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THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN EDUCATION: A PROPOSAL OF AN INTELLIGENT ASSESSMENT GRADING MODEL

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Abstract.
Purpose - *Artificial Intelligence (AI) has found extensive applications in education from online tutoring to automatic online assessment of students. The main open problem in AI application in education borders on prediction of students grades in order to determine early failure and dropout of learners from a course of study.*
Design/Methodology/Approach *-This paper analyzes the application of AI in education from current literature, and based on the analysis proposes an intelligent course allocation and students' assessment model for improved performance of students and efficiency of instructors.*
Findings – Literature *reviews and analysis of the application of AI in education show that although there is currently wide application and use of AI in education, there is still an open problem in the use of predictive AI tools to improve teaching and learning experiences of learners and instructors alike. While the focus of AI in education appears to be formative evaluation, assessments and automatic grading of students, it appears that the evaluation of instructors' performance for teaching, learning and assessment effectiveness has not been given same attention.*
Practical Implication - I*n the face of dwindling economic resources in support of education in the global South, and the high cost of education in both global North and South, the need for the application of predictive AI tools in order to determine early school failures and learners' dropouts' signs as well as instructors' ineffectiveness cannot be overlooked. Following our model and applying selected machine learning tools from the Weka toolkits in order to predict learners and instructors' performances for improved achievements, and instructors' effectiveness would yield good results. Weka which contains collections of machine learning algorithms for data mining tasks has tools for data preparation, classification, regression, clustering, association rules mining, and visualization. Use such tool can yield results which could indicate students and instructors' performance and efficiency. The use of an intelligent grading model as proposed in this study would allow education stakeholders to perform their activities successfully.*
Keywords: *Artificial Intelligence, Education, Computer Assisted Learning, Educational Technology.*

Introduction

Computer Assisted Learning (CAL) and Educational Technology have significantly influenced education outcomes in recent times. On the one hand, CAL can be defined as a type of education involving the use of computers, and other relevant technologies but without the need for human teacher-learner interaction [1]. CAL takes different forms and can be used at all stages of education from kindergarten to university levels using appropriate delivery media such as mobile devices, tablets, laptops, and desk top computers. Moreover, to aid in the learning process CAL employs visual display which is considered a great advantage to successful learning. In addition, grading of assessments in CAL is done by the computer so that feedback is timely provided to learners.

On the other hand, educational technology is an inclusive term defined as "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" [2]. In essence, computer hardware, software, and educational theory and practice are combined to facilitate learning. Furthermore, educational technology emphasises the process of integrating technology into education in order to facilitate and promote teaching, learning and assessments in an educational environment. In modern terms, the concept of electronic educational technology is synonymous with ICT in education, Computer Based Instruction (CBI), Computer Based Training (CBT), e-learning, instructional technology, and online education,.

Apart from the use of technologies in teaching, learning and assessments, learning dimensions do

include behavioral aspects, which can be effectively captured and analyzed as required. In this case, computer-based models of teaching and learning behaviors also exist. However, despite numerous attempts by psychologists to produce validated expressions of human cognitive psychology to aid the design of intuitive computer interfaces for teaching and learning purposes, there are still challenges of implementation Therefore, the use of academic search engines that use computational vector semantics for cognitive capabilities to find records is currently being employed [3].

The application of Artificial intelligence (AI) in education has also provided numerous opportunities to enhance the quality of teaching and learning through the application of new techniques, and innovations in education. These innovations in education include the use of teaching chatbots, online exams, online grading and assessment, online dictionaries, text checkers, automated grading and assessment tools, online invigilation and proctoring tools to mention but a few. These educational innovations have not only improved teaching, learning, assessment and timely feedback but has also motivated active interest in educational activities due to simplified approaches added to teaching and learning activities.

1.1 Statement of the Problem

Artificial Intelligence (AI) has found extensive application in education from online tutoring to automatic online assessment of students. The main use and application of AI appear to be formative evaluation and also in students' assessments/ automatic grading of students, neglecting the necessary evaluation of instructors' performance in teaching and learning. Moreover, there is currently an open problem in the application of AI to education which borders on the prediction of students' grades in order to determine early school failure and dropout as well as analyze students' performance for improved educational quality [13].

1.2 Study objective

The main objective of this paper is to analyze the application of AI in education and thereby propose an intelligent assessment and grading model for improved instructors and students' outcomes. The model can be used to predict students' academic achievements and instructors' efficiency using three classic machine learning prediction tools namely Naïve Bayes, Decision Tree, Random Forest and Neural Networks algorithms obtained from the Waikato environment for knowledge analysis (WEKA) machine learning toolkits.

2 Related Works.

Currently, education industry is applying artificial intelligence technologies in its daily activities. Educational policies have been formulated to promote the application of AI [4]. Moreover, effective teaching, assessment and learning approaches have merged in the education sector due to artificial intelligence technology. According to [4], Technical, model and practical levels are important features be considered to promote the application of AI in education. These include strengthen management of information security and ethics, improving relevant models of AI education applications, and expanding the practice and application scope of AI education respectively.

As explained in [5], virtual examinations provide number of benefits in AI application. They provide balances and checks to ensure security and eliminate misconduct. This is possible due to innovative artificial intelligence applications such as Proctoring, online invigilation, and online grading. Many software applications employ these artificial intelligence tools. In addition, online conference presentation with depicted images of presenter artificially presenting paper is also possible.

Hence, in application and relevance to education, AI assists instructors with administrative assignments such as grading and taking attendance [5]. According to [6], artificial intelligence is related to tutoring and assessment as such helps tutors to be more productive through constructive evaluation and automatic grading. Educational institutions have adopted artificial intelligence to improve their educational activities [7].

Artificial intelligence initially took the form of computer and computer related technologies, transitioning to web-based and online intelligent education systems, and ultimately with the use of embedded computer systems, together with other technologies, the use of humanoid robots and web-based chatbots to perform instructors' duties and functions independently or with instructors [7]. Using these platforms, instructors have been able to perform different administrative functions, such as reviewing and grading students' assignments more effectively and efficiently, and achieve higher quality in their teaching activities.

On the other hand, because the systems leverage machine learning and adaptability, curriculum and content has been customized and personalized in line with students' needs, which has fostered uptake and retention, thereby improving learners experience and overall quality of learning. Apparently, acceptance of AI is increasing across the society as people have become comfortable with AI use in advertising, basic service and other areas

of day-to-day life. In case of education, the use of artificial intelligence in grading students' discussion boards has presented an initial model of student expectations, discussed potential benefits and drawbacks of artificial intelligence and presented initial findings from a limited number of classes using AI grading [8].

According to [9] "there was A-level debacle in England, where grades were awarded, challenged, rescinded and reset. These events were potentially catastrophic in terms of how to trust national examinations, and the problems arose from using just one way to define academic success and one way to operationalize that approach to assessment. While sophisticated digital learning platforms, multimedia technologies and wireless communication are transforming what, when and how learning can take place, transformation in national and international assessment thinking and practice trails behind" pg 1. [9] In the high-stake assessment context, artificial intelligence is appropriate to be applied because of vast technologies. For instance, in England one testing agency is using test of English that assesses verbal, hearing, reading and written skills to explain and propose just how well new technologies can augment assessment theory and practice.

Consequently, precision education is a new challenge in leveraging artificial intelligence, machine learning, and learning analytics to enhance teaching quality and learning performance [10]. To facilitate precision education, text marking skills can be used to determine students' learning process. Text marking is an essential learning skill in reading. The model was proposed that leverages the state-of-the-art text summarization technique, Bidirectional Encoder Representations from Transformers (BERT), to calculate the marking score for 130 graduate students enrolled in an accounting course. Then, applied learning analytics to analyze the correlation between their marking scores and learning performance. Students' self-regulated learning (SRL) was measured and clustered into four groups based on their marking scores and marking frequencies to examine whether differences in reading skills and text marking influence students' learning performance and awareness of self-regulation [10]. High-skill readers who use more marking strategies perform better in learning performance, task strategies, and time management than high-skill readers who use fewer marking strategies. Furthermore, high-skill readers who actively employ marking strategies also achieve superior scores of environment structure, and task strategies in SRL than low-skill readers who are inactive in marking. As emphasized [11], a range of artificial intelligence models were used in secondary schools in England potentially to find the outcome. Results indicated that individual incorrect prediction can be larger than desired. It is acceptable for the models yield acceptable mean absolute errors.

Furthermore, virtual study opportunities are providing relaxed access to education around the world and it requires AI driven automation for grading leading to faster and fairer grading. Investigation is formulated to determine automatic grading as well as short answer grading. A survey of lecturers and teachers with grading experience showed that displaying the predicted points together with matches between student answer and model answer is rated better than the other tested explainable AI (XAI) methods in the aspects of trust, informative content, speed, consistency and fairness, fun, comprehensibility, applicability, and use in exam preparation in general [12]. According to [13] educational field has a concern of identifying challenges in terms of grading, student failure, and determination of well-founded analysis of student performance for improvement of educational quality and cost measures. It has been found that this challenge can be alleviated with the application of AI. Predictions of proposing working virtual model for grading by comparing different technologies to determine the best is possible with AI utilization. In current study, model teaching and learning dataset from students were submitted and utilized in machine learning algorithms in order to make the predictions.

3. Dimensions of Teaching and Learning Data

Educational data encompass several data of interest such as teaching, learning, assessments, communications and interactions among learners and instructors as depicted in figure 1.

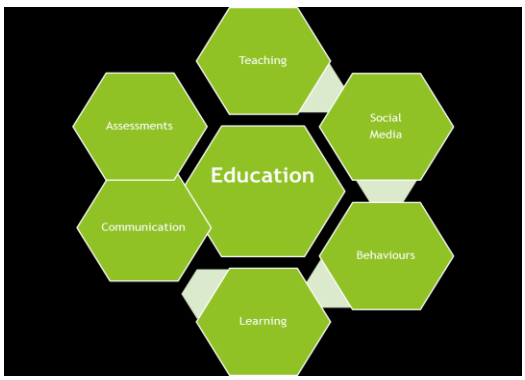

Fig. 1. Example of Dimensions of Educational Data .

3.1 Teaching and Learning in Computing Science

The teaching component relies on the instructors' subject matter expertise in a field or subfield of study. Course allocation to instructors in computing science (computer science, computer engineering,

software engineering, information technology, and information systems; including the emerging arears of cyber security, data science etc) must consider the instructors expertise (including comprehensiveness and mastery of the subject content or subject matter. Instructors assigned specific courses must demonstrate their ability to teach the course through acceptable use of design skills, course delivery skills, class management skills, infusion of mentorship skills, teaching development and innovativeness abilities, and learning assessment skills. In addition, course outlines must clearly indicate and reflect appropriate graduate attributes and skills to be learnt as well as the modalities of learning and assessments.

Essentially, assessments include all criteria used to assess learning including quizzes, tests, assignments, term papers, laboratory exercises and final exams. It is expected that instructors develop a good outline of the course prior to commencement of teaching which must include essential expectations from the course (course instructor identity and contact information, course objective, course content, recommended text(s), course assessment criteria/component and rationale), course grading scheme and range (A, B+, B, C+, C, D, E).

Communication and social media are aspects of teaching and learning. Learners communicate using social media and other social learning technologies. Such communications are already part of the learning management systems, and they are essential components of AI tools. It is also possible to assess learning behaviors based on sentiment of learners in a learning environment. Behavior is also an aspect of cognitive AI, and play important role in learning. Cognitive psychology deals with how the human mind perceives, learns, thinks, and remembers data. Despite the learning curve theory,[14], [15] state that learning has an evolutionary purpose among species and individuals that adapt to their environments. There is a strong correlation between the learners' performance and the time required to complete the task, and as a result, every individual reaches a point where learning is at peak level, where the human mind greatly remembers large amounts of learned data for purposes of assessment and grading. This advantage level may also decline; therefore, we need a proper automatic grading approach to capture such waves in response of human psychology. A semantic vector search model exists as an independent grading agent or as part of larger distributed systems that can analyze textual, open-ended, or essays for automatic academic grading. In[16] three automatic grading approaches have been outlined, namely dynamic analysis where input data is run and matched to the predefined answer, secondly software metrics the one which depend on program contents such as expressions, lines of codes, and statements for use as the basis for grading.

Additionally, there is a static analysis framework where contents are provided and the program model gets transformed into an abstract tree syntax, then used to calculate structural similarity. However, all these three pose their limitations for example, the first one, apart from being commonly used, depends on comparing the outcome to a predefined answer, as such in the case where there is no output the approach fails to assess and grade. The second one, despite its easy-to-calculate functionality, fails to capture program semantic similarities. The third one is more comparative and can calculate structural similarity but fails to perform semantic analysis. All these drawbacks prove the need for more research into semantic calculation technology-based instructional teaching tools.

A comparison was made in [13] that addressed a double prediction on a homogeneous set of input data, predicting the final grade per subject and the final master's degree grade. The results obtained demonstrate that the use of these techniques makes possible the grade predictions. The data gave some figures in which one could see how Artificial Intelligence was able to predict situations with an accuracy above 96%.

There are some simple grading systems designed as shown in Fig 2. It shows the grade between A, B, C, and fail a student attained per course based on the mark attained. This system can be incorporated in a main dataflow diagram for students grading system as in fig. 4.

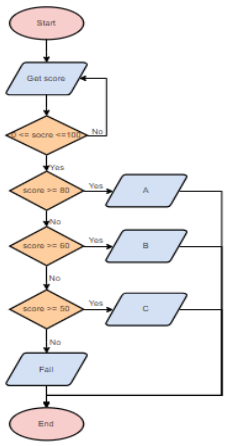

Fig 2: Data flow Diagram of Student Grading System

These grades are the primary indicators of student

performance within the schools. They encapsulate student learning and have influenced various high-stakes educational decisions about students such as college or university admissions [14]. Research has revealed that teachers rely on various achievement and non-achievement data when making grading decisions. According to [14] this practice caused doubts and concerns about ineffective grading practices and mixed grades have increasingly been expressed by teachers, parents, educational administrators, and researchers.

Furthermore, in [15] grading is a process within the practice of classroom assessment where teachers calculate students' grades for standardized report cards and is an important teachers' professional responsibility. Grades, which result from grading, also play an important role in students' life. They determine students learning paths, scholarships, post-secondary opportunities, and career choice. Consequently, grades provide information about students' achievement for stakeholders and represent the students' ability in learning.

Although grading is important, some teachers or instructors consider it a difficult task. Some of the difficulties include handling non-academic factors, such as, students' efforts which should not be part of a grade that represents academic achievement and teachers also seem confused with the communication function of grades and they try to communicate multiple pieces of information about students that cannot possibly be contained within a single academic mark which makes many teachers assign invalid grades [15]. It is required for the teachers to follow some principles of grading which would allow them to address the internal factors and avoid external factors.

4 Computer Science Education Instructors Skill Model for Course Allocation and Assessment

Computer Science Education (CSE) deals with all aspects of training and certification needed to be a qualified computer scientist and be prepared for a job in the computing sciences (Computer Science, Computer Engineering, Software Engineering, Information Technology and Information Systems) and technology workforce. With the unavoidable applications of computing in every aspect of life today, and the innovative developments in Computing and Information Technology (CIT) across all disciplines and careers, the knowledge of computer science (CS) is fundamental to students' future careers. Moreover, as computing and technology continue to shape the way things are done in the world today, it is estimated that by the year 2026 an estimated 3.5 million jobs in the US in STEM (science, technology, engineering and maths) would be in computing [16-17].

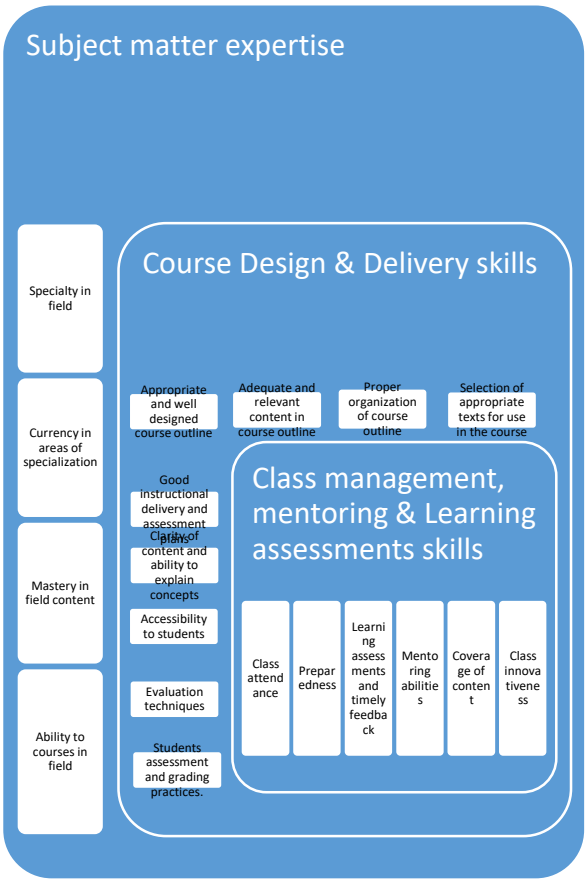

Fig. 3. Course allocation model

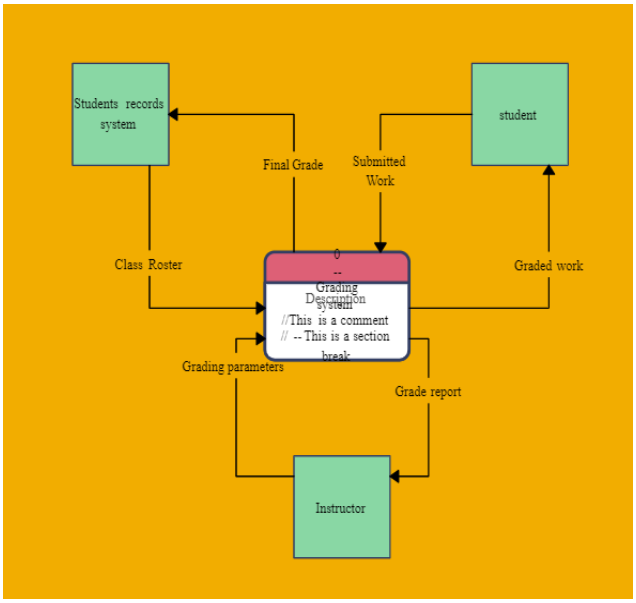

Fig.4 Course grading model

4.1 A Proposal of an Intelligent grading model

An intelligent grading model is a hybrid automated system that performs evaluation of the instructor(s), and the students based on predefined criteria. The evaluation of instructors considers only their teaching in terms of the criteria defined in figure 3 (a self-score instrument), the students' evaluation of course assessment and teaching (a students'-based score of the instructor(s) based on defined criteria, and instructors' evaluation of students' work. The model is depicted in figure 5 below.

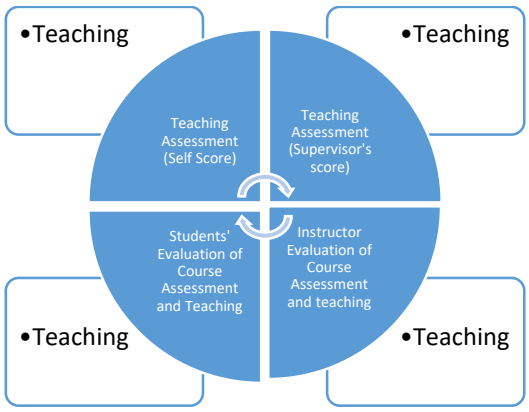

Fig.5. Components of the proposed intelligent grading model.

5 Discussion and Conclusion

In this paper, literature reviews and analysis of the application of AI in education show that although there is currently wide application and use of AI in education, there is still an open problem in the use of predictive AI tools to improve teaching and learning experiences of learners and instructors alike. While the focus of AI in education appear to be formative evaluation, assessments and automatic grading of students, it appears that the evaluation of instructors performance for teaching, learning and assessment effectiveness has not been given same attention. Moreover, in the face of dwindling economic resources in support of education in the global South, and the high cost of education in both global North and South, the need for the application of predictive AI tools in order to determine early school failures and learners dropouts signs as well as instructors ineffectiveness cannot be overlooked. The proper use of intelligent and predictive AI tools will ensure that instructors are allocated courses in their field of specialty and research interest in order to improve teaching and learning effectiveness of instructors on the one hand, and the timely prediction of learners achievements for necessary remedial action on the other hand. In concluding, this paper proposes an intelligent model to support both points raised in the forgoing analysis. Further work in predictive AI is suggested with experiment using machine learning algorithms such as Naïve Bayes, Decision Tree, Random Forest, and Neural Networks using teaching and learning data as appropriate.

The application of selected machine learning tools from the Weka toolkits in order to predict learners and instructors' performances for improved achievements, and instructors' effectiveness would yield good results

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