Design and Implementation of Secured E-commerce Digital Learning for the Educational System in Nigeria

*Sulaimon, H.A., & Owamoyo, N.

Department of Computer Science, Federal College of Education, Zaria, Kaduna State, Nigeria

*Corresponding author email: *sulaimonha@gmail.com*

Abstract
In this modern era, learners struggle with mastering or understanding whatever concepts they are taught in their education. This might be because of ineffective teaching strategies or a lack of passion on the side of the teachers. Therefore, this study develops a Secured E-commerce Digital Learning (SEDL) website application using the Django framework of Python and the system provides room for an administrator to list products for sale, accept payments, and complete students' orders. The developed SEDL website will be a helpful teaching tool for the fundamentals of e-commerce. The study also examined the steps required to design an online ordering and security architecture in the application. Data safety, privacy, and user trust are the major challenges. The SEDL application is implemented to encrypt all data transmitted over the client-server communication channel using the Secured Electronic Transaction (SET) protocol and Advance Encryption Standard (AES) cryptographic. The study then makes some recommendations, one of which is that the government should provide effective regulations that would facilitate the implementation of secured e-commerce digital learning for future growth in the Nigerian higher education system.

Keywords: Security, Safety, Encryption, E-commerce, SEDL

Introduction
E-commerce Digital Learning technologies are various technological applications used to enhance learning, facilitate interaction, assess instruction, organize materials, and produce educational resources. Internet-based tools have enhanced educational systems, particularly in Nigeria, where e-commerce plays a crucial role in the country's rapidly growing economy. Contextualized writing tools and e-commerce-enabled websites for student instruction. However, there are challenges in teaching e-commerce in Nigeria, such as a lack of diverse online programs. E-commerce involves the exchange of goods and data online, and the Georgia Institute of Technology's Graphics, Visualization, and Usability Institute found that it significantly reduces the number of individuals purchasing goods and the total quantity consumed through internet-based transactions (Kahiigi & Ekenberg, 2018).

E-commerce security risks are a significant concern in the competitive online retail market. Businesses must incorporate security-enhanced information technologies, e-commerce applications, and Customer Relationship Management (CRM) systems to build secure online shopping platforms and maintain efficient customer relationships (Saxena et al., 2019). Nigeria's e-commerce industry is gaining popularity, leading to increased security and privacy concerns. The emergency of the Covid-19 pandemic and cyber-attacks have increased consumer reliance on online shopping, necessitating closer examination of methods to maintain user's trust and security. Security is an approach to securing valuable information, and a framework or organization is considered secure when it is not subject to actions, events, or effects that could undermine its ability to function or maintain its intended state. The study aims to identify and quantify the security components required to maintain trust and privacy in e-commerce (Osho et al., 2016).

The primary media are textbooks and courseware, which have a single format and a slow updating rate. Kahiigi and Ekenberg, (2018) developed an online instructional material for college and university e-commerce, combining theoretical information with practical lessons. This framework establishes a uniform educational method, integrates online and offline materials, and encourages e-commerce sector growth. Online shopping popularity is increasing globally, leading to increased electronic transactions. E-commerce applications offer context-dependent educational methods to improve students' exposure to real-world business problems and digital literacy. Advancements in information technology and e-commerce have significantly impacted initiatives in developing countries. The study suggests that to achieve digital learning and online shopping in the Nigerian educational system, it is essential to fully utilize the available information technology resources in schools and improve students' understanding of technology skills. This shift in purchasing habits is significant in the digital landscape.

There is inequity in educational attainment and delayed design of full-time instructors, most of the instruction in e-commerce majors in colleges and universities is given orally by teachers, with textbooks and courseware being the primary media (Busari et al., 2021). To address these issues, an online instructional material was developed, combining theoretical information with practical lessons. This framework establishes a uniform educational method, integrates online and offline materials, and encourages e-commerce sector growth. The study suggests that to achieve digital learning and online shopping in the Nigerian educational system, it is essential to fully utilize available information technology resources and improve students' understanding of technology skills.

The related research works on e-commerce trust, security, and privacy are covered in this section. Rajesh (2018) carried out research on security issues and guidelines for a successful E-commerce system and found that integrity, non-repudiation, authenticity, confidentiality, privacy, and availability are the key components of e-commerce security. The researcher concentrated on the non-technical and technical fixes to enable secured online shopping. A security framework for e-commerce digital learning that shows how to reduce the risks of information privacy, appropriate transaction, content assurance, non-disclosure of information exchange, collaborating sales, and excellent safety measures in desired online purchases among the students was proposed. The following problems are taken into consideration in the procedures to rebuild the parties' trust and confidence in one another. Johnson and Brown, (2020) reviewed the Python Django framework for E-commerce and found out that the framework can handle a lot of the bothersome aspects of Web development and can allow someone to concentrate on developing an app instead of having to start from scratch. The main objective of Django is to make sophisticated, database-driven web construction easier. Django is used by well-known websites such as the Public Television Service, social media, Mozilla, The Washington Times, Disqus, Bitbucket, and Next Door as well.

Badotra and Amit (2021) highlighted availability, authentication, confidentiality, integrity, and non-repudiation as key measures for a secure online environment. Understanding these measures is crucial for web retailers to protect assets from unauthorized access, utilization, alteration, or destruction. Companies are also increasingly concerned about data privacy, requiring privacy-aware control of access to e-commerce applications. Saxena et al. (2019) clarified that the primary components of assurance in e-commerce are authentication, integrity, confidentiality, and non-repudiation. Another risk to e-commerce platform security is the way and procedure customers use information on e-commerce websites (Smith, 2021). A user's conduct moderated online security by Osho et al. (2016) for awareness of the privacy and security dangers associated with the internet.
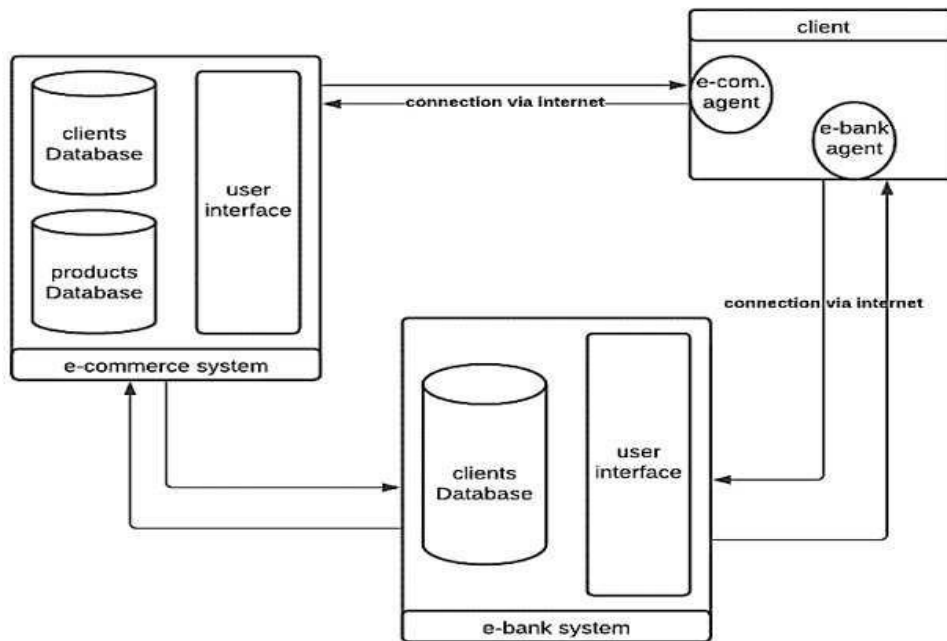
Figure 1: Secured prototype structure of e-commerce system (Farah *et al.,* 2022)

Farah et al. (2022). developed an online retail system network using Java, JSP, and spring architectures as depicted in Figure 1. The goal was to improve system performance, resulting in declined transaction processing, resource utilization, and launch times. The agent resolved issues, enhancing efficiency and resulting in effective users and monetary gain. The study reviewed architectural design and frameworks for secure e-commerce but did not address issues of deadlock, fair exchange among students, and security threats. The security framework used is no longer secure and fails to provide a full non-repudiation feature. The system is heterogeneous, with various parts maintaining and regulating offerings. This research paper focused on developing secured e-commerce techniques to regulate local and global business growth, using a Django framework in e-commerce and a Content Management System (CMS).

Statement of the Problem
E-commerce is a novel kind of online corporate activity and a key component of the information economy. It will take ongoing efforts in e-commerce education to bridge the gap between information technology and institution operations to support the growth of e-commerce digital learning and assist students in acquiring security issues in e-commerce technological literacy. Information, data flow, or transaction vulnerability is still a challenge. The issue of online insecurity awareness persists. This is the point at which the attacker finally seizes control of the internet connection, bans reputable users from the e-commerce server (clients or students), and eventually takes over the website's server altogether. We deem it necessary to propose a secured E-commerce Digital Learning (SEDL) website that will eventually maintain the authenticity and reliability of information exchange and cryptography, hence, the secured protocol will be examined and put into practice to give students greater trust.

Aim and Objectives of the Study
The main purpose of this study is to develop a secured e-commerce digital learning website application to aid students with a better grasp of information technology and security issues.
Specifically, the study sought to:
1. Investigate the effectiveness of the existing methods for e-commerce digital learning applications at the level of security performance.
2. Design a secured e-commerce digital learning platform for students to make online transactions.
3. Implement the proposed secured e-commerce digital learning framework.
4. Use the website to enhance students' information technology literacy and security issues in e-commerce.

Methodology

Framework Selection: The choice of the proper system is vital in web-based business site improvement. In this exploration, the Python Django framework was used as the structure of the design because of its vigorous elements and benefits. Django offers an elevated degree of safety, productive treatment of intricate web applications, and a rich biological system of outsider libraries and expansions. Also, Django's inherent validation framework and Object Relational Mapping (ORM)\ capacities work on the improvement cycle and upgrade the e-commerce general usefulness.

The requirements for the development are listed as follows:
 Python 3.x
Django 2.x
Operating system in (Linux, Windows, Mac)
Ngrok (Web server to work on local machine and internet.)
 Proposed Secured E-commerce Digital Learning (SEDL)
The design and implementation process of e-commerce involves many steps. The e-commerce site's plan involved a data set pattern for managing product data, student details, and orders, using Django's ORM for information base models.

Front-end improvements included responsive, easy-to-understand layouts using HTML, CSS, and JavaScript, incorporating dynamic information into the site's interface, and a clear route structure, item arrangement, and search functionality. Django's confirmation framework ensures secure client enrollment, login, and secret word reset, allowing only confirmed students to access specific elements like submitting requests or reviewing request history. The e-commerce site was integrated with a payment gateway by using, Django's various payment gateway libraries for secure and convenient online payment processing, allowing customers to make payments using various payment methods.

The SET protocol also provides additional various payment gateway libraries for secure and convenient online payment processing, allowing students to make payments using various payment methods. The process is shown in Figure 2, securely stored and transferred their data for online purchases, knowing their information is protected in case of device malfunction or loss, and Firebase offers customizable security options to restrict access and viewing of stored data.
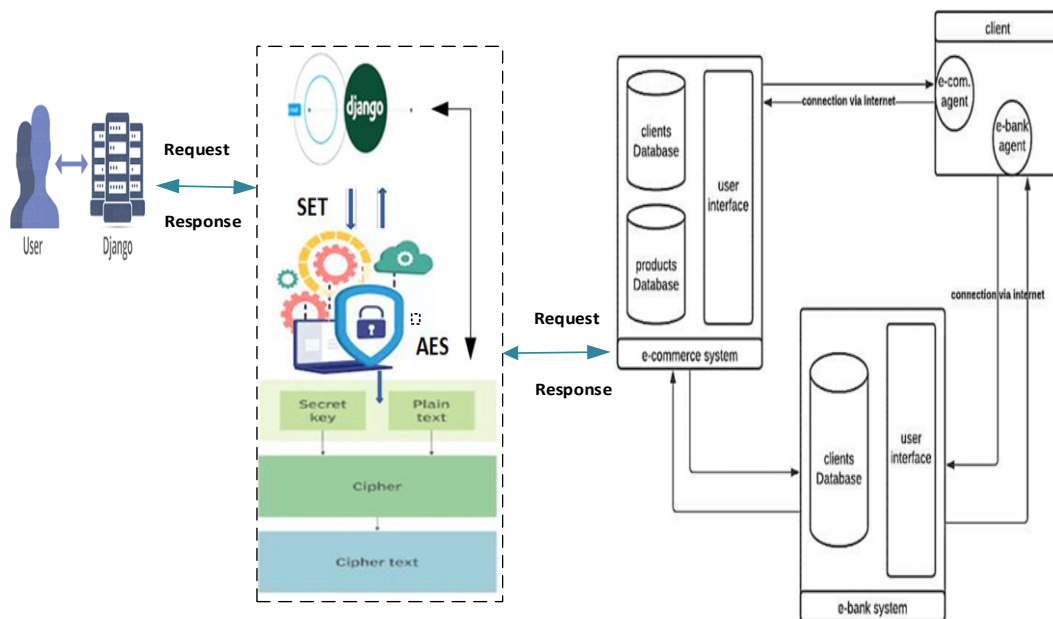

Figure 2: Secured E-commerce Digital Learning (SEDL)

The proposed system in Figure 2 shows a secure e-commerce environment, the architecture illustrates how three components of security techniques were used. The three security techniques include the Django framework, SET, and AES. The three techniques work together to prove reliable secure e-commerce digital learning.
The operation of the security techniques in SEDL
The security techniques provide an authentication system, that handles both authentication and authorization. The term "verification" refers to the process of confirming a client's identity and approving their actions, ensuring they are authorized to perform certain tasks.

Authentication systems are:
Student as users: Paired (yes/no) banners assigning whether a client might play out a specific undertaking.
Group: A nonexclusive approach to applying marks and consent to more than one client.
A configurable secret key hashing framework
A pluggable backend system

Django, AES, and SET operations in SEDL.
Django was used to host the SEDL website and enhancement of its presentation through resource management and improved database queries, and client confirmation was performed using Django's secure authentication framework. SET used in Figure 2, transmits Mastercard information, ensuring students' classified information is protected from unauthorized users and the entities involved as shown in Algorithm 1. When a cardholder makes a purchase, the shipper server ships the order, and the payment Server confirms approval using AES encryption calculations, ensuring the information remains secure. Encryption is a method used to convert plain text data into a non-readable format called figure text. This process requires a key or calculation to decode the data and return it to its original plain text form. However, free cardholder information is vulnerable to theft, as digital hoodlums can exploit this vulnerability by redirecting it to a retail location or dealer's central server. Encrypting either the actual information or its transmission can significantly reduce the information's vulnerability.

The payment gateway uses a back-end organization to contact the students and request payment. The students store the payment in the shipper's account, while the cardholder's bank stores it in the shipper's ledger, the procedure is summarized in Algorithm 1. The proposed framework uses an AES cryptosystem, which encodes the details inside the communication channel. Encryption is used to protect sensitive information like card numbers, track information, card security codes, and expiration dates of the transaction. The encryption process starts at the point of capturing, the student's details such as PIN and the online business page's information section. If the information stays encoded until it is received by the processor, it is protected during the transmission of the path, known as start-to-finish encryption. This scrambled card information is muddled and only affects the decoding key processor.

Proposed Student Transaction Algorithm
The transaction between the three components (Students, e-commerce site, and Bank) in SEDL comprises a few procedures as stated in Algorithm 1:

Algorithm 1: Procedure involved in the transaction.
Start
Step 1: Students sign in to purchase.
Step 2: Place items in cart
Step 3: E-commerce site request affirmation
Step 4: Give students the placing order to pay (given by students' data)
Step 5: The students consent to the request and gives the web his/her data to pay.
Step 6: The e-commerce site requests the bank for payment.
Step 7: The bank communicates with the students about the payment.
Step 8: After finishing the payment, the bank is to communicate the e-commerce site and the
        students with the total payment.
Step 9: Send a receipt and report to the separate purchaser.
End.

The Description of Students' Story Board in Secured E-commerce Digital Learning (SEDL)

SEDL provides a platform for students to request various items, including lessons, tests, guidelines, and class activities. The administrator is responsible for setting up items like PCs, student-created materials, and keys for legitimate requests, requiring students to collaborate on the webpage without using email or other external sites. Teachers could periodically post lesson materials, tests, instructions, and homework will be given out and graded according to their wishes as shown in the storyboard in Figure 3.
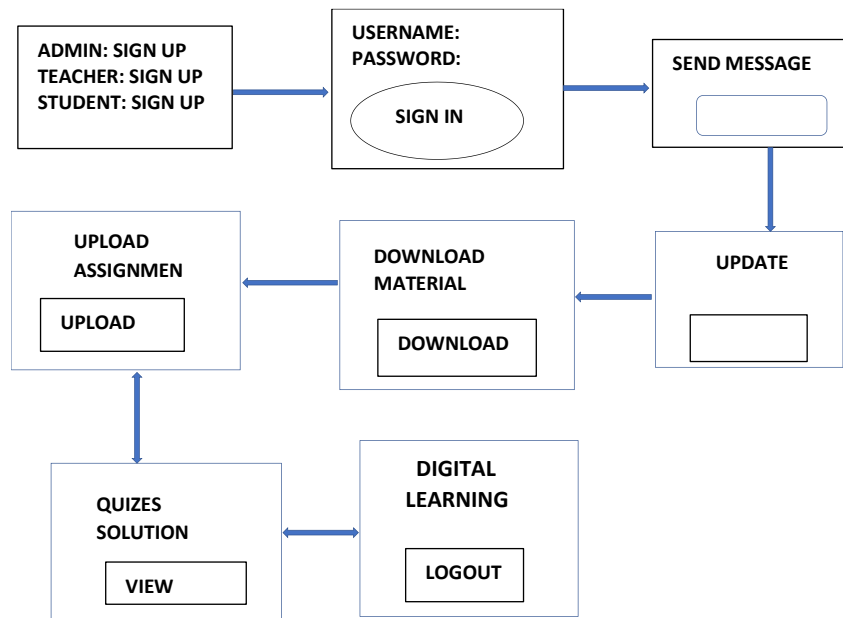

Figure 3: Story Board for Registered Student

The data flow aims to assist students in accessing information on their computers, classroom materials, and tasks at their convenience, without requiring traditional e-learning experiences. It includes modules like enrollment, browsing, search, and request as illustrated in Figure 3. It comprises of front-end side (Student side) and back-end side (Administrator side).

a. Student side. The front-end side provides features/modules like Client Enlistment, Login/Logout, Client Center, web-search tool, Shopping Basket Request, Shop Notice, Articles, Email, Executive Class, and History Viewing. It gives students room to register, browse products, search for products, and order.
i. Course Center. Courses are available online, with instructors providing course recordings and students grading from five perspectives: consistency, development, achievement, culmination, and fulfilment. Students can explore various learning resources such as e-reading materials, extracurricular books, periodicals, papers, sound, video, and courseware PPT digital books that can be downloaded in the domain.
ii. Training base. Students can participate in local rivalries, practice exercises, and explore functional divisions. They submit practice reports, with teachers grading and the system calculating scores.
In outline, the preparation based on the storyboard catches the act of e-commerce learning exercises including:
Assortment of thought among a gathering of studies on things that could be sold or purchased using visiting SEDL.
Pick products to sell on SEDL.
Use the camera to capture products.
Scan SEDL for a finished posting for a comparable product. Utilize other dealer postings to make an examination and get thoughts on the classification, cost, thing portrayal, and terms.
Portrayal of the thing and incorporate instalment and transportation terms.
Posting of e-resources and downloading the thing available to be purchased on SEDL.
Send a receipt to the separate purchaser.

Cite this article as:
Sulaimon, H.A., & Owamoyo, N. (2024). Design and implementation of secured e-commerce digital learning for the educational system in Nigeria. *FNAS Journal of Mathematics and Science Education, 5*(4), 23-32.

Verifying the request by transfer and adding more of the product.

b. Administrator Side. The back-end side includes the following modules: item classification, executive updates, inquiry items, and request manifest checking, as well as item conveyance status.

c. Teacher Side. The educator side consists of resource control, assessing, and providing material for proper upload to SEDL. They manage various activities of students, including data management. The system provides a convenient environment to conduct comprehensive assessments of students, including, drilling, study, and practice. They transfer information about competitions, rehearsals, and exercises, monitor student progress, review student reports, and provide their perspectives as related exchange of goods online.

Results

The SEDL online learning site was designed using Python Django, which comprises a wide range of features and functionalities.
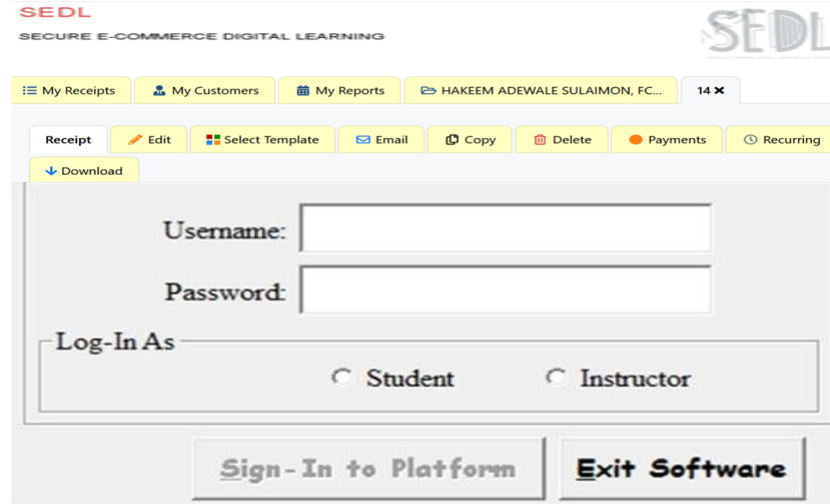

Figure 4: SEDL-User Authentication

Figure 4 above illustrates SEDL-User authentication, and this page will enable the students to register on the site or sign in to browse the site's items most especially the recently created resources. The sign-in interface requires users to input their username and password to access the teacher and student pages, where they can sign in and leave the stage. The page also provides links to all subjects for each frame level.
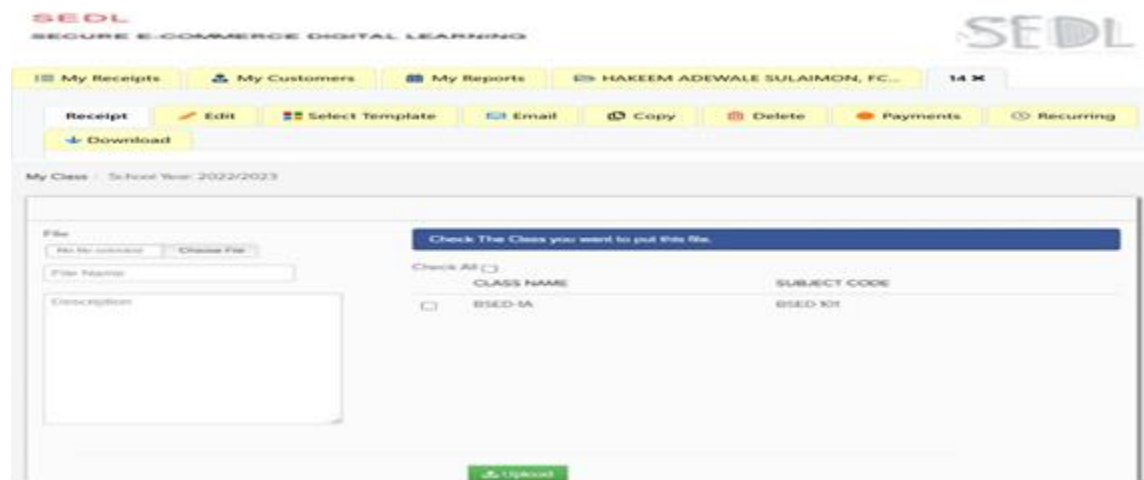

Figure 5: Uploading of Files, Documents, and Reading Materials

Figure 5 shows the site interface that allows teachers and students to study online through the site. This page provides materials to learn the fundamentals of e-commerce, exercises to practice, and online business resources. Teachers can relate with their students through this site by uploading topics, subject material, models, files, and related tutorial questions.

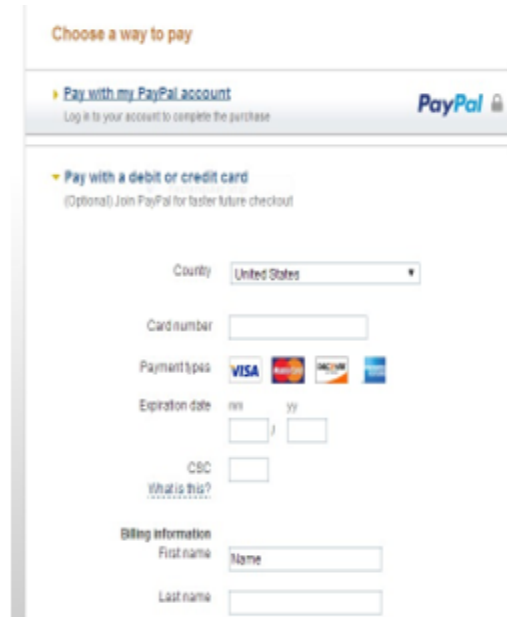**Figure 6a: E-commerce Contact page**   **Figure 6b: Payment Form**

Figure 6a shows an e-commerce contact page, it allows students to collaborate upon signing in, displaying items upon selection and details like the product for sale, students' orders, and the cost of the items. After choosing items, the system redirects the student to the payment form as displayed in Figure 6b, which in turn requests payment details. The messages sent through the system would be subjected to a security mechanism already implemented in the system before reaching the destination.
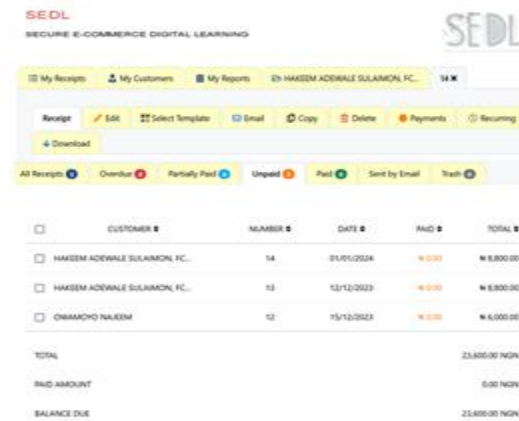
Figure 7a: Receipt

Figure 7b: Report

The page in Figure 7a shows the Receipt containing information on the selected product. The user can enter the quantity required and confirm the purchase through the confirmed selling checkbox. Figure 7b shows the report page that contains the purchase page, shows information about the product purchased by the customer or student. This information includes the product purchased, the previous charge, the current charge, the quantity of the product purchased, and the total price.

Conclusion

This study focuses on creating a secure e-commerce environment for students to learn about how to operate e-commerce platforms. The system uses a well-organized architecture, with transactions flowing through a secure channel and a database. The security framework and protocol improve the quality of security in the system. The platform can expand classes for e-commerce digital learning, provide a variety of intuitive materials, and enhance learning opportunities. The framework has been further refined in this study to make it more effective than traditional classroom guidance, the research work has been developed for students to understand web-based business skills with strong expertise and impressive capabilities and contribute to the long-term positive development of internet business in Nigeria.

Recommendations

Based on the findings of this study, the following recommendations were put forward:
1. The government should provide effective regulations that would facilitate the implementation of secured e-commerce digital learning for future growth in the Nigerian higher educational system.
2. To improve the usability for students, the researcher should work further and design the system for mobile phone compatibility.
3. It is important to provide more security patches to guarantee a more secure and encoded user's data on the web-based learning site.

Acknowledgements

Cite this article as:
Sulaimon, H.A., & Owamoyo, N. (2024). Design and implementation of secured e-commerce digital learning for the educational system in Nigeria. *FNAS Journal of Mathematics and Science Education, 5*(4), 23-32.

References

Badotra, S., & Amit, S. (2021). A systematic review of security in electronic commerce, threats and frameworks", *International Journal of Applied Science and Engineering* 18 (3) 17-21.

Busari, O. A., Adebisi O. A., Adeaga I. I., & Oni A. A. (2021). Development of online threats and frameworks*", International Journal of Applied Science and Engineering* 18 (3) 17-21.

Farah, T., Abdul H., Abdul M., Rahma, S. Hala, B. & Abdul W. (2022). Design and implement a new secure prototype structure of the e-commerce system. *International Journal of Electrical and Computer Engineering (IJECE).* 12(1), 560-571.

Johnson, A., & Brown, L. (2020). Python Django framework for e-commerce: A comprehensive review. *International Journal of Software Engineering and Applications*, 15(2), 78-94.

Kahiigi, E.K, & Ekenberg L. (2018). "Exploring the e-learning state of the art." *The Electronic Journal of e-Learning,* 6(5) 77-88.

Osho, F., Christoper I.O., & Ugwu J. N. (2016). ECommerce in Nigeria: A survey of security awareness of customers and factors that influence acceptance". *CoRI'9*(16) 7–9.

Rajesh, K. (2018). Security issues and guidelines for a successful E-commerce system. *International Journal for Research and Analytical Reviews* 5(2), 2-4.

Saxena, S., Vyas, S., Kumar, B. S., & Gupta, S. (2019, February). Survey on online electronic payments security. In *2019 Amity International Conference on Artificial Intelligence (AICAI)* (pp. 756-751). IEEE.

Smith, J. (2021). E-commerce website development using Python Django. *Journal of Web Development,* 20(3), 45-62.