Online Examination System with Cheating Prevention Using Question Bank Randomization and Tab Locking

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***Abstract*— Online examination system is used by educational institutions to improve the quality of instruction by having a supervised measure of outcomes for self-paced learning environments of their students. The reason E-learning became so popular is because of its fast feedback in assessing the examiners or candidates. An online examination system that has the ability to address academic malpractice should be the main concern to be able to trim down those acts at some degree. Saving time is one of the perks in having an Online examination system, but it also had limitations on dependency to the quality of Internet service leaving both the proctor and the examiners not being able to use the system. The research looked into interviewing through a focus group the proctors of online exams to identify root causes of academic malpractice at the same time interview exam content creators on possible approaches on exam questions generators that allow a validity of measure of outcomes. Generally, a final validation done by the focus group respondents and end users for effectivity and usability.**

Keywords*— *academic malpractice; randomization; assessment; e-learning; online examination

I. INTRODUCTION

A. Background of Study

Online examination systems used by educational institutions continue to address cases on academic malpractice with a common problem today due to easier method in attaining information for students in a learning environment based on the internet.

Taking answers from another and plagiarizing assignments are an example of an academic malpractice, this is the problem educational institutions want to address [1]. Since the proctor was not able to keep tabs with every examiner. Randomization of exam has the ability to address academic malpractice, this would provide the examiner's with different exam that would make them unable to commit such acts..

Exposing the long established method might prove to be unsuccessful to fully prevent academic malpractice during examinations. E-learning has its vital and integral assessment component using online examination [2]. Submitting exams in E-learning has already been done without a proctor present. As a result, students can easily commit academic malpractice during exams, educational institutions with E-learning depend on an examination process on which students take the exam in a physical controlled environment at the institution under a supervised condition, however, this contradicts the concept of the live E-learning environment.

Two primary benefits of online examination [4]. First, is the large cost savings of the substitution of machines for labor in grading, and second is the potential for enhanced student learning due to more frequent assessment. Another significant benefit is immediate feedback to students on homework assignments and examinations. Upon submission of the assignments and exams, the software provides students with answer keys and their own responses.

Another approach is controlling the local terminal of the examinee. There is a tool for learning system that lets you regulate an online assessment in the local terminal called Respondus [8]. It can also assist in database inquiry to a few online courses. Existing Respondus partners in developing exams in E-learning are Moodle and Blackboard to name a few. One key feature of the tool is locking the environment to the online exam window which deters the examinee from further investigation or communication.

Online examination results are assessed by the computer resulting to the time and cost saved against its manual examination counterpart. Based on the advantages of the internet, modifications have been implemented to the examination system concept by designing a website with online examination that sets questions and answers by the proctor. Said approach is evaluated by the

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computer in checking the results saving the proctor's valuable time in checking papers manually at the same time provide clear analytics and feedback on specific learning outcome clusters of the learners in terms of strengths and opportunities for improvement [3].

B. Conceptual Framework

In Forms Distribution Algorithm created by Al Bazar [2], implementing this algorithm will first require the exam maker to generate keys correspondent to the number of the exam takers present. The keys generated are for one time use only which will then be used to select a preset exam form with the same number of questions. This algorithm guarantees that there will be no exactly the same set of questions within an examination.

In a distribution technique developed by Khaled Suwais, the model considered choosing the exam questions randomly [5]. However, the location of the students is taken into consideration to ensure that no students will receive an exam with the same set of questions but needing to address that the same difficulty level should be looked into given a randomized question set.

Online examination system sets different admissions and procedure interface for users or examinees with different roles, the users enter into a particular interface, and have different set of exam according to different permissions like set A and set B [6]. The System's primary objective is providing online examination service for examiners, therefore, the examinee is the heart of the system.

On the basis of the course of the preset packet filtrating regulation, the moment the system discovered any unauthorized packets of data, the exam will be stopped and a warning message will appear in the examiners' computer or else the computer will be locked rending the examiner to continue the exam [7].

Figure 1 represents the conceptual approach of the development of the online examination system with 3 main components namely: A weighted value based randomizer that determines unique but same level of difficulty and coverage of the exam content limited to objective type of exams; Second a Tab locking system to prevent other browsing and window navigation function during the exam; And an analytics checking function to identify scope of learning outcomes and the corresponding performance result.

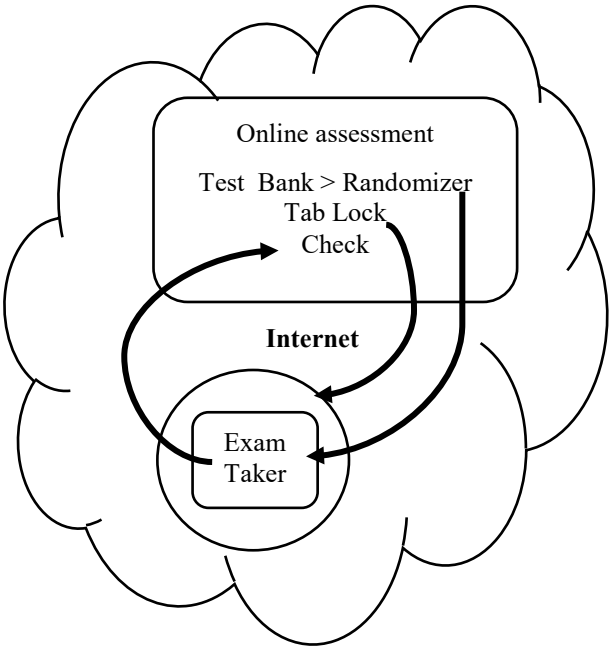

Fig. 1. Conceptual Framework

C. Related Literature

A research done by the International Centre for Academic Integrity, says that over 70,000 undergraduate students 68% of them admitted into committing academic malpractice on examinations and plagiarize on assignments. Another survey was done by the Canadian Broadcasting Company on 54 Universities of Canada, declaring that 73% of students admitted on academic malpractice in the academic year 2011-2012 [9]. In the U.K., according to Guardian, they discovered an increase of 42% in academic malpractice acts involving gadgets since 2012. Also, in the U.S. Harvard University, a prestigious university had experienced academic malpractice dishonor on a take-home final exam in which 125 students were accused of working jointly, according to the school this could prove to be the largest Ivy League academic malpractice scandal in recent memory.

The educational philosophy of playing down the scores of examinations pay more thought on knowledge, comprehensive quality and the ability has not yet been completely touchable in teaching and managing activities of every department. It brings that a few students explore quick success and instant gain, learn calmly to cope with examinations. The examination cannot be used as the only test to recognize and separate the sheep from the goats [10].

Most of the online examination systems spawn exam questions automatically are derived by the number of items from the question bank following a set condition that will simply randomize the question [11]. This structure is effortless to implement, however, it does not

remove the fact that it is inefficient, unable to be backtracked and not very innovative as it is easy to get into an endless loop.

II. METHODOLOGY

The study utilized a model guideline from Winston W. Royce in this project as seen in Figure 2. It established various phases and techniques which will be applicable in developing the system.

The Royce Model generally applies a constant backward validation test method as such the design is accepted through it development stage.

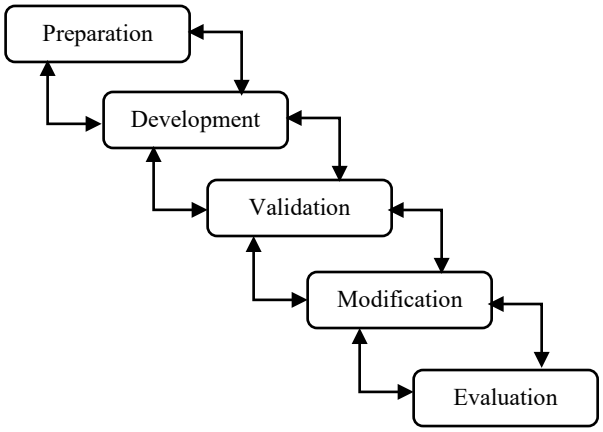

Fig. 2. Royce model

Preparation

This stage is the most crucial part of the project because it gives the proponents a direction on the development of the project. The proponents will investigate on what programming language and database design will be used in developing the project. A focus group approach was used in interviewing exam creators and understanding assessment goals and methods. Another aspect of the focus group then looked into the exam proctors whom on the field are more familiar with the occurrence and conduct cases of academic malpractice.

Development

In the development stage, following the data's gathered, the proponents will focus on the preparations and plans. Writing the codes is the most laborious and consumes a great amount of time of the project since it is a web-based system. After writing the codes the database design will be the major part of the project. Lastly, de-signing the assessment of the system plays a part in the development stage. General targets in the development stages looked in embedding a weight system in the test bank and an outcomes cluster field as such the randomizer algorithm will now considers specific characteristics of the exam set by the exam creator. This framework derived from the focus group discussion is presented in Figure 3 aimed to address the ability to generate unique exams but measures and assess the same targeted learning outcomes. One key note also from the Focus Group was the need to be able to sizeable test bank in the consideration of the number of exam takers at a given instance on the assumption of a similar group. The other target is the Tab locking feature that allows the website to look the local system from navigating from one window or browser tab until exam was completed or terminated.

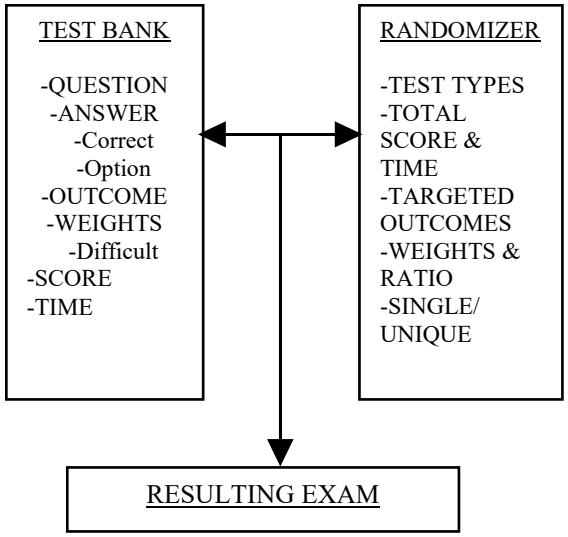

Fig. 3. Concept Exam Generator

The development phase of the concept exam generator in Figure 3 under the Test bank procedure looks into the followings fields created in the database. The fields include the question of the item with field on correct answer having alternate option of selection in case for matching type exam. The question field included the following four fields that will give more decision characteristic to be used by the randomizer namely: the outcome cluster on topic the question is grouped, the level of difficulty and importance in weighted percentage with its corresponding score if answered correctly and time needed to ideally complete and answer said question.

Validation

In this stage, the framework of the proposed project and its segments were analyzed in order to guarantee that the procedures are running under the expected conditions. In conclusion of the series of de-bugging and testing, the proponents arrived in their presumption and considered whether a couple of modifications are necessary. One key observation was the limited size of the test bank database to further determine the ratio and extent of exam uniqueness of the randomizer on the assumption of large classes taking the exam. The Ratio of test bank size and

against the size of class taking the exam at a given time was set a limitation of the study.

Modification

The proponents accumulated some information by way of consultations. Additionally, the proponents decided to include several modifications to the proposed project by adding a Comma separated values (CSV) extraction. The proctor can import an examination by extracting it from the CSV file. The proctor can then adjust to how the randomization will perform.

Evaluation

The evaluation was done based on looking into a parts approach in reviewing expected outcomes at a per development process. As for the final outcome a parts approach is also applied in terms of evaluating the technical components through test scripts and the learning or exam component through user live testing of students and educators by observing and gathering survey feedback.

III. RESULTING SYSTEM

The process flow proposed in Figure 4 illustrates the flow of the system from the perspective of the proctor.

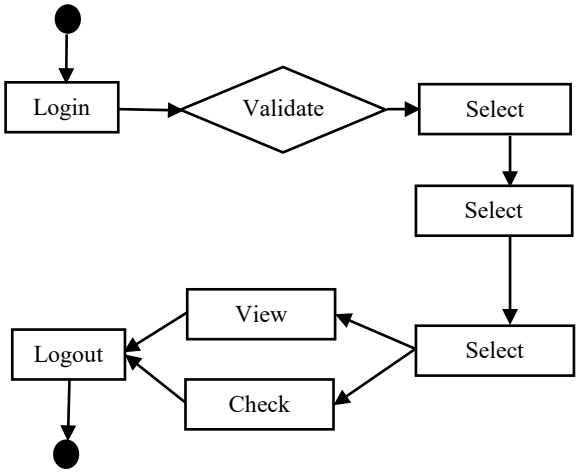

Fig. 4. Proctor Process Flow

Figure 4 also illustrates the proctors' guideline in using the system. The proctor can set how many questions in the exam should be randomized and create a question in 3 types namely Multiple Choice, Identification and Matching Type. After that, the proctor can set the time and period to complete the exam. The exam key is automatically generated based on how many examiners are taking the exam. During the Select Exam process the proctor will also set the randomizer setting based on the scope of outcomes the exams that will be generated. As referenced to Figure 3. The outcome choices will have fields on its percentage weight of difficulty in terms of overall average difficulty of the exam and the ratio of the difficult to average questions in the generated question. It is also set in this process on whether the exam questions to be generated are identical to all or unique.

The proctor is also capable to import an exam from a CSV file in the Set exam process and that helps the proctor to save time instead of manually encoding the questions and choices into the system. The proctor can also select and assign the weighted fields of the questions in the CSV file. Generally, the weights look into a Likert scale of 1 to 5 with 5 being highest or difficult. From this point an averaging approach was used to validate the randomized selection of the questions as such two items are then checked on exam were generated. For example, proctor has set difficult ratio to 10% with overall difficulty to a score of 2. The program will cross check the randomized exam generated on whether such will qualify by determining the number of question weight of 4 above against 3 below and should meet 10% and the overall average of the weight should +/- 1 scale from 2.

In the perspective of the examinee, Figure 5 illustrates the flow of the system from the point of view of the examiner.

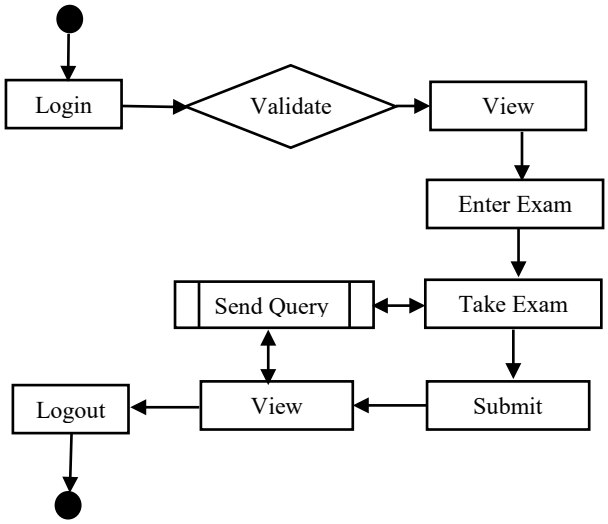

Figure 5 Examiner Process Flow

The examinee's only requirements in using the system is an account and an exam key provided by the proctor. The examiner can send a feedback to the proctor if there are errors in the given exam. Assessment is automatically generated after submitting.

The developed system also allows the proctor to manually lock the exam to all the examiners or unlock the exam. The system based on the Tab Locking process [8] automatically locks the examinees terminal once it opened a new tab or minimizes the screen and it will appear in the proctors' terminal that the said examiner has forfeited the exam because of at-tempted academic

malpractice. From this the examinee can send a query to proctor to access this manual feature if deemed allowable.

IV. FINDINGS

The system is tested through a test script and the data collected were analyzed based on the survey conducted with 100 College student respondents. The processed data is shown in Table 1 to Table 5.

TABLE I. *EVALUATION OF THE RESPONDENTS ON THE "FUNCTIONALITY" CRITERIA*

Functionality	$\bar{x}$	Verbal Interpretation
Purpose	4.75	Excellent
Suitability	4.80	Excellent
Accurateness	4.82	Excellent
Interoperability	4.77	Excellent
Total	*4.79*	*Excellent*

The criteria on functionality as presented in Table 1, looked into whether the system has served it intended function which allows examinees to take an exam online with features embedded that deters academic malpractice for objective based exam questions. The respondents generally agree with a score of 4.79 that such features like unique exams per student knowingly will deter the temptation of communicating with other students for answers or scope in taking the online exam.

TABLE II. *EVALUATION OF THE RESPONDENTS ON THE "RELIABILITY" CRITERIA*

Reliability	$\bar{x}$	Verbal Interpretation
Free from errors	4.77	Excellent
Recoverable	4.73	Excellent
Compliant	4.82	Excellent
Total	*4.77*	*Excellent*

As indicated in Table 2, the Reliability of the intended system based on the evaluation respondents has attained an overall average of 4.77 with an excellent remark. This shows that the system is accurate and precise and that there are no bugs and errors found during the testing phase.

TABLE III. *EVALUATION OF THE RESPONDENTS ON THE "USABILITY" CRITERIA*

Usability	$\bar{x}$	Verbal Interpretation
Understandability	4.78	Excellent
Learnability	4.76	Excellent
Operability	4.74	Excellent
Total	*4.76*	*Excellent*

The evaluation results on Table 3 on Usability pointed out that the intended system is easy to handle, and that the functions are effortless to perform and easily remembered, and that allows straightforward operations for the supervision that enabled it to attain an overall interpretation of Excellent with an average of 4.76.

TABLE IV. *EVALUATION OF THE RESPONDENTS ON THE "EFFICIENCY" CRITERIA*

Efficiency	$\bar{x}$	Verbal Interpretation
Time behavior	4.62	Excellent
Total	*4.62*	*Excellent*

In terms of Efficiency as measured in Response time performance as seen in Table 4, even though it is subjective and conditional due to the location of the infrastructure of the Internet it was tested. Overall the result was excellent.

TABLE V. SUMMARY OF THE EVALUATION OF THE PROPOSED SYSTEM ONLINE EX-AMINATION SYSTEM WITH CHEATING PREVENTION USING QUESTION BANK RANDOMIZATION AND TAB LOCKING

Criteria	$\bar{x}$	Verbal Interpretation
Functionality	4.79	Excellent
Reliability	4.77	Excellent
Usability	4.76	Excellent
Efficiency	4.62	Excellent
Total	*4.74*	*Excellent*

Based on the numbers from Table 5 overall the proposed system got an Excellent result on all the criteria.

The respondents or testers have made recommendations and insights on how to further improve the project. They were all satisfied about the system that addresses academic malpractice, but further modifications should be needed to make the system more reliable. Those are mentioned in the recommendations part.

As shown in the table the Efficiency part has achieved the "lowest" remark due to connectivity, a clarification feedback and suggestion was also noted that on a situation that the examinees have tried to submit an unfinished exam. They suggested that there should be a notification that pops out if the examinee has not answered all the questions before submitting in order to aid in efficiency in answering the exam.

In relation to the qualitative feedback of the user test. The developed project was described as an expanding and comprehensive study. The proponents have analyzed 100 feedback remarks the respondents and also the suggestions of the invited panel of professors who evaluated the process flow of the online exam generator. Based on their statement they were satisfied with the systems feature and functions but it still needs some alterations to make the system invulnerable to other forms academic malpractice namely physical sources of information beyond scope of the computer and its access to the internet and also developing feature for subjective based exam questions..

The functionality part is where they were mostly impressed as the tab locking will prevent the examiner to open a search engine or minimize the tab of the screen. The professors also gave praise about the CSV importation as it will save them a lot of time, because the system currently used in the school has to manually encode questions and answers to create an exam. The professors also noted the auto exam generator based on a randomizer with weights which allows them to generate unique exams but still measure similar outcomes as compared to traditional randomized exams which has limitations that there is a probability that an examinee will have an exam that has the difficult questions and another examinee has the probability that the exam questions he/she receives may have an easier exam question being addressed. On the same thought, a qualitative feedback from processors noted that even though the randomizer claimed to balance out the exam difficulty level at the same time being unique sets of exam questions. It may not necessary be perceived by the examinees to be fair as they may perceive the exam they took was either difficult or easy as it is dependent on the amount of preparation they have done prior to taking the exam.

V. CONCLUSION

The Online Examination System with cheating Prevention using Question Bank Randomization and Tab Locking has achieved a remark of excellent in all categories. In terms of the functionality, reliability, usability and efficiency, based on the remarks of 100 College student respondents, they were all impressed about its functionality that addresses academic malpractice.

In the functionality part there were no bugs and errors during the testing phase thus receiving an excellent remark was achieved. The system was flexible as it can import an exam from a CSV file that according to the professors, it saves a lot of time in creating an exam. Excellent as appraised in terms of reliability, the proponents have made the software free from bugs and errors. It is also excellent in terms of usability; All the following steps to use the system are easy to remember and if the user does not have an idea to use the system they can just refer to the test scripts to be able to familiarize them about the flow of the system. Excellent in terms of efficiency, the system works and gives immediate feedback in assessing the examiners. For this reason, the system can be used to be deployed on educational institutions that want to have an online examination system that has the ability to address academic malpractice.

VI. RECOMMENDATION

Adding a feature that rates the weight of the questions through analytics as the exam as it is used through time. This will allow the weights to normalized based on a crowd based behavior as easy question may become difficult and difficult questions may become hard based on the feedback of the professor respondents. Currently, the exams as it is just randomized based on fixed weights with the difficulty level of the questions for each examinee is assumed un-changed.

Include a Gaze Tracking into the system that uses the camera that lets the proctor observe the examinees, and if the examinee tries to look at their seatmates the Gaze Tracking feature will detect it and automatically locks the examinee's exam and automatically notifies the proctor that someone has attempted academic malpractice.

The examinee assessment should be improved by adding a feature that lets the proctor discern if the examinees' performance in the class is improving by comparing their scores from the first quiz until the last quiz of the class, and also from prelim to finals. The system should be able to generate a statistical graph and charts that help the proctor to determine what term or quiz where the students/examiners performed badly.

The suggestions above were all provided by the testers of the system, the panel of professors and educators of the project.

REFERENCES

[1] Baohe, W. (2009),"Web-based examination system design and implemen-tation" Tianjin: Nankai University.

[2] Hussein Al Bazar. (2017), "Forms Distribution Algorithm for Online Examination Systems"

[3] Singh, S. (2017). What are the benefits of online exams? Retrieved from https://www.quora.com/What-are-the-benefits-of-online-exams

[4] Barkley, A. (2001). AN ANALYSIS OF ONLINE EXAMINATIONS IN COLLEGE COURSES. Retrieved from https://ageconsearch.umn.edu/record/36049/files/sp01ba02.

[5] A. Fayyoumi1, and K. Suwais "Online Exam Questions Distribution Technique based on Terminals Locations: The Case of Arab Open University", Journal of Computations & Mod-elling, vol.5, 2015.

[6] Bai Yi-chen. The Design and Implementation of the Online Examination System Based on MVC Model [D].Shandong University, 2012.

[7] Wu Wei, Wei xiao, Wei Shimin. Research of defending online-test cheating based on manager server [J]. Computer Engi-neering and Design, vol 8, pp. 1941-1943, 2007.

[8] Smetters, D. (2013). Respondus LockDown Browser, Assessment tools for learning systems, October 2013. Retrieved from https://www.respondus.com/products/lockdown-browser/

[9] Canadian Broadcasting Company. (2006). Campus Cheater. Retrieved from https://www.cbc.ca/manitoba/features/universities/

[10] Wenbin, Z. (2007). "Discuss on the normalized and scientific administration of college examination," Contemporary Edu-cation Forum, No. 1, Jan. 2007, pp. 20-21.

[11] Zhang Yong-sheng, Feng Xiu-mei, Bao Ai-qin. The Research and Design of Online Examination System. 2015 7th Interna-tional Conference on Information Technology in Medicine and Education