World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(RESEARCH ARTICLE)

Check for updates

A responsive assessment model for mitigating endemic knowledge gap in educational training

Adedara Olusola Gabriel and Innocent Uzougbo Onwuegbuzie *

Department of Computer Science, the Federal Polytechnic Ado-Ekiti, Ekiti State Nigeria.

World Journal of Advanced Engineering Technology and Sciences, 2022, 06(02), 088–099

Publication history: Received on 04 July 2022; revised on 09 August 2022; accepted on 11 August 2022

Article DOI: https://doi.org/10.30574/wjaets.2022.6.2.0088

Abstract

Learning outcome measures the quality of knowledge a student possesses after the completion of an academic programme. For successful attainment of this feat, it is necessary to periodically engage in assessment exercises to measure the expected learning outcome before the completion of the students' academic programme. However, it is observed that this is not the case for institutions of higher learning in Nigeria. The traditional assessment method of pen and paper is not only inadequate but no longer tenable in this information and Communication Technology (ICT) era. To address these inadequacies, this paper proposes a Responsive Student Assessment System (RSAS) to mitigate the endemic gap between actual knowledge and expected knowledge. RSAS addresses assessment from both the student and teacher's perspectives. It engages assessment in three (3) assessment modes; diagnostic assessment, formative assessment, and summative assessment. Diagnostic assessment is performed at the beginning of the semester, formative assessment is performed in the middle or during an ongoing semester, and summative assessment is performed at the end or towards the end of the semester. The outcome of these exercises arms the teacher with the academic performances of the student who thereafter advises as to whether the student should proceed to the next class or repeat the just concluded class. RSAS was test-run for a number of students and staff using performance and perspective analysis, for one academic semester. Results show a remarkable improvement in the student's academic performances, subsequently, the perspective analysis reveals a high level of acceptance of RSAS.

Keywords: Assessment; Responsive; Learning outcomes; Polytechnic; University

1. Introduction

Assessing student academic performance is a feedback mechanism that informs the teacher or lecturer how well their student is doing in their academic pursuit. In an era driven with ICT [1], [2], a good number of graduates of the institution of higher learning in virtually every discipline have been discovered to be half-baked or inadequately groomed for the labour market, despite the successful completion of their courses of studies. There is no arguing the fact that all is not well with the educational sector, considering the general outcry of concerned stakeholders that some definite steps must be taken to save the sector from total collapse.

These inadequacies can be put to check by implementing an assessment mechanism that keeps track of the student academic performances as well as the teachers' performances in the discharge of their duties. According to [3]. Assessment is an integral part of learning. Through assessment, the teacher can measure the extent of the learning outcome of the student. Assessment is said to have the most influence on students, as assessment probes the student's curiosity and encourages them to buckle up for their studies [3]. One of the ways to determine the effectiveness of teachers in the discharge of their duties is by periodically assessing the student's performances. It not only exposes the strength and weaknesses of the student but also that of the teacher.

* Corresponding author: Innocent Uzougbo Onwuegbuzie
Department of Computer Science, the Federal Polytechnic Ado-Ekiti, Ekiti State Nigeria.

The outcome of an assessment generates feedback. Feedback exposes the gap that exists between lessons taught (teacher-centred) and knowledge demonstrated (student-centred). It provides information about the actual and expected performance. Feedback is more than just information, it is information generated for a particular specific purpose [3]. An important fact about feedback is that it gathers the information that helps improve the future performance of an existing system.

The attainment of a student completing their academic pursuit is very significant for any institution of higher learning, and this is made possible by a solid academic record of the student's performance through effective periodic assessments during the duration of the study [4]. As graduation is an indicator of a student's success in completing their studies, assessing learning outcomes can be used to measure the student's progress during the period of their studentship, and to do so, this paper proposes a web-based Responsive Student Assessment System.

This paper is organized as follows; the Statement of the problem is presented in Section 2, while Section 3 discusses the Literature Review. Section 4 talks about Method and Study Design, and the Results and Discussion is presented in Section 5. Section 6 discusses Performance and Perspective Analysis, while Section 7 presents the Conclusion and Future work.

2. Statement of the Problem

It is appalling to observe that little or no attention is given to the assessment of learning and teaching approaches in institutions of higher learning in recent times, as final semester examinations are only used to judge the students' performances. The reasons often highlighted for the poor output from our educational institutions are that the learning environment is not conducive, the latest and state-of-the-art equipment is lacking or in short supply, incessant industrial strikes, poor and epileptic power supply (electricity), most teachers are not having the expected higher qualifications (such as Ph.D.), or are not adequately motivated.

Why assessment is an important tool to measure and ascertain the academic strength and weaknesses of a student, this process is not adequately used in most institutions of higher learning in Nigeria. The institutions only rely on the traditional end-of-semester or end-of-term or sessional tests and examinations to evaluate the student's performances. Experiences have shown that this approach has not yielded the expected learning outcome in students as there exist knowledge gaps at the time the student is made to take the end-of-semester examinations in the average Nigerian student. The outcome of this practice has yielded graduates that do not fit into the labour market even after successful graduation. Upon this, proactive action is needed to adjust the curriculum to be industry-focused, such that graduates can almost completely fit into the labour market as soon as they graduate with little or no training. This paper proposes a Responsive Student Assessment System (RSAS) to mitigate the endemic knowledge gap between the Nigerian student and the industry.

3. Literature Review

The Assessment of student performance at various stages of their academics, not only provides the teacher with how well the student is doing but also assists the students to improve on their academic activities. This section presents the literature of scholars in regards to student assessments.

The author [5], describes students' performance evaluation as the necessary tool to measure students' academic performances and particularly exposes the areas that needed improvements. He defined teaching as a process that determines the actual achievement of educational goals. Measurement was described as the measure of quantitative information and observations related to a phenomenon using tools such as observation of report cards, tests, and trend measures. It is expressed as a quantitative estimation of objects or goals.

Formal education is described as the teaching and learning process and an integral part of student performance assessment [6], it involves the collection, evaluation, documenting, and analysis of students' academic performance using various techniques of assessment. These assessment techniques involve oral tests, practical tests, project work, group work, pen-on-paper tests, and the use of other testing methods. Of all these assessment methods, the pen-on-paper test is the most commonly used performance assessment method in most academic institutions. The assessment was further described as a measure that aimed at deciding students' academic progression while providing the student with feedback to enhance their learning experience. The goal of formative assessment is to ensure assessment for learning rather than the assessment of learning. Proving feedback to students, formative assessment has helped to improve students' academic performances. Formative assessment is an integral part of a self-regulated, self-assessment

system. When adequately performed, it can activate growth and development, reduce uncertainties, and leads to a more focused, efficient, and skilled student [6].

The Artificial Intelligence (AI) approach to student assessment, presents a new way of assessment as presented by [7]. AI's method of assessment allows the student to take their assessment without the restriction of time and space, as compared to the traditional assessment method which takes place after the teacher finishes the grading process. One of the advantages of AI-enabled assessment is the collection of students' data while learning, this information is later used in behavioural analysis of the student, which often reflects the student's cognitive abilities. This information helps the tutor to provide student-targeted guidance. [8] Stated that the interface of the online-based assessment method plays a significant role in assessing the academic status of the student. He argues that a poorly designed online assessment interface may hinder the student's assessment exercise and affect their performance and the outcome may not be a true representation of the student's performance. They advised that the interfaces of an online-based assessment should be student-centred, designed in such a way to enhance students' performance rather than inhibit a supposedly smooth assessment experience.

In their work [9], the authors stated that there are four(4) criteria that enhance the quality of learning particularly in science education, these are; the quality of students, the use of quality learning materials, the teaching and learning process, and the educational output. The quality of learning reflects the quality of knowledge delivery. This can be approached in two (2) ways; the teacher and students' perspectives. From the perspective of the teacher, it involves the teacher choosing the most adequate teaching materials, media, and learning tools that will aid the interest of the student in learning new things in a conducive environment. From the student's perspective, a productive teaching experience can only be from the student's desire to learn and grasp new knowledge. This is also driven by the teacher's skill in discharging the knowledge.

The era of the COVID-19 pandemic exposed the shortcoming of the academic system, and this, therefore, necessitated new ways of teaching and learning [10]. The authors presented deep learning and machine learning approaches for the formulation of an automated way that estimates students' performance with partial or full students' academic records. Presenting their approach, a large dataset of 15 courses from both the public and academic research domain was used, a statistical analysis was carried out on the dataset, and predictive analysis was used to analyse the dataset. According to the authors, the outcome of their research led to an improved prediction of student performance and expected learning outcomes.

Frequent quizzing of class activities has proven beneficial to student learning outcomes as presented in their study [11]. It is claimed to promote frequent attendance at classes, academic engagements, practices, and other activities. However, the authors claim that excessive quizzing may obstruct smooth academic activities of teaching and learning as this may encourage unnecessary anxiety and lack of confidence in the students. Even though the traditional semester-end examination has been used to assess student performances, little is known of the impact of in-course assessment on students learning outcomes. The authors, therefore, administered weekly quizzes for biomedical students and found that it improved students learning outcomes in a controlled student group in both easy and oral presentations. Their findings help in the design of an academic curriculum that enhanced optimal teaching and learning for both the teachers and students.

3.1. Types of Assessments

Three (3) major types of assessment have been prevalent in assessing students' academic performances, these are *Diagnostic Assessment (DA), Formative Assessment (FA), and Summative Assessment (SA)*. These 3 types of assessment measure the student learning outcome throughout their learning experience, and they are usually moderated or controlled by the teacher or lecturer. Details of these assessments are presented.

3.1.1. Diagnostic Assessment

This type of assessment is usually used to test the student's knowledge of prior subjects or courses at the beginning of an academic semester or year. The outcome is used to measure how much knowledge the student has before engaging in the current academic pursuit. It also helps the teacher to know how to go about teaching the student to attain maximum learning outcomes and experience. [12], [13].

3.1.2. Formative Assessment

This type of assessment is aimed at providing continuous feedback on students' performance through the teaching and learning process. This assessment is mostly carried out while the semester activity is ongoing. The outcome of this

assessment guides the teacher to know how well or poorly the student is doing, hence providing immediate actions to manage them [12], [13].

3.1.3. Summative Assessment

This type of assessment is used to evaluate both the teacher's and student's performance. It is mostly carried out at the end of the semester or academic session. The purpose is to evaluate all aspects of teaching and learning [12], [13].

4. Method

The method used to develop the proposed application is presented in this section.

4.1. Study Design - Responsive Student Assessment System (RSAS)

RSAS is a responsive web-based application that automates the process of assessing students' academic performances in all three modes of assessment; diagnostic, formative, and summative assessments. In this research, RSAS is designed to address the academic assessment of students in the institutions of Higher learning, particularly in the Polytechnic tertiary institutions in Nigeria, nonetheless, it is equally applicable to the universities and other institutions of higher learning. The Nigerian Polytechnic has the following academic levels; National Diploma One (ND1), National Diploma Two (ND2), Higher National Diploma One (HND1), and Higher National Diploma Two (HND2). Performances are assessed based on these levels. ND1 is entry-level. This category is made for students that have just graduated from secondary schools. After gaining admission into the polytechnic, their level of academic knowledge is put to the test with respect to their prior requisite knowledge.

At the inception of an academic semester, DA is carried out on the student to ascertain the extent of the student's prior requisite knowledge, while FA is conducted during an active and ongoing semester to measure how much the student is grasping the lessons. Finally, SA is conducted to draw a definitive conclusion on how much knowledge the student has gotten through the entire academic session. This whole exercise serves as a yardstick to measure the student's overall academic performance as well as expose courses or subjects that need immediate redress and improvements.

4.2. How RSAS Works

Across each level, RSAS assessment is conducted in three stages; DA, FA, and SA. A schematic flowchart on how RSAS works is presented in Figure 1.

4.2.1. Diagnostic Assessment (DA)

To assess the level of student's knowledge in past courses or subjects, a diagnostic assessment exercise is conducted. This results in the student taking a series of tests on related subjects to test their prior knowledge of past courses or subjects. If the student passes the test and can demonstrate the knowledge of previous subjects or courses, then RSAS automatically provides advice according to the outcome of the student's result. If the student pass, the advice is as follows:

Congratulations!!! You performed excellently well and have demonstrated your mastery of knowledge from the previous course learned. You are qualified to enrol in courses in the current semester.

Else if the student fails the DA and is not able to demonstrate the knowledge of previous subjects or courses, RSAS advises as follows:

Failed!!! Unfortunately, you are not able to demonstrate your knowledge of previous courses learned. You are advised to repeat the current class, then retake this assessment.

At the ND level, if the outcome of the students for DA is successful, the student is qualified to enrol in the current semester courses and engage in the learning experience for the semester, else is advised to repeat the semester and retake the DA at a later time as shown above.

4.2.2. Formative Assessment (FA)

While the semester is ongoing, it is important to keep track of the student's performance. The student must have successfully passed the DA to be able to undertake the FA exercise. At this stage, the student is mandated to take the Formative Assessment (FA) test. Similar to DA, the student is made to take a series of tests for which questions are

drawn from courses in the current and ongoing semester. If the outcome of the assessment is successful, RSAS advises as follows:

Congratulations!!! You performed excellently well and have demonstrated your mastery of knowledge for the ongoing courses. Keep up the good work as this will later qualify you to enrol for future semesters and advanced courses.

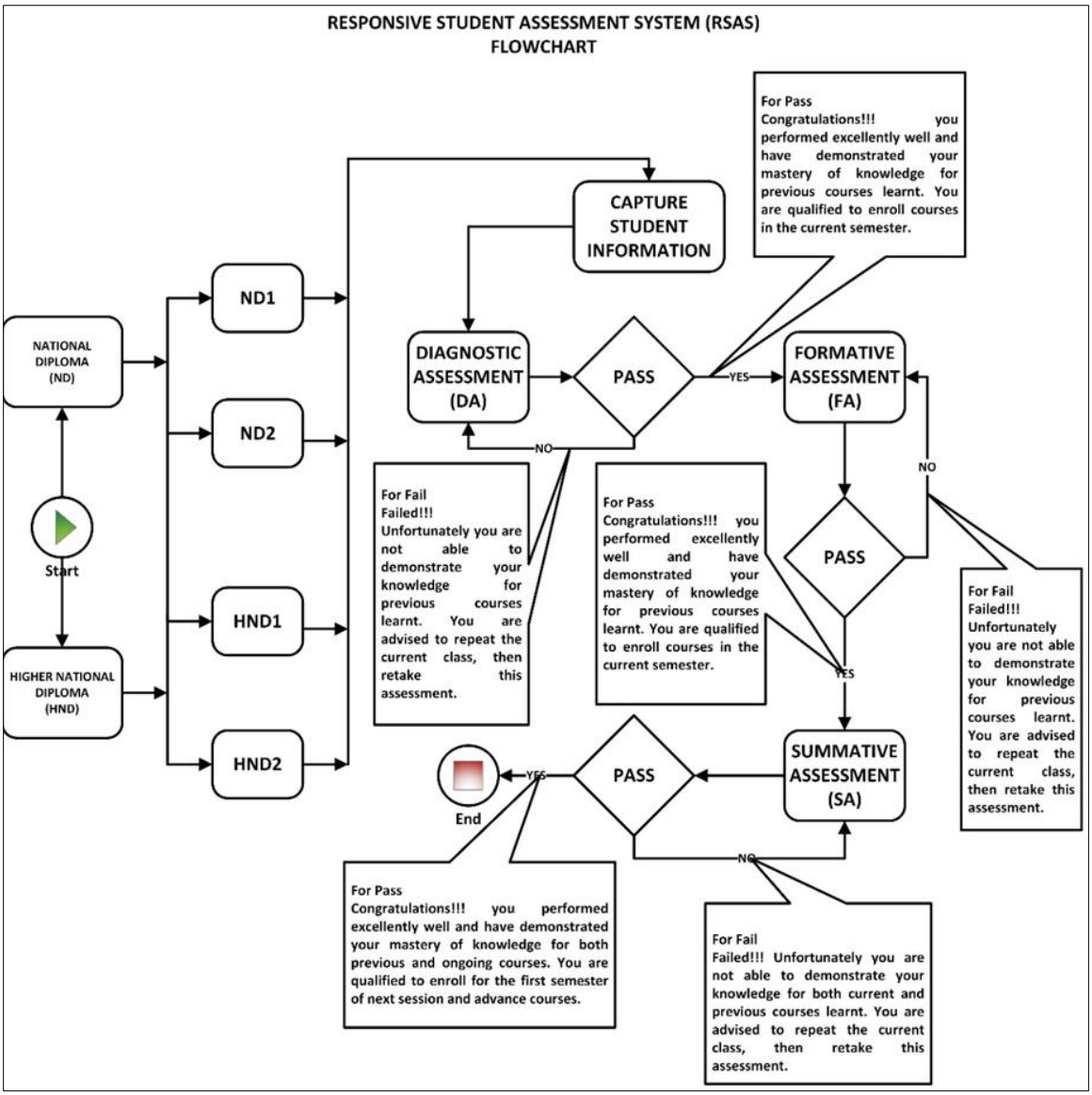

Figure 1 How RSAS Works

And if the outcome is failed, RSAS advises as follows:

Failed!!! Unfortunately, you are not able to demonstrate your knowledge for the ongoing courses. You are advised to take your ongoing courses more seriously in other to qualify you to enrol in future semesters and advance courses.

In the event that the student failed, RSAS strictly advises the student to buckle up in the ongoing semester to avoid not being able to enrol in courses in the coming semester.

4.2.3. Summative Assessment (SA)

As the academic session progresses, towards the end of the semester, a summative assessment is conducted for the students. The outcome of this assessment helps to draw a meaningful conclusion about the performance of the student throughout the entire session of two (2) semesters. During the SA, like the DA and FA, the student is required to take

tests with questions cutting across the entire academic session. If the student passes this SA, RSAS automatically gives the advice:

Congratulations!!! You performed excellently well and have demonstrated your mastery of knowledge for both previous and ongoing courses. You are qualified to enrol for the next semester and advance courses.

Else, if the outcome is failed, RSAS advice is as follows.

Failed!!! Unfortunately, you are not able to demonstrate your knowledge of both current and previous courses learned. You are advised to repeat the current class, then retake this assessment.

Judging from the pass and fail outcomes, a student with a pass for SA has fulfilled all requirements to enrol for the first semester of the next academic session, and with the outcome of a fail, the student is advised to repeat the current semester or perhaps the entire session as the case may be. With these outcomes, a lecturer is well equipped with the academic performances of the students, across the entire academic section of two (2) semesters. It is now at the discretion of the teacher/lecturer to work in line with the advice provided by RSAS or not.

These three stages of assessment are applicable for both the ND and HND levels. That is students in each of the categories will undergo these assessment stages within the semester of any academic session. The following section discusses the outcomes of the RSAS test-run.

5. Results and Discussions

Results and discussions are presented in this section.

5.1. The Outcome of the RSAS Test-run

The assessment of student's performance at various stages of their academic pursuit not only guarantees academic success but also helps the tutor to make sure the expected learning outcome is attained. RSAS is only an automated assessment and advisory system, but the final decision of what action to take in line with RSAS advice lies in the hands of the teacher/lecturer. It is important to note that RSAS on its own does not improve students' academic performance and should not be mistaken as such, rather it is only an automated mechanism for assessing student academic performance, and providing corresponding advice. Figures 2, 3, 4, 5, and 6 presents the various application interfaces of RSAS.

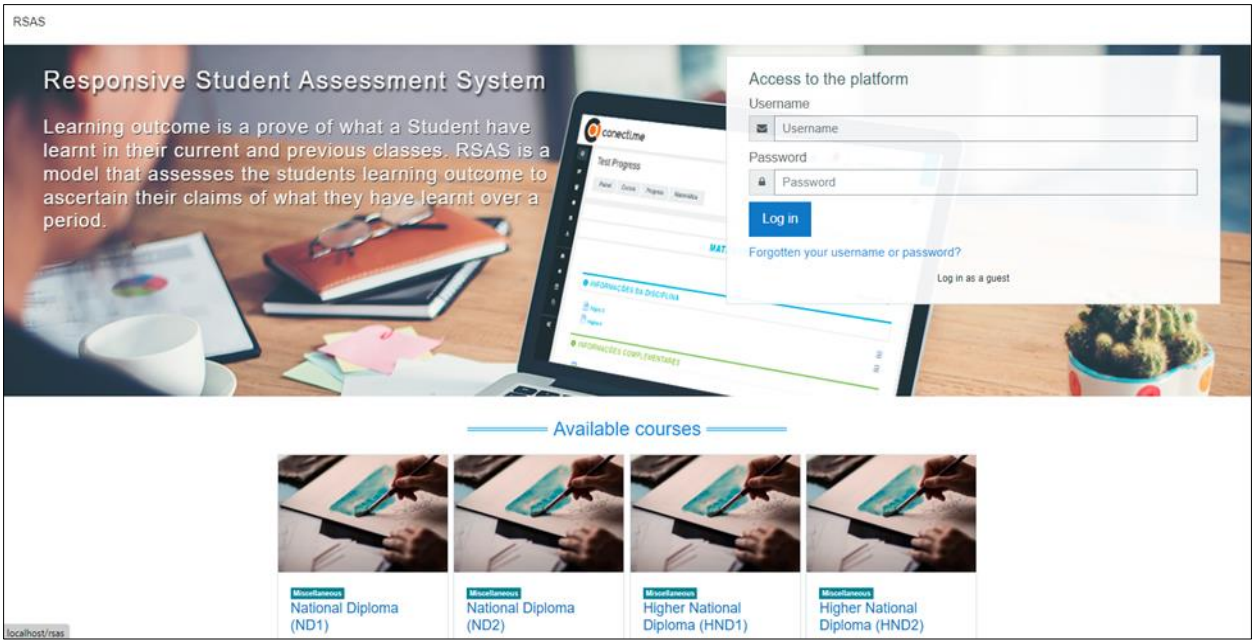

Figure 2 RSAS Login Interface

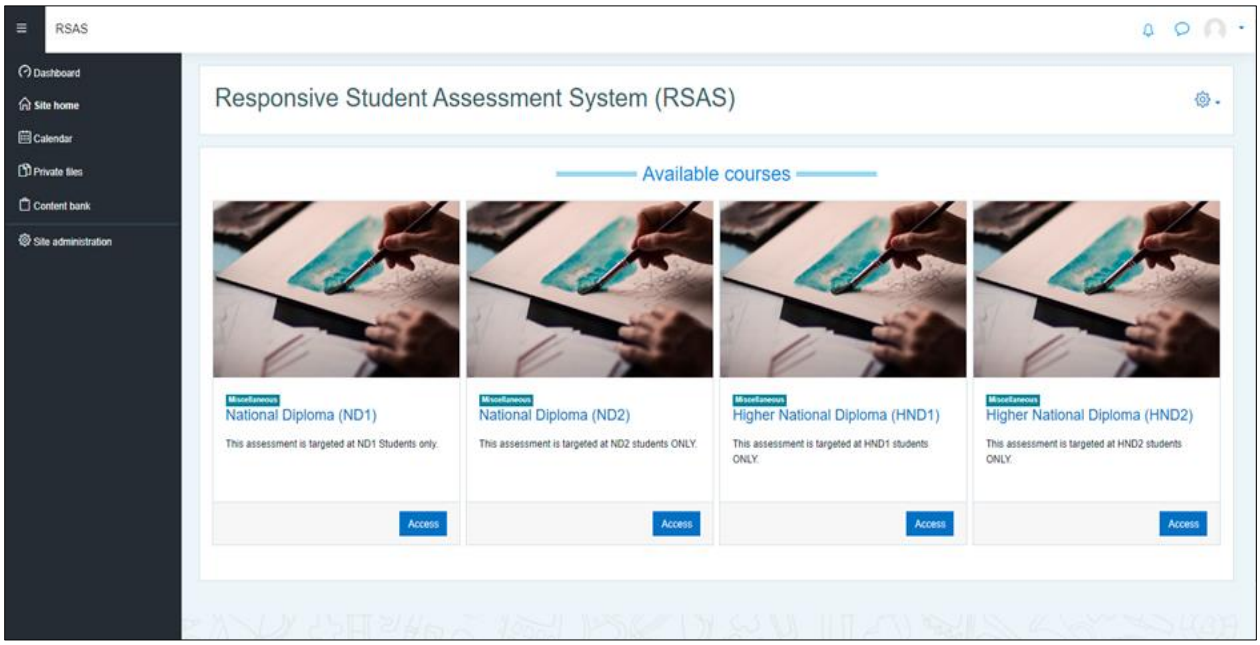

Figure 3 RSAS Logged in Interface

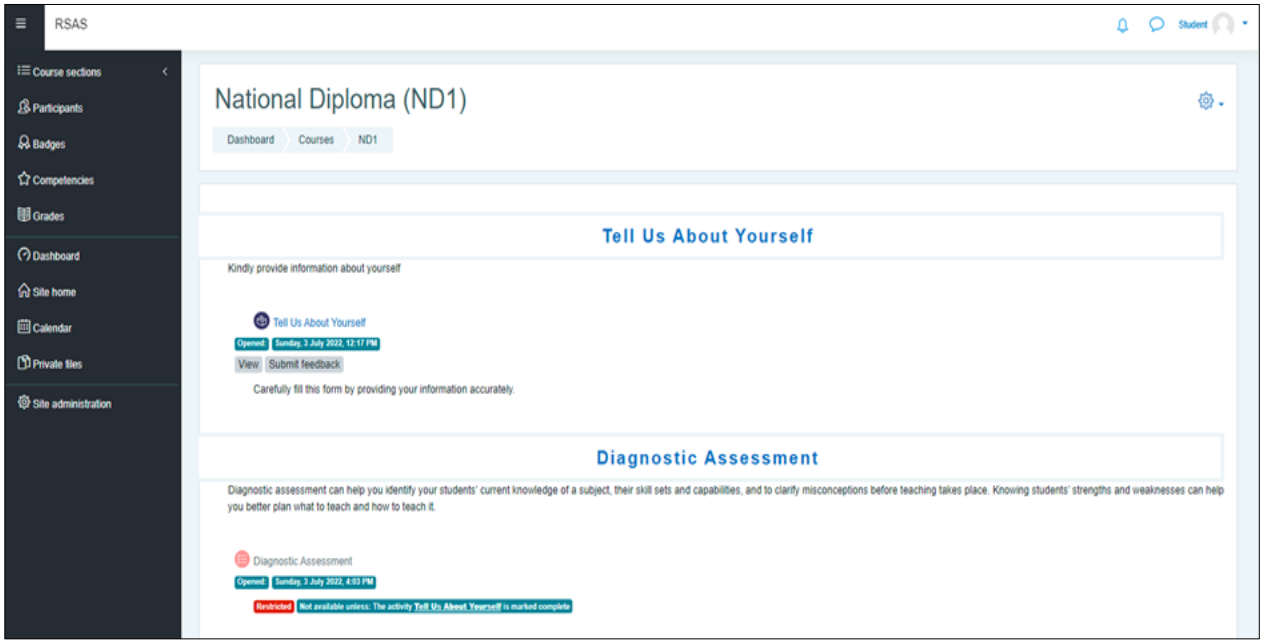

Figure 4 ND1 Assessment Interface

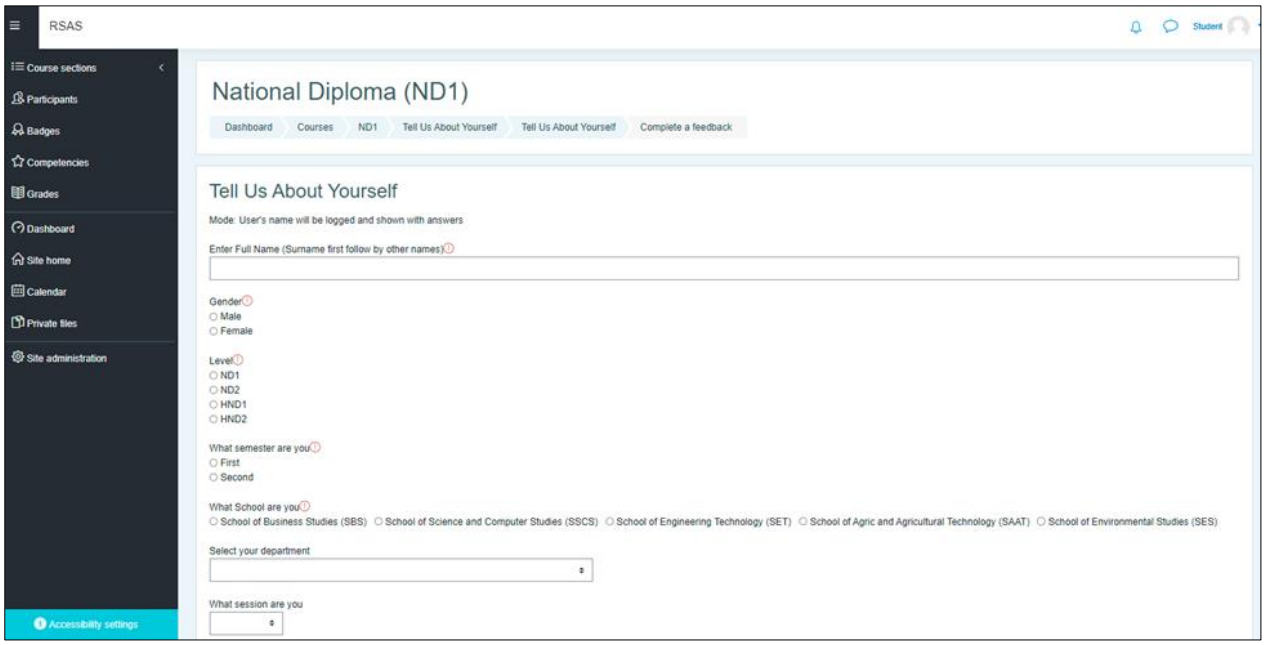

Figure 5 Tell Us about Yourself Interface

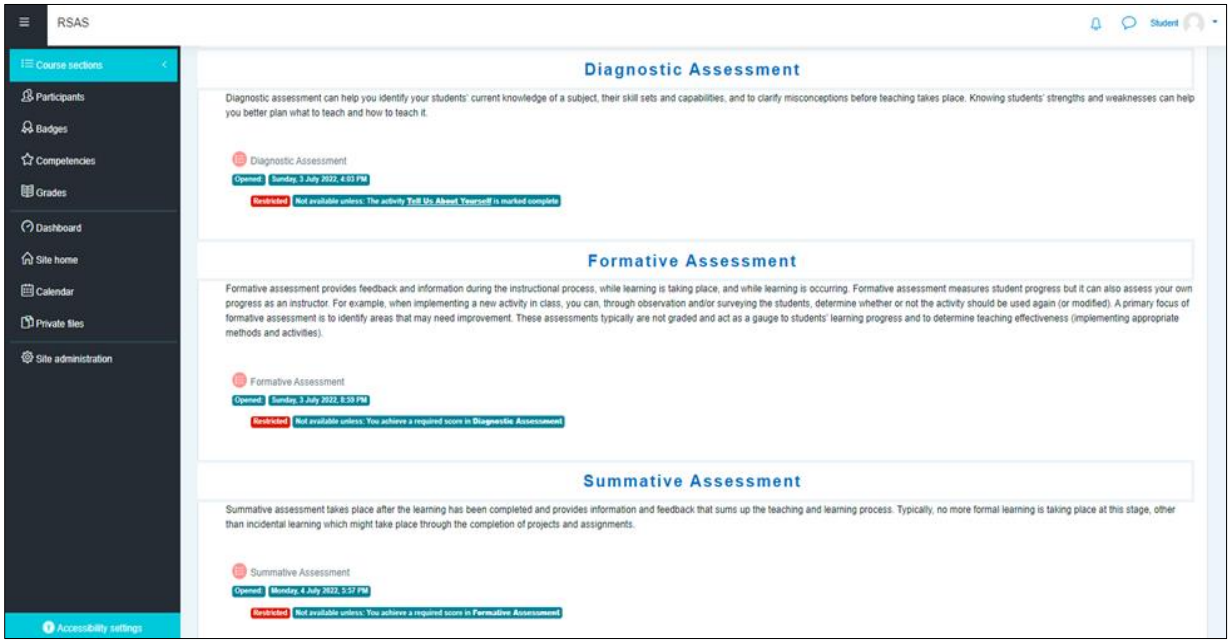

Figure 6 RSAS Interface for DA, FA, and DA

5.2. RSAS Access Restriction

RSAS is developed in such a way that ND1 registered students do not have access to ND2, HND1 and HND2 registered students' interface. The same restriction access applies to ND2, HND1, and HND2 respectively. This means that no student can have access to a section that he or she is not enrolled in.

6. Performance and Perspective Analysis Metrics

To ascertain the credibility and performance of RSAS, a performance assessment analysis was carried out on a total of 40 students; ten (10) from ND1, ten (10) from ND2, ten (10) from HND1, and ten (10) from HND2. These students were made to independently, and at different intervals attempt the DA, FA, and SA tests.

Subsequently, a total of twenty (20) students, five (5) from each level, and twenty (20) Lecturers were used to conduct a prospective assessment analysis. The perspective assessment analysis investigates the perception (acceptability or rejection) of students and staff of RSAS. The outcome of these assessments is presented in the following section.

6.1. Performance Assessment Analysis

Figures 7, 8, and 9 present the performance assessment analysis of DA, FA, and SA for ND and HND levels of students. The outcome of the assessment was categorized into *Pass* and *Fail* and the assessment was performed in ten (10) rounds at different times within an ongoing semester (that is, DA at the beginning of the semester, FA at the middle of the semester, and SA at the end of the semester), while ensuring that no student repeats the same exercise across all forty (40) students for each round of DA for all 10 rounds. Regarding Figure 7, DA results show a tight competition between pass and fail, with a total of 203 passes and 198 fails. The figure shows that at the beginning of any semester, students struggle to recall all they have been taught in past semesters, courses, or subjects, hence the marginal performance of pass over fail. As the semester progresses, the FA is conducted for the students somewhere in between the semester. Regarding Figure 8, the results show a sharp improvement in students' performance compared to the results of DA. This indicates a strong and encouraging academic improvement of the students as the semester progresses. Figure 9 shows the result of SA. SA is conducted at the end of the semester to know how much the students have learned throughout the entire session. Similar to FA, results show a remarkable and sustained improvement of the students with a total of 331 passes to 69 fails. This means that as the semester progresses from the beginning through the mid-semester towards the end, students' academic performance subsequently improves due to periods assessment exercises. RSAS is able to provide detailed results of the student's academic performances through DA, FA, and SA, which serves as an indicator of how well the students are doing, and the lecturer as well in discharging their duties to teaching and mentoring the student. It also exposes the courses in which the student performed poorly and needs improvement. RSAS subsequently provides advice accordingly in this regard. It offers the lecturers an overview of students' performances in various courses offered.

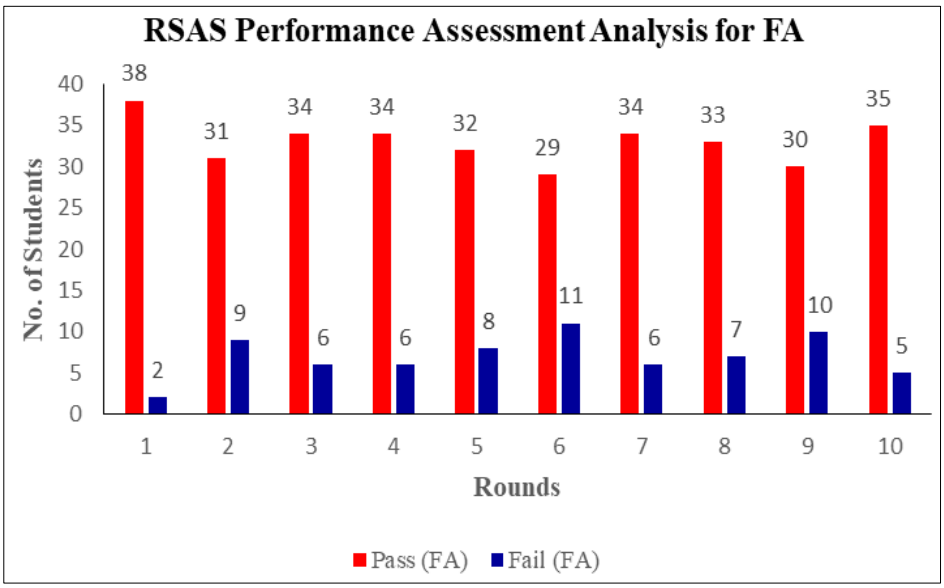

Figure 6 RSAS Performance Assessment Analysis for DA

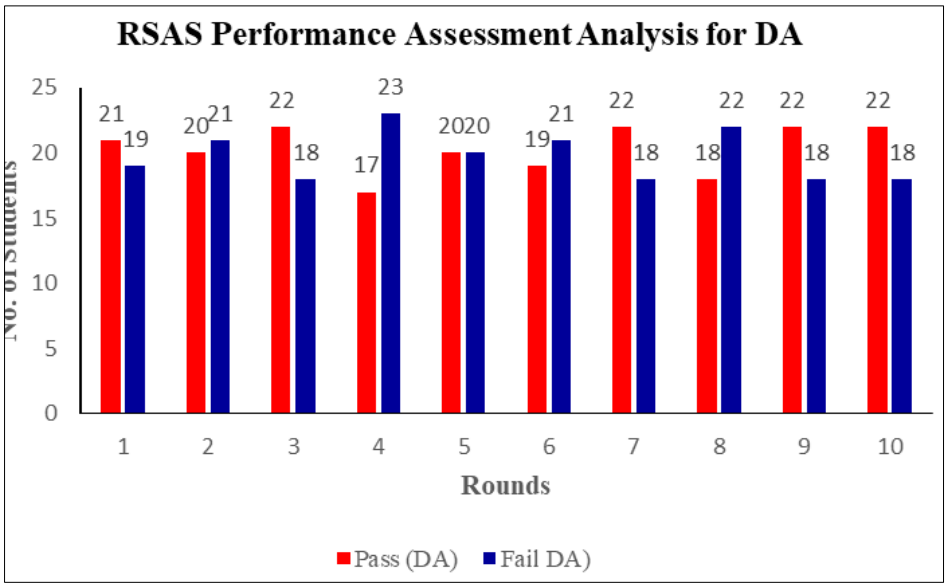

Figure 8 RSAS Performance Assessment Analysis for FA

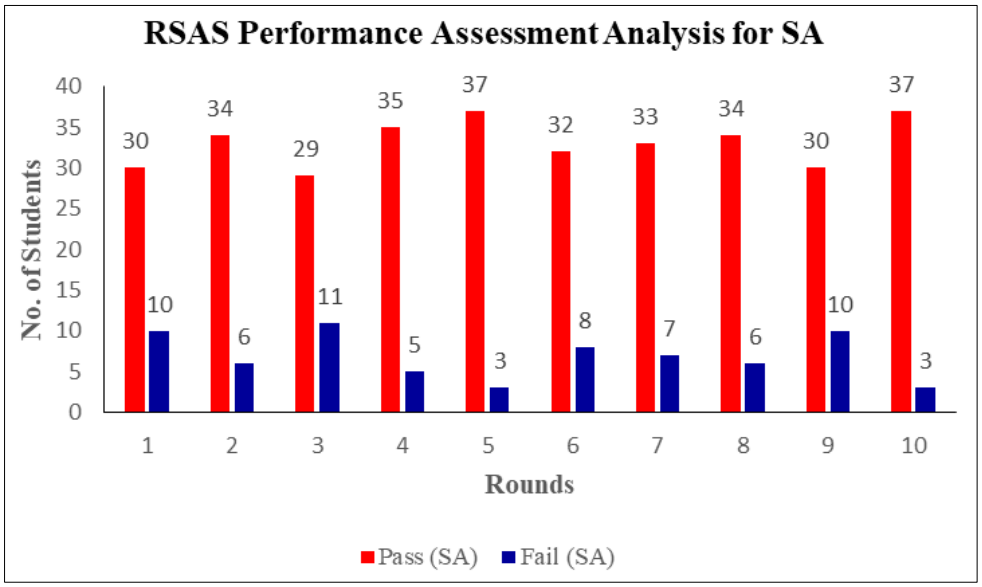

Figure 7 RSAS Performance Assessment Analysis for SA

6.2. Perspective Assessment Analysis

Figures 10 and 11 present the perspective assessment analysis of RSAS. The perspective assessment shows the acceptability or rejection rate of RSAS from the perception of the students and lecturers. The assessment was conducted in two phases; twenty (20) students and twenty (20) lecturers were selected at random to participate in the assessment, and the assessment was conducted for (10) rounds, which were spread across an entire semester, and no student or lecturer repeated the assessment twice. The outcome of the assessment was categorized into Yes, No, and Maybe. Where Yes indicates a total acceptance of the application, No indicates a total rejection, and Maybe indicates somewhere in-between acceptance and rejection. A digital questionnaire form was used to gather the needed information. In the early rounds of the exercise (rounds 1, and 2), results of both assessments (Figure 10 and 11) shows an almost close competition between yes, no and maybe, however, from rounds 3 to 10, there exists a clear distinction in the perceptions of the students and lecturers, with a total of 142 yes, 35 no and 24 maybe for the students and 143 yes, 32 no and 26 maybe for the lecturers. The overwhelming outcome of yes for both assessments, shows that both the students and lecturers are in favour of the RSAS.

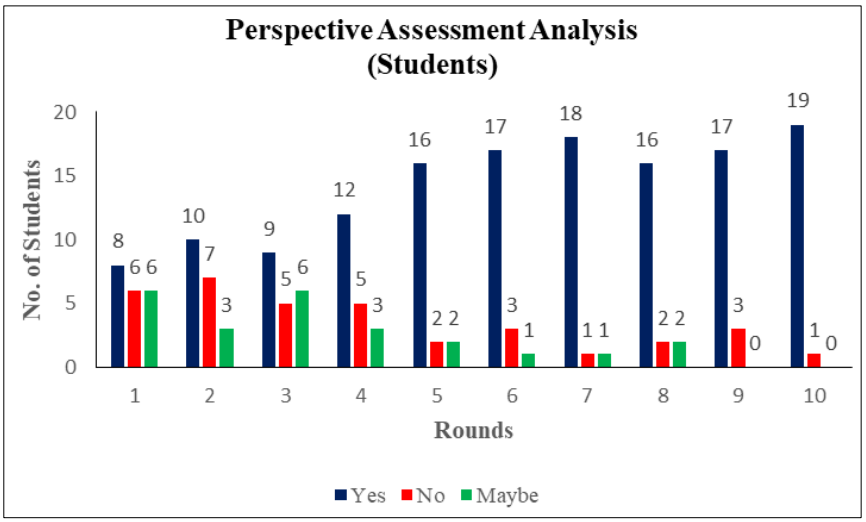

Figure 8 RSAS Perception Assessment Analysis for Students

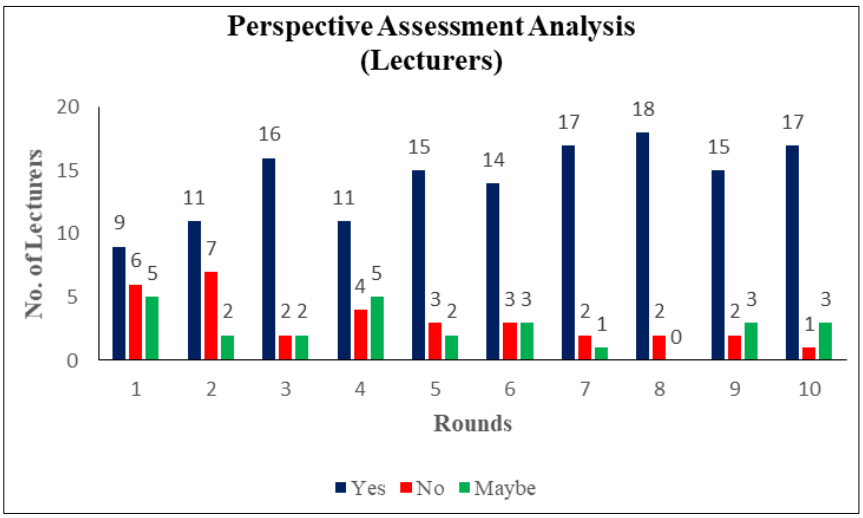

Figure 9 RSAS Perspective Assessment Analysis for Lecturers

7. Conclusion and Future Work

Mitigating the knowledge gap in educational training in institutions of higher learning has become a necessary approach to closing the gap between expected knowledge to actual knowledge, and this can be done by a system or process that reveals the performances of the students in various courses, as well as shows the courses where they are performing poorly and needs improvement. The system should also serve as an indicator, showing how well the lecturer is doing in discharging his duties as a mentor and tutor, which in most cases is a direct reflection of the student's academic performance. RSAS was developed to automatically address these issues. The application approached student's assessment in three stages; diagnostic assessment, formative assessment, and summative assessment. Results of performance assessment analysis show that RSAS is able to practically automate the process of student's academic assessment with clear and acceptable results and outcomes. These outcomes serve as a guide for the lecturers to judge the academic performances of their students and hence know the areas they are doing well or lacking and needs improvements. It also reveals to the students how well they are performing academically. Subsequently, the outcome of the acceptability and rejection of RSAS by the students and lecturer was carried out with the perspective assessment analysis for one semester. Results show that both the students and lecturer accepted RSAS as a flexible and pragmatic academic performance assessment system. In conclusion, RSAS is proven to be a practicable student performance assessment system for students of higher learning in Nigeria. It is important to note that RSAS is not an academic improvement system, but rather a system that serves as an indicator to show how well the students and lecturers are

doing in the discharge of their duties as a learner and tutors respectively. Our future work will involve the improvement of RSAS to serve as a system that can handle students' internships and assessments.

Compliance with ethical standards

Acknowledgments

The authors would like to thank the editor and the anonymous reviewers for their meticulous approach to ensuring that this paper meets the required standard. Subsequently, we thank the Tertiary Education Trust Fund (TeTFund) for supporting the research work.

Funding source

The authors wish to thank the Tertiary Education Trust Fund (TeTFund) for providing the grant for this research.

Study Limitations

The study is limited to all forms of Institutions of higher learning.

Disclosure of conflict of interest

The authors declare no competing interest.

References

[1] OI Uzougbo, A Samuel-soma, F Taiwo. An overview of wireless sensor network security attacks: Mode of operation, severity and mitigation techniques. Arxiv. 2020. (August); Available from: http://arxiv.org/abs/2011.06779.

[2] IU Onwuegbuzie, A Samuel-soma, F Taiwo . Performance Evaluation of RPL Objective Function : A Case of Contiki Operation System. Preprints. 2020. (December); Available from: https://www.preprints.org/manuscript/202012.0615/v1.

[3] D Wiliam. What is assessment for learning?, *Stud. Educ. Eval*. Mar 2011; 37(1): 3–14.

[4] K Jantakun, T Jantakun, T Jantakoon. The Architecture of System for Predicting Student Performance Based on Data Science Approaches (SPPS-DSA Architecture), *Int. J. Inf. Educ. Technol.* 2022; 12(8): 778–785.

[5] OA Haraki. Investigation of the assessment system in primary schools in Turkey and Syria (A comparative study), *Board Educ. Train.* May 2022; 1(6): 119–139.

[6] L Konopasek, J Norcini, E Krupat. Focusing on the Formative: Building an Assessment System Aimed at Student Growth and Development, *Acad. Med.* Nov 2016; 91(11): 1492–1497.

[7] ACM Yang, IYL Chen, B Flanagan, H Ogata. How students' self-assessment behavior affects their online learning performance, *Comput. Educ. Artif. Intell.* 2022; 3: 100058.

[8] C Ricketts, SJ Wilks. Improving Student Performance Through Computer-based Assessment: Insights from recent research, *Assess. Eval. High. Educ.* Sep 2002; 27(5): 475–479.

[9] H Hartono, RI Indra Putri, R Inderawati, M Ariska. The strategy of Science Learning in Curriculum 2013 to Increase the Value of Science's Program for International Student Assessment (PISA), *J. Penelit. Pendidik. IPA.* Jan 2022; 8(1): 79–85.

[10] V Bansal, H Buckchash, B Raman. Computational Intelligence Enabled Student Performance Estimation in the Age of COVID-19, *SN Comput. Sci.* Jan 2022; 3(1): 41.

[11] A El-Hashash. Weekly Quizzes Reinforce Student Learning Outcomes and Performance in Biomedical Sciences in-course Assessments, *Open J. Educ. Res.* Jun 2022; 2(4): 168–178.

[12] E Haipinge, N Kadhila, LM Josua. Using Digital Technology in Transforming Assessment in Higher Education Institutions beyond COVID-19, *Creat. Educ.* 2022; 13(7): 2157–2167.

[13] BMS Botirjonova Sitora Umidjon qizi, Functions and Types of Assessment In Teaching English In Primary School Students). 2022; 393–395.