutions. Conversely, higher institutions are working in a progressively more intricate and competitive setting. They are, however, in rising demands to retort to the international and national transformation such as the evolving need to amplify the ratio of learners in TVET, setting in employability and occupational attributes to the learners and making sure that the standard of TVET programmes stands the taste of time [6]. To triumph over from this grave state of affairs and to improve the learning process, TVET and related institutions are fitting on the rising skills in taking the right decision according to the situation. As a result, academicians are at the present barely seeking to apply the big data analytics in discovering the potency and flaw of both the learners and schools and to compare with other schools. The paper was enthused to improve learning process taking into cognizance the problems and prospects for its application in TVET.

In education, the instructive decision made by teachers is to improve the learning process. The usage of learning management systems in education has been growing in the last few years, today, TVET students are on track using smart mobile phones to access online learning materials [7]. These learning materials generate a gigantic number of unused data that are shattered as conventional learning methods are not capable of processing them [8]. This has resulted in the penetration of Big Data analytics into education to process a large amount of data involved to measure the understanding,

personalize the learning experience and facilitate to design new interesting courses [9]. It is against this background that this study looks into the recent applications of Big Data analytics for improving the learning process: Problems and Prospects for its application in TVET.

The study focused on big data analytics for improving the learning process: problems and prospects for its application in Technical Vocational Education and Training (TVET) in Nigeria. Specifically, the study determines the:

1. Problems of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET).
2. Prospects of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET).

2 Literature Review

2.1 Conceptual Framework

The conceptual framework for this study is the accomplished connection between the concepts and how each turns to one another in developing and validating e-content for teaching and learning of automobile lighting system. Hence, the conceptual framework of this study which shows the major variables of the study is schematically illustrated in Fig. 1.

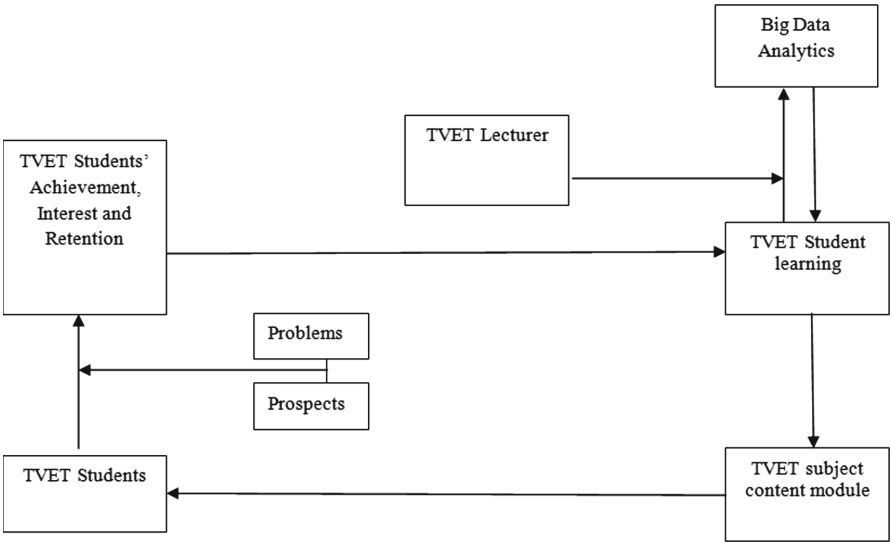

Fig. 1. Schematic illustration identifying the applications of Big Data analytics for improving the learning process: Problems and Prospects for its application in TVET.

The above figure shows the connection between the variables of this study. The diagram is defined to determine the applications of Big Data analytics for improving the

learning process in TVET. The illustration is included into a school setting on TVET students through the guidance of the TVET lecturer. The entire course of action is documented to obtain response and be evidence for on what emerges in the structure; spotting what out the requirements to be improved, amending the chart on the inference obtained and going over the development in anticipation of a satisfactory end result is attained via big data analytics.

2.2 Social Constructivist Theory

The Social Constructivist Theory of development and learning was propounded by Lev Vygotsky (1896–1934). The theory holds up the belief that an individual devotedly search for knowledge. It expounds an individual cognitive development, proffers direction on how and what to teach and as well confer methods on the means to manage learning conditions. The theory can be used as a channel to efficiently work with learners to build their understanding on what they are acquainted with and their experience because learners study best through activities and experiences that was instigated by them.

The central part of this theory is that students must autonomously verify and modify multifaceted data to make it their own by sensing through the most recent solutions to problems along with the older ones and perking up on the outdated ones. This paper has philosophical propositions for education since it promotes a lively place for TVET students to be taught autonomously.

This theory gives a deep-seated basis on which big data analytics is anchored in TVET. The theory outlines the unambiguous function of building TVET students to grow to be active in building their knowledge. Furthermore, it put emphasis that learning occurs effectively if the teacher gives their students a stepladder which they ought to ascend using their learning strategies.

2.3 Concept and Benefit of Big Data in Education

Big data is a wide term that refers to the analytics applications, sheering data, systems and technologies. The functional meaning of big data is the Information assets portrayed by such a High Variety, Velocity and Volume to necessitate definite Analytical Methods and Technology for its conversion into Value [8]. According to the International Data Corporation (IDC), big data is an innovative making of technologies to efficiently mine value from extremely enormous volumes of an array of data by facilitating high-velocity capture [10]. Therefore, Big Data refers to the bulky and distinct amount of data produced by applications, machines and people. It is in advance growing awareness from arrays of the field in education, such as the TVET. Lots of educational institutions have shown that analytics can facilitate student achievement, finance, interest as well as appropriate resource distribution and utilization [11]. [9] state that analytics is used in the planning, staffing, administration, supervision and financial plan. The prospective advantage of analytics in education is to estimate the expenditure to complete a programme (such as diploma and degree); school undertakings that have not been recognized as well as resource optimization. Numerous online portals like Coursera have leveraged analytics to grow and optimize their dealings [11]. On the other hand, through tracking the amount exhausted on teaching resources make possible for the teachers to assess the improvement

report of the individual learner and besides assist to personalize learning conditions as per the want of the learners.

[11] highlight some of the benefit of Big Data in the educational sector is to make certain the worth and suppleness of education, it also assists parents and learners to discover the preeminent educational program, transparent education financing and matching student and employment. It also helps students put together learning models and in due course oblige the students to learn hands-on.

2.4 Big Data Analytics Techniques in Education

The utilization of technology in education has trail such a swift tempo. If the development of the general public has been noticeable, over the precedent few decades, has turn out to be an deficient growth in the use of a enormous technological tool for managing different responsibilities in the school such as assignment. Owing to the expansion in Information and Communication Technology (ICT), it permits the expansion in enormous data processing activities in education. The expansion of ICT conveys the increase of lots of schools caught up in the current big data analysis from the learners' dealings leading to the development of working condition and environment.

Big Data Analytics is the way of developing actionable insights through problem characterization and the use of statistical models and investigation alongside virtual upcoming and/or existing data. When taking into account analytics in the field of education, it is helpful to reflect on how these techniques are applied in the framework of the institution [9]. Furthermore, other common techniques of analytics in the field of education are learning and academic analytics [10]. The former, include the evolving research field of learning analytics to investigate individual student performance. Learning analytics build applications that sway educational activities to analyze the data collected during teaching and learning. Learning analytics is further divided into macro, meso and micro level [11]. The macro-level analytics enable data sharing across institutions for a range of purposes including benchmarking. Meso level analytics work at the level of individual institutions and include analytics based on business intelligence approaches and the micro-level analytics support the tracking and interpretation of process-level data for individual learners. The latter presents the general information about what is the experience in a specific programme and how to address performance challenges. Academic analytics aims to assist the curriculum planners to measure, collect, interpret, report and effectively share data so that activities related to student strong points and limitations can be known and aptly rectified [12]. Therefore, in education, academic analytics reveal the function of data analysis at an institutional level, whereas learning analytics centres on the learning process.

2.5 Big Data Analytics in the Context of TVET Education

Big data analytics is the system of gathering, managing and analyzing large data sets to blueprint and other valuable information. Its application helps educational institution where TVET education takes place to better comprehend the information contained in the data and to categorize the data that is most vital to the business and future decisions in TVET and related field. Regarding TVET education, Big data predicts the understanding

of a spacious operational and managerial data, bringing together measures designed at evaluating institutional steps forward to envisage potential performance and issues associated to research, educational improvement, teaching and learning techniques [10]. In addition to this, Big Data Analytics could be useful to check for student admission on a course evaluation, dialogue board and blog entries or wiki activity, which could spawn thousands of student activities per lessons [11]. These data are collected in its original form as it is conducted and then analyzed to advocate courses of action.

2.6 Summary of Literature Review

The review of literature has revealed that researches have been carried out on big data analytics instructional strategy and some other teaching strategies for improving students' thoughts and analytical skills that are vital in the 21st-century. Though, no study is identified to the researchers on the applications of Big Data analytics for improving the learning process in TVET.

Thus, this study hence intend to fill this gap by identifying the recent applications of Big Data analytics for improving the learning process: Problems and Prospects for its application in TVET which is based on philosophy that will facilitate the learning process and allow the learners to triumph over the intricacy of understanding the contents in TVET. This will smooth the progress of invention of quality learning process.

3 Methodology

The descriptive survey design was used for the study. A structured questionnaire titled "Big Data Analytics in Technical Vocational Education and Training" (BDATVET) is the tool used for data compilation. Simple Random Sampling (SRS) was employed in the selection of the sample for the study. The population of the study comprises of 180 TVET and educational technology lecturers. Using the Krecie and Morgan table [13], the sample size of the study was made up of 123 respondents. This method was used to give every respondent in the population equal chance of being selected into the sample. In other to note the suitability of BDATVET items before administering it to respondents, three experts, two in TVET and one in educational technology validated it. Their suggestions were used to develop the final copy of BDATVET. Cronbach alpha Statistics was selected to establish the reliability of BDATVET. Number Cruncher Statistical System (NCSS) version 11 was used to work out the reliability coefficient and the result was found to be 0.81. Thirty-seven (37) validated items are used for the study. BDATVET was prepared for TVET and Educational Technology Lecturers in Niger State College of Education Minna and the Federal University of Technology Minna. Out of the 123 copies of BDATVET administered, 117 copies were duly completed. A real limit of number was used to determine the level of acceptance or rejection with numerical values as follows: Strongly Agreed (SA) - 3.50–4.00; Agreed (A) - 2.50–3.49; Disagreed (D) - 1.50–2.49; Strongly Disagreed (SD) - 1.00–1.49. The data collected from the respondents were analyzed using mean and standard deviation.

4 Results and Discussion

4.1 Research Question 1

What are the problems of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET)?

Table 1. Mean responses of the respondents on the problems of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET)

								N = 117
S/N	Items	SA (4)	A (3)	D (2)	SD (1)	$\overline{X}$	SD	Decision
1	Data management	38	74	3	2	3.26	0.34	A
2	Data storage	82	30	5	0	4.12	0.37	SA
3	Data privacy	96	19	1	1	3.79	0.45	SA
4	Data collection	17	63	24	13	2.72	0.22	A
5	Converting Ideas into a model	33	43	31	10	2.85	0.13	A
6	Data protection	93	24	0	0	3.79	0.43	SA
7	Capability to maintain learning analytics system	43	57	15	2	3.21	0.25	A
8	Error correction in analytics	49	62	6	0	3.37	0.30	A
9	Lack of expertise to prepare TVET lecturers to leverage on opportunities afforded by big data	38	41	26	7	2.85	0.15	A
	$\overline{X}$**a**					**3.33**	**0.29**	**A**

Keys: SA = Strongly Agree. A = Agree, D = Disagree, SD = Strongly Disagree, N = Number of respondents, $\overline{X}$ = Mean Value, SD = Standard Deviation, $\overline{X}$a = Grand Average value.

The analysis of mean responses of the two groups of respondents from Table 1 reveals that items 2, 3 and 6 under this sub-heading are rated as strongly agreed (SA); items 1, 4, 5, 7, 8 and 9 under this sub-heading are rated as agreed (A); none of the items is rated as disagreed (D) and Strongly Disagreed (SD). Since the SD value (0.29) in a statistical data set is close to the mean (3.33) of the data set, this gives the impetus to conclude that the respondents agreed on the problems of big data analytics for improving learning process in Technical Vocational Education and Training (TVET).

4.2 Research Question 2

What are the prospects of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET)?

The analysis of mean responses of the two groups of respondents from Table 2 reveals that the items 1 and 5 under this sub-heading are rated as Strongly Agreed (SA); items

Table 2: Mean responses of the respondents on the prospects of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET)

								N = 117
S/N	Items	SA (4)	A (3)	D (2)	SD (1)	$\overline{X}$	SD	Decision
1	Allow the teacher to measure the student's understanding of the material	98	11	8	0	3.77	0.46	SA
2	Allow the teacher to monitor in real-time to the student's understanding of the material	63	41	10	3	3.40	0.27	A
3	Allow the teacher to respond in real-time to the student understanding of the lesson	16	11	0	0	3.14	0.48	A
4	Build a learner knowledge model	48	56	7	6	3.25	0.26	A
5	Build a learner experience model	83	34	0	0	3.71	0.39	SA
6	Establish a learner behaviour model	38	41	25	13	3.06	0.12	A
7	Construct a domain knowledge model	41	70	5	1	3.29	0.32	A
8	Provide learners with personalized learning	38	79	0	0	3.32	0.37	A
9	Predict trends and outcomes for future learning	36	55	15	11	2.99	0.20	A
10	Provide learners with an adaptive learning environment	28	62	20	7	2.95	0.23	A
	$\overline{X}$ **a**					**3.29**	**0.31**	**A**

2, 3, 4, 6, 7, 8, 9, and 10 under this sub-heading are rated as agreed (A) and none of the items is rated as Disagreed (D) or Strongly Agreed (SD). Since the SD value (0.31) in a statistical data set is close to the mean (3.29) of the data set, this gives the impetus to conclude that the respondents agreed on the prospects of big data analytics for improving learning process in Technical Vocational Education and Training (TVET).

4.3 Discussion of Findings

The findings on the problems of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET) is data collection. This finding corresponds to [14] that collecting data for analysis is been a major problem for the execution of educational analytics. More to the point, poor quality and incorrectly

formatted data and information from rarely accessible database system can cause significant problems. The study also revealed that data privacy is one of the problems of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET). This result concurs with [15] that data needs to be protected from illegal access. The study discovered that lack of expertise and academic development opportunities to prepare educational researchers to leverage opportunities afforded by Big Data. This result coincides with [16] that it would be difficult for the students and teachers to represent their ideas in form of information in an accessible and informative way to the system and hence would be inflexible to cooperate with the system.

The findings on the prospects of big data analytics for improving the learning process in Technical Vocational Education and Training (TVET) revealed that big data establish a learner behaviour model. This result corresponds to [17] that learning behaviour model of learners is formed by building a big data learning platform to predict learners' failure in learning with a prediction precision of over 75%. Furthermore, the result also revealed that big data help in teaching strategy analysis. This agrees with [9] that the ultimate goal of using big data in education is to help educators formulate teaching strategies and analyze the collected information of learners to explore the functions of various components of the learning system and to analyze learner learning outcomes and teaching strategies. Addendum, [18] also corroborated that the prospects of big data are to analyze and summarize the teaching strategies to provide more effective teaching strategies in the field of education.

The finding also revealed that big data build learner experience model by collecting questionnaires of students' achievement to the data of retention, performance, behaviour. The use of big data in education also includes individualized learning, adaptive learning system and trend analysis. The individualized and adaptive learning systems are the ultimate goals of big data application [19]. The study also revealed that the collection, analysis and processing of big data provide TVET students with individualized and adaptive learning environment; the analysis of big data explore the student's learning trends to discover the correlation between secondary and post-secondary results for future learning,

The study also revealed that big data analytics predict the trends and outcomes for future learning. This concurs with [20] that big data investigate the student's educational trends by showing the link connecting preschool behavior and future results. [21] also corroborated that big data helps to produced through student learning to evaluate educational development, forecast upcoming performance and spot latent problems during teaching and learning. The result also revealed that big data build a learner experience model. This concise with [22, 23] and [24] that by retrieving opinion poll of students' interest with learning, big data helps in analyzing and enhancing the students' educational performance and philosophy of the teacher efficiency. The study also revealed that the critical target of using big data in education is to help teachers devise teaching techniques and evaluate the gathered data of students to discover the purpose of different systems of and to study the instructor teaching strategies and students learning results to make available more efficient teaching methodologies in the field of education [25].

5 Conclusion

There is no doubt in the fact that analytics bring massive improvement in the quality of education. This paper showcases the application of big data analytics in TVET, different sources, kinds and nature of data that are present in the TVET have been identified. In conclusion, with the help of such contemporary technology like big data analytics, the TVET education system will be enhanced with new strategies that will make learning of TVET courses more proficient and targeted.

6 Recommendations

1. The stakeholders in TVET need to uphold the fundamental security of their data and who may access information about their competencies.
2. TVET institutions and students must be conscious of data security and maintenance. So that they can work with it efficiently in support of the course organization.

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