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Design and Implementation of an Essay-based E-Examination System

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ABSTRACT: This research focuses on an E-examination system that revolves around essays. Its objective is to improve the examination process by automating it. To achieve this, an algorithm is developed to implement the designed system, assess its functionality, and create a database management system. The system consists of three modules: Administration (Admin), lecturers/staff, and students. These modules utilize the computer system to enhance the examination process electronically. The proposed method is based on a review of previous research and the current practices of various institutions conducting examinations. The project incorporates the Levishstein distance Algorithm, which measures word and sentence similarities to score students based on their answers. The interface design and program operations are implemented using the C SHARP programming language.

Keywords: Essay-based; E-examination; exam integrity; exam process

INTRODUCTION

The utilization of electronic examination (e-exam) has become increasingly popular in the field of education due to its suitability and effectiveness. Examinations have long been acknowledged as a reliable method for assessing students' knowledge and skills, employing various formats such as oral, written, paper-based, electronic, practical, and essay-based exams. Traditional paper-based examination systems faced numerous issues, including bribery, demands for teacher gratification, and impersonation. Consequently, e-exam systems were introduced to replace these outdated methods (Adebayo and Abdulhamid, 2014).

Although detection technologies have been developed, cheating during exams remains a widespread problem. Numerous research studies have examined cheating behaviors among students, and educational systems have made efforts to address this issue. In the United States, a staggering 80% of students from high-achieving secondary schools admitted to cheating during exams, with 95% of those cheaters believing they couldn't be caught. Furthermore, 51% considered cheating acceptable, 81% of college students saw it as a means of gaining an advantage, 75% confessed to cheating, and 90% didn't think cheaters would face consequences (Bawarith et al., 2017).

With this, e-exam needs serious security measures that will eliminate cheating during the exams. Based on this, several security measures (biometric fingerprint, facial recognition, text encryption and online proctor i.e. e-protector) have been put in place to ensure exam integrity. E- Proctor is a method that can be used to monitor the candidates while taking e-exams. E- Proctor serves as an integrated solution that brings academic and e-exams to e-learning. E-Proctor needs finger print scanner for authentication of student's identity, it needs an eye tracker to track the students eye movement which helps to detect where the students is looking at on the screen (Bawarith et al., 2017).

With the security measure put in place combined with the advanced technologies used to design and implement e-exams, e-exams is now recognized as a great tool by providing direct and immediate feedback to students. It enhances students' motivation to increase their performance. It reduces students' tendency to cheat by

setting different questions in different order. E-Assessment has become essential tool that helps the teacher to enhance the quality of feedback to track the student performance as well as make analysis across many assessments in the school especially where there are a large number of students. It supports high-order that thinking skills such as critiquing goal as new educational goals, problem solving using science, mathematics and supported by IT. Due to this, it provides more accurate result than paper test (Alruwais et al., 2018).

Presently, e-exams have gained widespread adoption in Nigeria as a result of their promising features. They have become the primary method for conducting entrance exams into higher educational institutions and are being used at certain levels in universities. The use of e-exams offers several advantages, such as saving time, reducing resource requirements, maintaining comprehensive records of results accessible to both students and staff, safeguarding exam content, and ensuring secure testing sessions (Adebayo and Abdulhamid, 2014).When it comes to administering questions to students, the e-exam system possesses the capability to organize and adjust the difficulty of the test based on the students' responses. If a student answers correctly, the system can increase the difficulty of subsequent questions, while incorrect answers may lead to a decrease in question difficulty.

In evaluating the existing research on e-exams, several approaches have been employed, including Multiple Choice Questions (MCQ) with manual evaluation on printed paper, evaluation using printed paper and optical mark recognition, and computer-based exams (e-exams). Among these methods, computer-based exams have emerged as the most effective, although they may not fully demonstrate students' abilities and knowledge as they are limited to answering multiple-choice questions (Tiwari, 2018).

Statement of the problem

Numerous research studies have focused on e-exams in order to uphold academic integrity, and these systems have proven to be efficient, secure, and reliable. However, there are still challenges associated with e-exams. One of the main issues is that they are primarily based on multiple-choice questions (MCQs), which cannot accurately assess students' abilities and knowledge as they limit their expression. Consequently, even less academically inclined students may achieve high scores by chance if they happen to select the correct answers. Additionally, there is a risk of non-departmental students taking exams and potentially passing by randomly choosing correct answers without understanding the subject matter. Furthermore, traditional essay (theory) exams are still conducted manually, leading to problems such as excessive workload for lecturers, inadequate result computation, errors during marking, and the possibility of script omissions. Considering the aforementioned challenges, the objective of this research is to design and develop an e-exams system that specifically focuses on essay-based exams. The aim is to address the limitations of existing systems and enhance the evaluation process by allowing students to express themselves effectively.

The system will aid easy conductivity of exam and ensuring that each student must be registered to answer the questions being set. With this automated system, all those problems stated above will be solved.

Literature review

With the ongoing progress of information technology, an increasing number of institutions and researchers are embracing electronic examination (e-exam) systems. Ensuring security is of utmost importance for these organizations utilizing e-exams, as it guarantees the confidentiality, integrity, and availability of information while safeguarding their reputation. Numerous studies have focused on secure e-exams, leading to the implementation of security measures by multiple e-exam website providers. One such provider offers various secure features, including a secure browser implementation, remote proctoring via the client device's camera, SSL data encryption, and an audit log (Rosmansyah et al., 2019).

E-exams have become increasingly prevalent in higher education institutions worldwide and offer several benefits over paper-based methods, including reduced costs, automated grading, adaptive testing, increased assessment frequency, and the ability to test larger numbers of students. Additionally, e-exam systems allow the integration of various multimedia elements, such as text, images, audio, video, and interactive virtual environments. However, challenges still exist, such as security and human interference, limitations in evaluating high-order thinking skills, inadequate technological infrastructure, and the complexity of the system, requiring significant training (Pagram et al., 2018).

In a research conducted by Shraim (2019), the perception of e-examination practices among undergraduate students at Palestine Technical University-Kadoorie was examined. A total of 342 participants completed an online questionnaire survey for the study. The research investigated the benefits of e-exams, such as their practicality, reliability, and efficiency in comparison to traditional paper-based exams. However, the study also acknowledged the presence of challenges related to security, validity, and fairness that required attention to ensure the successful implementation of e-exams. To tackle these issues, the

paper aimed to analyze the existing electronic examination systems in six universities and propose a new system that would effectively address the identified shortcomings. The new system utilizes data encryption and biometric fingerprint authentication to improve security and address existing issues.

The importance of e-exam

After careful preparation, formulation, and revision of an exam, students can commence answering the questions. Prior to the exam, student information is inputted into a computer system for future reference, emphasizing the necessity of utilizing suitable and high-quality software. E-exams offer numerous advantages, including the ability to integrate multimedia elements into questions, receive immediate support and feedback, and allow for flexible exam scheduling. They also enable the creation of equivalent exam versions for a large number of examinees situated in different locations, which can be submitted via mail or online platforms. E-exams yield instantaneous results and facilitate swift analysis of group performance. Furthermore, they allow for the establishment of a question bank for future utilization. In terms of time, effort, and cost, e-exams prove to be cost-effective. Additionally, they enable student monitoring, entry of student details prior to initiation, direct reporting to students, ensuring equality among students, precise assessment, and the inclusion of video or audio clips in questions, while also allowing for specification of the examination duration (Ahmed et al., 2021).

Categories of e-exams

Electronic examination (e-examination) is intended to serve as summative (final) assessment, e-exam in order to define the evaluation grade for a course. Electronic examination can be defined as ‘a system that involves the conduct of examinations through the web or the intranet. Functionally, an e-exam can be provided using a dedicated system or it can be included as a module part of a LMS (Kuikka et al. 2014).

E-Exams process can be categorized into three types: diagnostic, formative, and summative test. A diagnostic test is given before the lesson proper to assess students’ prior knowledge. A formative test is given during the discussion to identify whether further discussion or revision is needed. A summative test is given after the course to define the student’s grade. Currently, e-exams are usually given at the end of the course (Ahmed et al. 2021).

Evaluating students’ knowledge

Despite the efficiency, security, and reliability of maintaining academic and exam integrity, it remains crucial. Multiple Choice Questions form the basis of assessments, yet they encounter several challenges. One such challenge is the inability to adequately assess the abilities and knowledge of students (Tiwari, 2018).
In evaluating the research works that have been conducted on e-exams so far, they are all based on Multiple Choice Questions (MCQ) involving;

- Printed paper and manual evaluation,
- Printed paper and optical Mark Recognition based evaluation and
- Computer based exams (e-exams).

Out of these three ways of evaluating the students, computer based exam become best compared to others but it doesn’t justify the ability and knowledge of the students accordingly since they cannot express themselves in answering on Multiple Choice Questions (Tiwari, 2018)

Related works

Despite the fact that current e-Exam systems have been effective in resolving some traditional exam-related issues, they still suffer from numerous problems. The authors identified these issues and developed a new e-Exam platform to address them, with the aim of providing a better quality exam that saves cost, time, effort, and reduces the probability of cheating. The new e-Exam platform was implemented on client/server network architecture in three computer laboratories at the IT department in LFU. Since October 2015, the platform has been used by 14 lecturers to create daily quizzes, midterm and final exams for 142 students in both morning and evening classes, replacing most of the paper-based exams. The platform is composed of three main subsystems that work together to generate e-Exam packages and deliver the e-Exams. To establish the client/server model, a special e-Exam Browser was created using C Sharp (Al-Hakeem and Abdulrahman, 2017). The University College London in the UK implemented Moodle as their course management system, as well as for online exams and quizzes (Sorensen, 2013). On the other hand, the University of Nottingham developed a freely available assessment management tool called the "Rogō e-Exam system" for conducting e-assessments. Additionally, the University of Helsinki in Finland has been conducting e-Exams in computer classrooms for ten years. However, it should be noted that certain universities still adhere to the practice of administering traditional paper-based exams (Rytkönen and Myyry 2014).

Towards the end of June 2014, 1526 e-Exams were conducted using Soft Tutor e-Exam system at Turku University of Applied Sciences (TUAS). Academically, the

system enhances the situation but only few teachers are actively using it now in TUAS (Kuikka et al., 2014). E-exams were adopted to replace traditional exams at Universities in France. For instance, in 2014 at University Joseph Fourier, pharmacy exams have been organized electronically using tablet computers (Kassem et al., 2015).

In 2014, the University of Queensland in Australia carried out experiments involving e-Exams during their semester exams in undergraduate courses. They utilized a Bring-Your-Own-Device (BYOD) system along with an open-source platform. Similarly, several universities in Nigeria, such as the Federal University of Technology Minna, University of Ilorin, Covenant University Ota, and National Open University of Nigeria, have also conducted trials of e-Exam systems for their examinations. At the VU University Amsterdam in the Netherlands, computer-based exams were employed to assess undergraduate students in departments like Medical, Arts, and Life Sciences. Utrecht University implemented Remindo digital assessment software in 2015 and conducted pilot programs of Electronic-Exams across various faculties, including Life Sciences, Economics, Law, Governance, and the Medical Center. Furthermore, the College of Science at Kerbala University developed a secure e-Examinations system specifically for students in the College of Sciences. The Faculty of Heritage and Archaeology at the University of Kufa (2016), adopted e-Exams for students in two departments.

Muhammad and Adebayo designed an Electronic-Exam system and deployed it within six universities in Nigerian, it runs on intranet and internet, and fingerprints was used as security measure, the candidates will be supplied with a multiple choice questions which will be marked immediately the candidates finish the answers and their result will be displayed (Adebayo and Abdulhamid, 2014). Magdi el al proposed an e – exam system that has auto-grading features for different types of multiple choices, numeric, fill-in the blanks, matching and essay questions which need the lecturer's grading (Kandil et al,. 2010). Tufekci et al proposed Mobi system (e-exam system) that is functioning well in mobile and web modules; sometimes reading questions has become a problem because some mobile phones do not have the features of graphic display function besides a difficulty in reviewing answers in mobile rather than the web.

Related system

Budi Darma Setiawan and Mochammad Ali Fauz proposed two methods for evaluating student answers using cosine similarity and n-gram. N-gram is used for feature extraction, and it is modified with cosine similarity to split words instead of letters. Rababah and Al-Taani (2017) designed a system for Arabic essay scoring based on cosine similarity measure.

Phil and Arunesh (2016) developed a system using the cosine similarity algorithm to measure text similarity between two documents, which can be used in essay scoring or information retrieval. Another system, presented by Mohammad et al. (2021), is an application that generates modules for multiple e-exams, including one-word answers, multiple choice, true/false, matching, and dragging. The instructor submits the exam questions with appropriate scores and evaluation scales, and the student uses a PC screen interface to access the e-exam modules. The scoring system follows an immediate final score, and the tools used include MySQL, Oracle, Visual Basic 6 language, HTML, and system implementation. The system preprocesses words by removing stop words and stemming after tokenization, and then weights the words using the TF-IDF model represented in a vector model. The cosine similarity algorithm is then used to measure the similarity and relevance between the student vector and teacher vector.

METHODOLOGY

The approach of this suggested system relies on an examination of prior research conducted in the field and the current practices employed by various institutions. To assess student responses, the project incorporates the Levishstein distance Algorithm, which evaluates the percentage of word and sentence similarities. This algorithm assists in scoring students based on their provided answers. For the design and operation of the program, the research project will utilize Visual Studio 2010 and the C SHARP programming language for interface development.

System designs

This section explains the procedure followed in the design of the proposed system, it comprises of the architectural design, which involved three modules namely: Admin, lecturer and the students. The Admin registers the lecturers that will take the courses in a semester with the courses they will take. Admin also registers the students with the courses they are offering in that semester. A registered lecturer can set the question, provide the answer and then assign the mark to each question. After the exam, registered lecturer can view the result directly from the system. While the students can only seat for the exam and check the result after the exam (Figure 1).

System implementation

The system was created using the visual studio 2010 platform, which includes programming language C SHARP and other tools for programming on Windows.

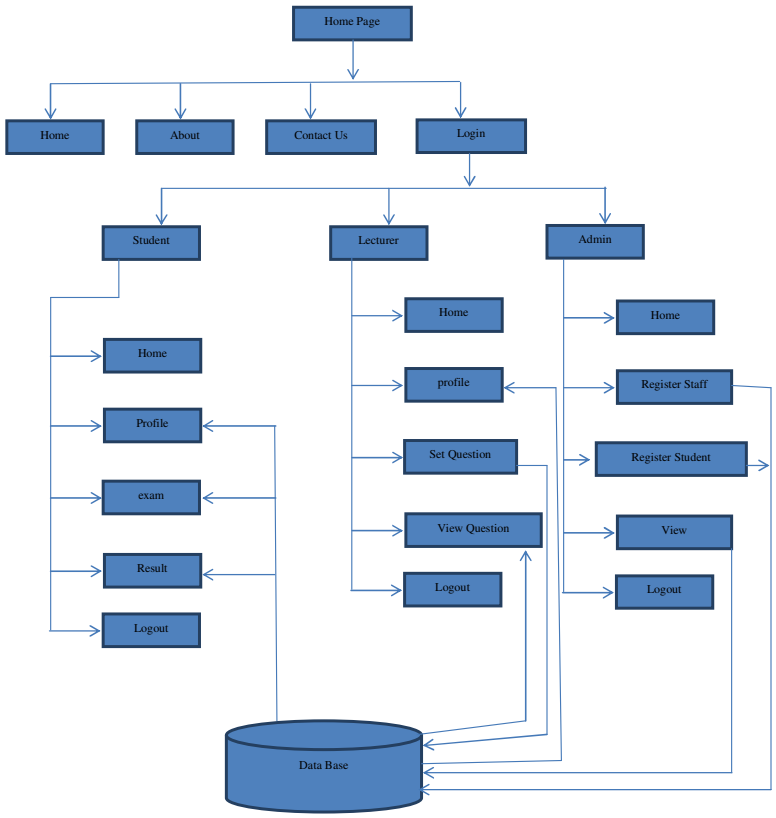

Figure 1: Architectural Design

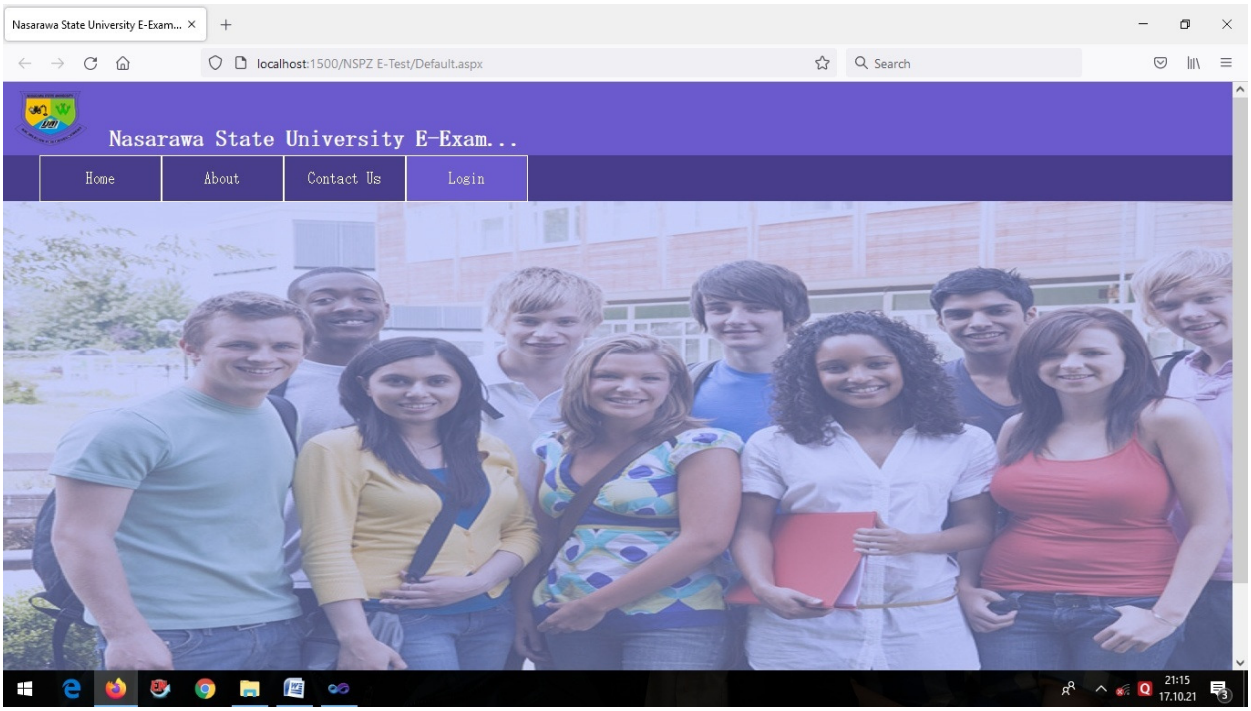

Figure 2. The Welcome page

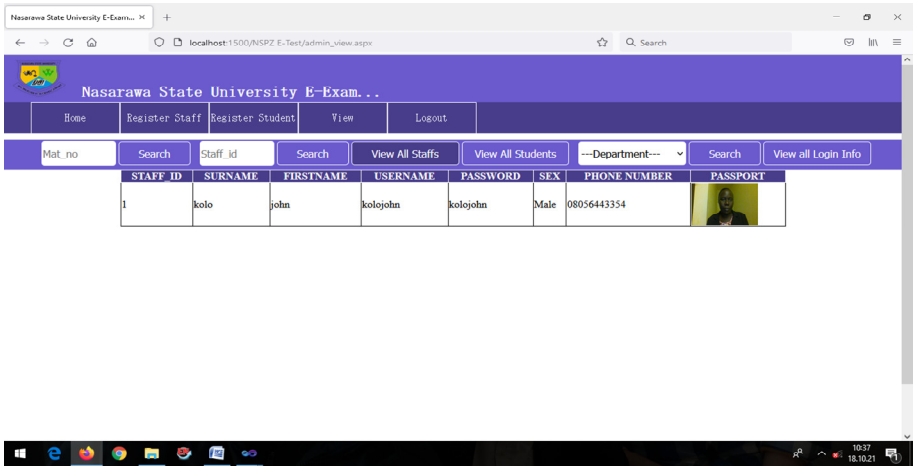

Figure 3: Lecturer page: showing a registered staff.

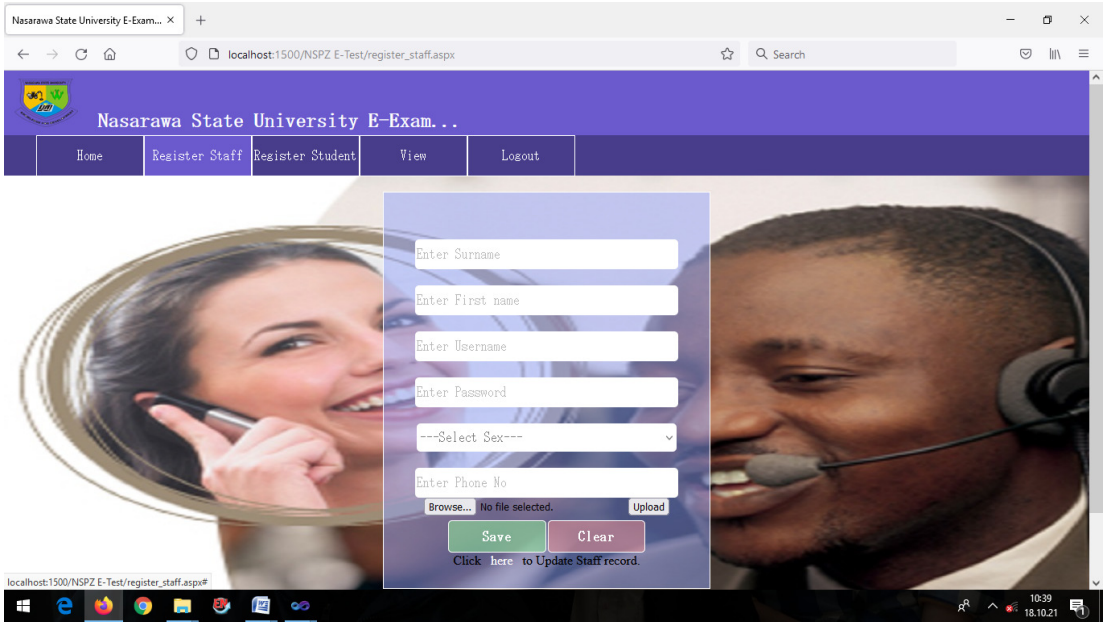

Figure 4: Lecturer page: setting question.

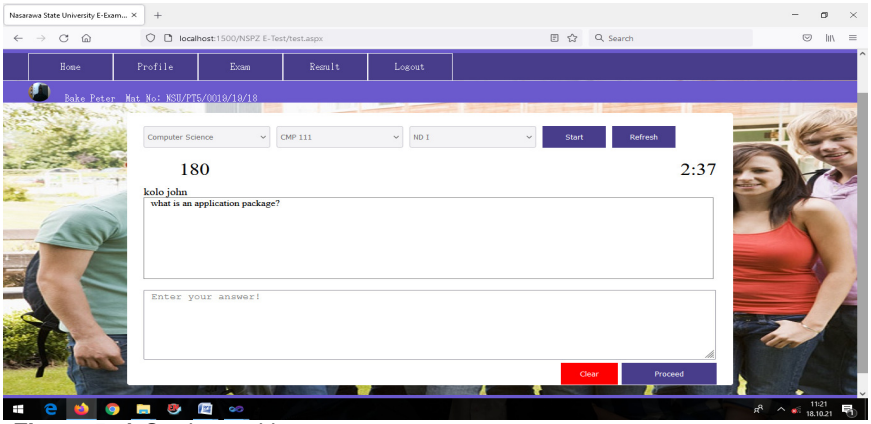

Figure 5: A Student writing exam

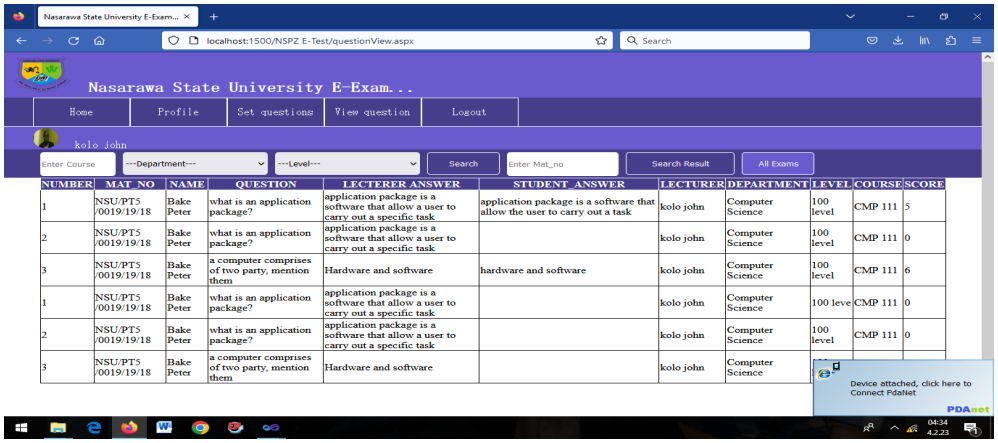

Figure 6: A Lecturer page: viewing the exam scores

In order to tackle the large task at hand, the development team utilized C#, asp.net, and Microsoft Access. Access was used as a query language for retrieving information from the database. The development team was able to successfully implement the functionality of the three modules (Admin, Lecturer, and Students), and communication between these modules was established (Figures 2 to 6).

Conclusion

The continuous enhancement of the Essay-Based E-exam system involves the regular adjustment of its functionalities. Its interactive interface reduces the workload in the education field and offers cost savings by eliminating the requirement for paper procurement. Furthermore, it streamlines human effort and time by automatically managing exam durations. This technology is exceptionally innovative. The system can securely store and retrieve records of each staff member or student as needed. With its capabilities, students have the convenience of writing their exams remotely as long as they have internet access to the designated web URL.

Recommendation

The Essay-Based E-exam system is specifically tailored for Nasarawa State University, Keffi. It is suggested that an additional feature be incorporated into the system, namely the result compilation functionality, which would calculate the semester grade point (GP) and cumulative grade point (CGP). This addition would enhance the effectiveness of the system for the university's needs.

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