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Baseline Study of Different Sentiment Analysis Computing Methods to Enhance Quality Assurance In Teaching and Learning

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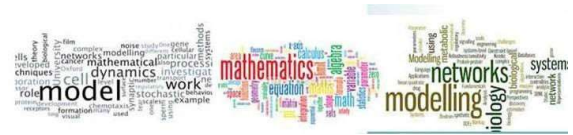
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ABSTRACT

The idea of modernization has become a norm in society, and the quality of the education sector that is been delivered to society is worth being assessed, and this will reflect the caliber of graduands these institutions are producing. As the key to this assessment is to x-ray clear-cut metrics used in the assessment of these institutions of higher learning by regulating authorities, parents, and other stakeholders These institutions' academic deliverables in terms of availability of experienced teachers, modern teaching and learning amenities, open access to learning materials, open access to assessment results, and timely responses to transcripts application to mention just a few needs proper evaluation. A lot of institutions' indices of performance are not encouraging, which translates to a high level of students dropping out, poor student performance, and low productivity which affects the standard of living and overall planned change that education is supposed to bring to the generality of the society at large. We must appreciate the efforts of previous researchers who have spent precious time using various sentiment analysis tools to unveil these challenges facing our education institutions and providing far-reaching measures that will make these institutions improve all indexes of measurement approved by regulating authorities globally as a mark of global competitiveness. Literature reviews by researchers using natural language processing and other machine learning techniques to get students and other stakeholders' feedback by applying sentiment analysis to improve the quality of teaching and learning in the education sector have yielded the required results. Given the above this research effort aimed at reviewing published papers geared towards improving learners' experiences and enhancing quality assurance in the education system from published articles between 2016 to 2023 in referenced databases from high-impact journals. The research study collated 80 useful articles from the pool of 4595 that were earlier surfed using eligibility criteria which entailed employing exclusion and inclusion characteristics. The outcome of the literature reviews showed that 70% of researchers have used sentiment analysis as feedback and improvement analysis tools in enhancing the student learning experience and quality assurance in the higher education sector. The highly used sentiment analysis algorithms are lexicon-based, Support Vector Machine (SVM), Naïve Bayes(NB), Linear Regression(LR), and Artificial Neural Network(ANN).

Keywords: Sentiment Analysis, Education Sector, Supervised Machine Learning Algorithms, social media, Questionnaires, Lexicon-based, Natural Language Processing(NLP)

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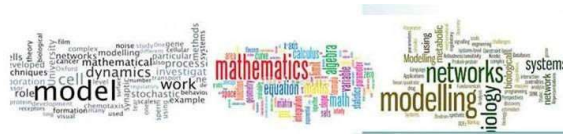
1. INTRODUCTION

The tertiary education institutions within the education system play major roles in the production of big volumes of information through the social medium such as WhatsApp, Twitter, LinkedIn, youtube, etc and in these social groupings, a lot of messages concerning all challenges and successes attributable to these our various institutions, thereby generating a lot of data that required continuous mining and evaluation. Moreover, lecturers are outside of this process and do not understand the learning problems that are in their classrooms. The only way to extract the numerous opinions of students and other stakeholders anonymously is by deploying sentiment analysis tools in a bid to identify the classroom mood during the learning process (Clarizia et al., 2018). Sentiment Analysis involved the processing of collating and mining human emotions and feelings from the unstructured dataset (Hemmatian & Sohrabi, 2019), and these sentiments expressed in vast areas of human endeavours such as politics, news, sports, and products to mention just a few provide ample opportunities for the organizations to consider ways of improving their services(Pacol & Palaoag, 2021).

Moreso in this era of e-learning, teaching and learning is virtually based, the aspect of face-to-face interactions between teachers and student is missing, and the opportunity of carrying out comprehensive assessment become impossible. Evaluation of students feedback in virtual learning platform is to carryout analysis of theirs sentiment freely expressed in social media platforms thereby giving institutions administrators the golden opportunity of improving learners experiences(Khanam, 2023).

Opinion mining can help unrivalled student attitudes, changes in emotion, mental health, key issues that are bothering them, and various their opinions on the way forward (Zhou et al., 2020). A comprehensive evaluation that focuses on students' learning process, their level of class participation, the seriousness towards completing their assignment and submitting in record time, the number of WhatsApp groupings and comments of public discussion posts, and their final exam assessment results are key features that sentiment analysis can provide the relevant data that are necessary to enable managers, educators and administrators take informed decision(Zhang, 2021).

Sentiment analysis is a technique deployed in carrying out student performance in tertiary education institutions evaluation of the rate at which students dropped out of their various courses of study(Grimalt-Álvaro & Usart, 2023). Continuous improvement of identified pitfalls in any system is a sure way of guaranteeing quality assurance and using sentiment analysis or opinion mining which can extract positive, neutral, and negative opinions by mining these volumes of data that comes from various social media platforms within and around our various institutions of higher learning(Kastrati et al., 2021). The focus of this study is to carry out exploratory reviews of previous researchers' findings, machine learning algorithms used, and their effects on the level of quality assurance from these vast educational institutions and further opine uncovered areas that are yearning for solutions. Other sub-topics that will be covered in this study are as stated below: Background of the reviewed papers, sentiment analysis methodology, outcomes of the findings, research gaps, limitation, conclusion and areas that required further research.



2. BACKGROUND OF THE REVIEWED PAPERS

Background

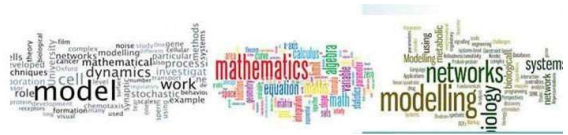
The ancient approach applied by teachers to appreciate and support their student to work hard andT surmounts obstacles in improving their studies experiences were are at microlevel, (Khairy et al., 2023) in such situation having robust analysis of the efforts geared in that direction becomes impossible. The extraction of sentiments from textural inputs become possible with used of natural language processing which is initial steps in efforts to carry out sentiment analysis in view of unraveling hidden information in those opinions(Mhamed and Noja, 2023). Administrators of Institutions of higher learning should redouble their efforts to improve learning facilities, training and retraining of theirs lecturers, reviewing their curriculum, reviewing their courses on regular basis and develop a realistic planning, monitoring and evaluations of all their activities in order to provide well tested education system (Alkhodair, 2023).

In furthering the idea of carrying out sentiment discovery and analysis as way of appreciating the enormous roles sentiments analysis have proven beyond reasonable as a key tool used by management, teachers, learners alike to do know the challenges and feasible solutions available for our education systems(Han et al., 2020). If the opinion mining tools are lacking in any institution, the concept of continuous improvement will be seriously lacking in the educational institutions, thereby increasing the decay day by day (Li, 2018). The idea of using data related information and scientific approach that can be verified and confirmed authentic to aid managers of institution in their decision making cannot be overemphasized, several researchers have opined philosophy that without records and data that decision should not been be taken, unless otherwise (Troisi, Grimaldi, Loia, & Maione, 2018).

Furthermore, Zhou and Ye, 2020 have re-echoed how sentiment analysis is been utilized in many sectors of our economy outside education, thereby noting the realization of organizations across the globe on the need to incorporate in the decision-making process of top management, the need to get a summarized reports of feedback analysis on various issues at the board meeting in order to avoid the normal response syndromes of management saying they are not aware. In like manner Lasri et al.2023 echoes the important roles tweet feedback analysis had help in university ranking in line with academic performance and excellent services delivery as a byproduct of continuous services improvement based on sentiment analysis outcomes. Finally, more credits and innovation could be ascribed to idea of emotion extraction that have given teachers at all level of education the earlier areas of improvement in terms of class room lectures deliverables, scheme of work preparation, marking of student examination scripts, releasing of results and their conduct while teaching (Dehbozorgi et al., 2020; Md Faridee & Janeja, 2019)'

Literature Review of related articles

Managing student admission processes with high level of transparency, devoid corruption and other sharp practices and making sure they do deviate from the purpose of getting admitted in the first place is a big challenges education administrators and other stake holders are confronted. The concept of educational students and other vested interest in education feedbacks reports required intensive mining to assist managers of institutions with ideas of optimization of teaching and learning processes in our tertiary institutions (Shaik et al., 2023).



Furthermore, a lot of innovation and new breed concept have resurfaced as result of covid-19 pandemic globally, the process of teaching and learning now incorporate the idea of virtually in a bid to advert face to face contact which scientifically adduced as faster means of spreading the disease. As the days and months of these lockdowns continue elongate, educationist and learners alike see need for opting for alternative ways of continuous feeding the minds of the students with new lectures, courses, new topics and other safety measures virtually so as allow them survive and continuous improving their learning adventures so as not spend theirs entire schooling.

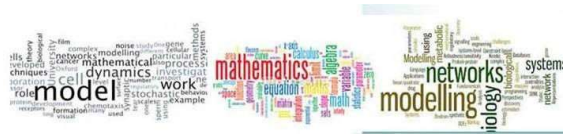
This brought about fresh debates, divided opinions, different sentiments among scholars and learners in the education sectors within that period as result of concept of a students must have 70% class attendance before sitting for any exam. Mining these information from all stakeholders, the new realities for our education sector to move forward at this point in time is for us all to accept the virtual mode of teaching and learning processes, including test and exams to be conducted online which add more impetus to idea of distance learning and massive opened online distance learning (Qaqish et al., 2023).

The unique roles of sentiment analysis across vast industries, processes and in all area of our lives that is been optimized cannot be overemphasized. A researcher on sentiment analysis, Shanta and Gorabal, 2023 restated and buttresses efforts of other researchers on the aspect collating educational institutions feedbacks from the public domains and was able to analyzed group them in following such as: poor, satisfactory, moderate, good and excellent the report opined.

As we all aware a lot of researches from vast researchers have collaborated the enormous roles the applications of sentiment analysis solutions and findings have helped to solve major educational problems thereby producing excellent universities like Harvard, Oxford, Massachusetts Institute of Technology (MIT) just to mention a few. Shaik et al.2023, also collaborated their research on how opinion mining of students' feedbacks have been able to draw management attentions to challenges that students are facing that required urgent management interventions.

In furthering the wind of adding new concepts such as computer, projector, adjusted board for easy accessibility by both teachers and learners, well-conditioned classrooms, well cleaned classrooms, clean toilets and availability of clean water on campus and part of various discoveries that the deployment of sentiment analysis from students feedbacks reviews have brought to bear for the management of institutions of higher learning to always used as a marking scheme of kind of yearning these student are hoping and praying to see it happening on our campuses.

In addition to the above management should always find a way of bringing modern and innovative technologies that will improve the process of teaching and learning and making the student to have nice while been under your watch. The biggest byproduct of our education system is for them to produce good, discipline, academically smart, highly intelligent and well equipped to handle and solved all myriads of problems confronting mankind in general, so managers of our institutions should always find a way of improving student performance (Shuhaimi et al., 2023).



Finally, a group of researchers such as: Shan, 2023, Su & Peng, 2023 and Baragash & Aldowah, 2021 have beamed searchlight on some many issues in term of carrying testing the accuracies of our model before we recommend to the larger society and at same time other researchers among them have reechoed that need for institutions collaborations whereby indices of improvement identified by management of a particular institution through their rigorous mining of student feedbacks should be shared with other institutions to adopt such recommendations or readjust some of recommendations to suit their peculiar circumstances. While the other researchers x-rayed some of machine learning algorithms used by many researchers to carry out sentiment analysis to be Support Vector Machine (SVM), Naive Bayes (NB) and K-Nearest Neighbor(KNN) to mention just a few.

3. RESEARCH METHOD

The technique used in this paper is an exploratory literature review of sentiment analysis algorithms used by various researchers in opinion analysis of student feedbacks and other stakeholders' feedback by exposing the hidden opinions of these stakeholders concerning their feedback sentiments by adopting the method used by several researchers in their various articles (Shaik, T., Tao, X., Dann, C., Xie, H., Li, Y., & Galligan, L., 2023).

Research Question

This study has identified key researchable questions that are yearning for answers. Listed below are the researchable questions:

Firstly, what aspects of education are researchers beaming their findings to unravel with the use of sentiment analysis? Secondly, what are the prevalent techniques used in education student feedback analysis while applying sentiment analysis? Thirdly, what are the most prevalent and effective measuring metrics used by previous researchers in carrying out sentiment analysis? Fourthly what are the prevalent methods of collating students and other stakeholders feedback used by other researchers?

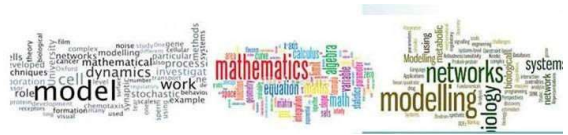
Search String

To have a feasible search string, there is a need to frame these queries with keywords that involved the size of the populace, prevalent outcome, findings, and other viable parameters. Important research that makes use of the high impactable data source base is used as the keywords such as SpringerLink, ACM DL, Web Science, Science Direct, Scopus, IEEE Xplore, SciencePG, EBSCO, etc were used in surfing the network to get needed outcomes. Finally, the search involved relevant keywords such as Sentiment Analysis, Education Sector, Supervised Machine Learning Algorithms, social media, Questionnaires, Lexicon-based, Natural Language Processing(NLP)

Data sources

The uses of high-impact factor journals used in extracting relevant papers for this research work cannot be overemphasized because of their wide acceptability and the additional support they add to the findings. Find below some of the impact factors journals consulted:

- **Scopus:** is a high database of researched materials such as peer-reviewed journals with the capacity of thirty-four thousand, three hundred and forty six journals, with titles documents from different fields amounting to thirty-six thousand, three hundred and seventy-seven titles



in different fields that are published in eleven thousand, six hundred and seventy eight with different publishers.

- **ScienceDirect:** very resourceful database with over nine hundred thousand published articles with over fifteen million researched scientific articles in its repository
- **EBSCO:** they have over six hundred thousand electronic books, over three hundred magazines and three seventy-five full-text databases in their repository.
- **IEEE Xplore:** a reservoir of resource material amounting to over one billion resources materials in their database in order aid further research in different fields.
- **Web Science:** Database with the following categories of information in which over two hundred and eleven millions of information in forms of conference proceedings, journals and books and that is not enough and over one hundred and fifteen million patents and in aggregate producing thirteen million datasets which support present and future research efforts.
- **SpringerLink:** contained over one thousand two hundred peer-reviewed journals and over twenty-five books series which is big resource to support present and future research efforts of today and future researchers.
- **ACM DL:** two hundred thousand records of dataset covering the academia, computer science and other different fields of human endeavors are unique resources that form a based other researchers to use it as reference point for their decisions
- **.SciencePG:** is having over three hundred and twenty open source materials in peer-reviewed journals that easily accessible to the entire research community globally is a database that required researchers acknowledgement.

Data retrieval

The initial search for relevant information in sentiment analysis as it concerned teaching and learning, students and stakeholders' feedback, from highly impact factor journals and other sources are tabulated in Table (1).

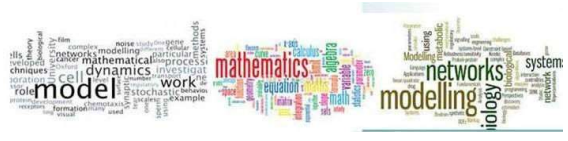
Table (1): First search string answer

Journals	Scopus	Science Direct	EBSCO host	IEEE Xplore	Web Science	Springer Link	ACM DL	SciencePG	Others	Total
Number of Articles	52	500	900	600	546	456	354	187	1000	4,595

Further searches were skewed towards computer science researched works and other related publications ranging surfed from 2016 to 2023.

Table (2): Second aggregate search string answer

Journals	Scopus	Science Direct	EBSCO host	IEEE Xplore	Web Science	Springer Link	ACM DL	SciencePG	Others	Total
Number of Articles	10	65	30	52	47	43	34	21	151	453



After second multiples searches, the relevant papers recorded were 453 which comprises publications related to computer science and topic of highest concentrations is on teaching and learning. education sector, students and stakeholders’ feedback, and sentiment analysis-related materials.

Table (3): Articles skewed toward relevant topics

Journals	Scopus	Science Direct	EBSCO host	IEEE Xplore	Web Science	Springer Link	ACM DL	SciencePG	Others	Total
Number of Articles	5	25	15	25	23	14	10	6	55	178

In the course of the researched, these surfed articles were grouped into:

- (i) Very important articles related to the title of study.
- (ii) Closely related to the title of study
- (iii) Not closely related to the title of study.

This will enhance the preparation of the final Table(4) that form inferences to the final reports of this exploratory literature review.

Table (4): Final reviewed articles

Journals	Scopus	Science Direct	EBSCO host	IEEE Xplore	Web Science	Springer Link	ACM DL	SciencePG	Others	Total
Number of Articles	4	8	6	7	8	5	5	7	30	80

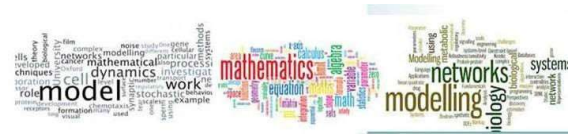
Eligibility criteria

Inclusion criteria

Articles from various researchers that are related to sentiment analysis on teaching and learning as a means of improving the education sector from highly impacted journals, conferences, etc between 2016 to 2023 were used to prepare this current paper.

Exclusion criteria

Articles that were not related to sentiment analysis in this research work were discarded.



4. RESULTS

The results are displayed by providing answers to the already postulated researched questions. Find below the necessary answers provided:

First researchable question: What aspects of education are researchers beaming their findings to unravel with the use of sentiment analysis?

The use of sentiment analysis is a reflection of third opinion outside the institution's management decisions on so many issues affecting their institutions. In order to take decisions that addressed the myriads of problems affecting our ivory tower, there is need to carry out opinion mining of what the students are saying concerning their lectures, delays in releasing semesters results, poor grading system by some lecturers, the institution's facilities, tuition fees, courses structure, course outlines, laboratories, classrooms, which are not presented formally for management action but they expressing these sentiments in various social media platforms. With the advent of social media like WhatsApp, Facebook, LinkedIn, Twitter, blogs, and the like, students have decided to form social groups on campus, in which everything confronting our institutions of higher learning are been discussed on these platforms. The student's basic emotions on all their complaints regarding the institutions are been expressed in these tweets and chats.

The use of suggestion boxes is becoming outdated and not necessary in the 21st century with the digital revolution and the flow of big data of information in a couple of seconds. Illustratively from table (5), it is clear that a lot of published works of previous researchers' findings of student feedback showed 65% remarks is skewed in favour of lecturers which highlight the key impacts of quality of education lies with the caliber of lecturers employed by any institutions., while 10% student feedbacks are skewed in favour of the institutions and 25% are targeted at their courses and institutions combined. These findings are vital information for universities Management and head of institutions to see the need for training and retraining of lecturers, updating of the course's curriculum on regular basis, renovation of universities classrooms and buildings, toilets, hostels, street cleaning, removal of endemic cobweb encroachment and all indexes of dirty environment should be taken care of.

Table (5): Student Feedback based on reviewed articles

Students' opinion	Skewed in favour of Lecturers	Skewed in favour of Institutions	Skewed in favour of Courses and Institutions combined
Percentage	65%	10%	25%

Secondly: What are the prevalent techniques used in education student feedback while applying sentiment analysis?

The tabulated numbers shown in Table (6) give a highlight of various machine learning algorithms employed by a lot of researchers to improve the accuracy of their researched work. It was observed some researchers deployed both supervised and unsupervised machine learning algorithms in a bid to produce a hybrid model in order to improve on the metrics of overall system performance.

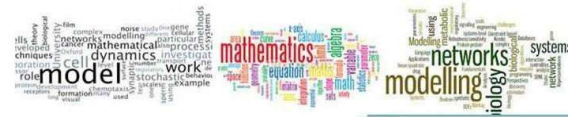


Table (6): Methods used in Sentiment Analysis in Education Sector

Learning Techniques	Papers
Unsupervised Machine Learning	[3], [4], [7],[11], [14],[19],[20],[24],[25],[29],[32],[35],[39],[42],[43],[46], [48],[49], [53],[54],[56],[57],[60],[62],[66],[75],[78],
Supervised and unsupervised Machine Learning	[9], [10],[23], [27],[28],[31],[34], [36],[37], [41],[44], [63],[64],[65],[69],[70]
Supervised Machine Learning	[1], [2], [5],[6],[8],[12],[13],[15], [16],[17],[18],[21],[22],[26],[30],[33], [38], [40],[45],[47],[50],[51], [52],[55],[58],[59],[61],[67],[68],[71], [72], [73], [74], [76],[77], [79],[80]

Table (7) present some of the commonly used supervised and unsupervised models. These models are applied to opinion mining of students and other stakeholders' feedback. These Algorithms are decision tree, support vector machine, k nearest neighbor, naive bayes, and artificial neural network.

Table (7) Analysis of Supervised and Unsupervised Machine Learning Algorithms

Supervised Machine Learning Algorithms	Articles
Decision Tree(DT)	[1], [2], [5],[6],[8],[12],[13],[15], [16],[17],[18],[21],[22],[26],[30],[33], [38], [40],[45],[47],[50],[
Support Vector Machine(SVM)	[51], [52],[55],[58],[59],[61],[67],[68],[71], [72], [73],
K-Nearest Neighbor(KNN)	[74], [76],[77], [79],[80]
Naïve Bayes(NB)	[18],[21],[22],[26],[30],[33], [38], [40],[45],[47],[50],[
Artificial Neural Network(ANN)	[3], [4], [7],[11], [14],[19],[20],[24],[25],[29],[32],[35],[39],[42],[43],[46], [48],[49], [53],[54],[56],[57],[60],[62],[66],[75],[78],

As stated above in table (7), a summary of supervised and unsupervised machine learning techniques used in the reviews of previous work carried out both in their literature reviews and others in stakeholders' feedback Sentiment analysis. There are key relevant lexicons such as Valence Aware Dictionary and Sentiment Reasoning (VADER), Sentiwordnet, TextBlob, MPQA, and Sentistrength, they are displayed in table (8) and related articles that use it.



5. IDENTIFIED GAPS AND CHALLENGES

Regarding the first research question, one of the key challenges is the use of abbreviations, emojis, and other slang languages or symbols which are outside sentiment lexicon dictionaries' embedded keywords. This poses huge challenges for this hidden information that they are supposed to disclose for easy improvement of our education system.

The second question the student and stakeholder feedback used of idiomatic expression to make their views is a big challenge which required the incorporation of vast challenges student uses to express their views. We should have yearly updates of our sentiment lexicon dictionaries for various sectors of human endeavours. Globally sentiment analysis has become the hope for systems improvement in education sectors and other sectors, so the need for incorporation of hashtags, abbreviations, idioms, figure of speech, emojis, etc cannot be overemphasized.

Finally, the fourth question observed a gap in the reviewed articles where these data sets are not structured and problems are peculiar to each institution, and that is why the aspect of the generalizing solution becomes a challenge. Sentiment analysis should be given the highest point of consideration when management is looking for reliable information to aid in decision making.

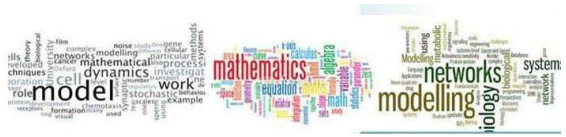
6. RESEARCHED LIMITATION

The drive for Scopus-indexed journals have affected the use of local researched work published within the locality, thereby missing local content and local journals database which could have triggered locally breed solutions towards solving the myriads of problems affecting the education sector. Sentiment Analysis as a field of opinion mining from non-state actors and sentiments are expressed on per second basis, so there is need to involve artificial intelligence and other big data analytics.

7. CONCLUSION

The study has shown that 70% of the reviewed articles applied some level of statistical tools to establish the viability of their algorithms. Kappa and Pearson R-values were applied and the results are 2% and 3% respectively in the reviewed articles while 25% of some of the reviewed articles in this researched work have no established accuracy metrics of measurement. Skewing the research towards considering Supervised machine learning tools such as Support Vector Machine(SVM), Naive Bayes (NB), K-Nearest Neighbor(KNN), Decision Tree(DT), and Unsupervised Machine learning, such as Artificial Neural Network(ANN), to establish the adoption of these prevalent sentiment analysis tools in analyzing student feedback and other stakeholders to incorporate their suggestions, advice and free recommendations in the management decisions.

The use of lexicons-based approach features in some of the articles reviewed and they are MPQA (Multi-Perspective Question Answering), TextBlob, Sentistrength, and Sentiwordnet. Furthermore, it was observed that major channels researchers are used to collate raw data for feedback analysis is from social media such as WhatsApp, Twitter, LinkedIn, Facebook, WhatsApp groups, etc and some blogs, research platforms such as Kaggle, questionnaires/surveys.



These data sources mentioned above enable researchers to get the third opinions on majorities of issues affecting the institutions of higher learning. Some of challenges these institutions are facing are listed below such as: poor institution facilities, lack of electricity in campus, availability of heavy dust in the school campus, calibers of lecturers/teachers employed, state of insecurity in campus, delay in releasing results, intimidation of student, high rate of increase in school fees, bully in campus, cultism in campus, lack of good laboratory for practical, lack of school ID cards for registered students, the list of what is confronting student while in the campus are endless.

Finally, Sentiment analysis is a key tool that will give managers of institutions at all levels, the specific areas that required their urgent attention at any point in time. The computer science department should champion the idea to Management, that information in data form extracted from these social platforms and Google forms are verifiable databases such that after mining should aid management in decision making. The era of asking the Administrative Boss to tell the Management of the challenges the institution is facing is over. This time around technology and verifiable data that is presentable like word cloud, Emotional Valence of Feedback, and bar graphs that are pictorial to represent vast opinions on a particular issue is the norm globally. As we all know pictures, and graphs are easy ways to put the message across to the Top Management of our institutions and Regulatory Authorities, in a bid to enhance quality assurance in our education system.

8. FURTHER WORK

The biggest challenges in carrying out sentiment analysis is the inability of the system to unrivalled the sentiments that these abbreviations, and idioms are conveying. Furthermore, the incorporation of big data analytics, artificial intelligence, and robotics are key areas where opinion-mining efforts should be focusing.

Declarations:

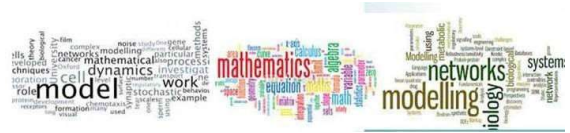
Consent to Participate: All the Authors stated agreed and freely play their roles in the preparation of the write-up.

Consent for publication: All the Authors agreed that this work and data therein should be published.

Availability of data and materials: The data and materials that support the findings of this paper are available and can be obtained from the corresponding author upon reasonable request.

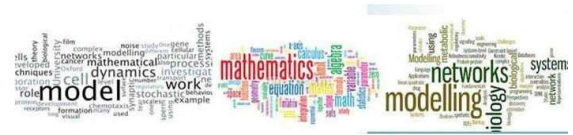
Competing interests: I have the consent of all the co-authors to submit this work to your Journal and I can assure you that there is no contesting interest in this publication.

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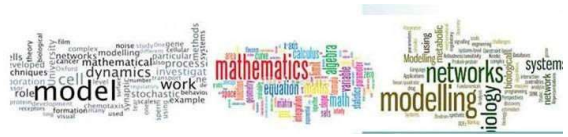
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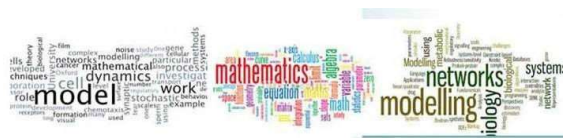
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