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An Intranet-Based E-learning System for Curriculum Delivery in Rural Settings

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Abstract: Electronic media can be used to provide an effective means of curriculum delivery, enhancing learners experience using e-learning. In a rural setting, the Internet often proves difficult to access and many times inaccessible. This paper focuses on how an e-learning platform can be deployed on an intranet to solve this problem and improve curriculum delivery in rural area settings. An e-learning system of knowledge delivery was developed that provided e-learning service on the intranet of an academic institution of Federal Polytechnic Ilaro, Ogun State, Nigeria. The model was developed using Modular Object-Oriented Dynamic Learning Environment (MOODLE). A network server was used to run the software developed on Moodle platform. A total of eight (8) access points was set up to cover the polytechnic campus and these were connected to the server room via a 24-port Cisco switch. The switch was used to provide interconnectivity to the server and the server room wireless base station. The developed software model was deployed on the server over a wireless network facility to support about 2000 concurrent users (students) on the polytechnic campus. After implementation, the result shows that the developed system promised to positively affect the manner of knowledge delivery on campus which by extension will apply to a rural or remote area and can be adopted by other institutions and colleges having this challenge irrespective of their locations. The developed model can enhance curriculum delivery in rural settings where Internet access is not available.

Keywords: Adaptive Computer Learning, Collaborative Learning, Course Assessment, Educational Setting, Educational Software, E-learning

1. Introduction

E-learning is an electronic platform for lecture (curriculum) delivery that uses multimedia and technology in and out of the classroom. It provides ease of use and accessibility to different types of students (part-time, full time, distance learning) and learning environment to undertake a study or attempt an exercise at a time convenient for the students. It also allows learning to continue after lecture hour by allowing students to go online and watch lectures, access lecture materials and engage in forum discussion [1]. Several authors defined e-learning as learning which was supported and/or made possible by the use of modern ICT and computers [1] or as a term used to represent open and flexible learning [2]. E-learning was born due to the development that occurred over the years in technology, especially the Internet [3].

Before the advent of the Internet and the popularity of home and office computers, correspondence was used to attend to students in a distance environment, lecture materials were sent via postal mail to the recipient and the assignment sent back through same process [4]. When the advent of the computers system and Internet connectivity came to light, e-learning became popular where students can be anywhere in the world and access the same materials like those on campus. E-learning was introduced into pedagogy as a form of learning management system (LMS) [5] which is a software application or Web-based technology used to plan,

implement, and assess a specific learning process [6]. Some researchers opined that the LMS failed to deliver on its promises but yet the e-learning found its way into traditional learning system under the umbrella of blended learning which involves the mix of e-learning and traditional teaching in the classroom [7-9] where a student can be online and participate in a class, access learning material when he or she is available, watch recorded video of lectures and practical description of things taught in the class, or describing a live industrial experience.

Over time, educational computing research has been conducted on the effect of technological changes in learner's experience in the classroom [10]. E-learning uses communication and information technology in improving learners experience in the classroom. The Internet has changed the delivery of lectures in the classroom [11]. Indeed, its adoption is increasing in most universities and institutions of higher learning all around the world [12] and making learning easier. The breakout of COVID-19 and its attendant lockdown made this more of a worldwide experience and dramatically affected mode of education [13, 14]. It has been shown in the literature that e-Learning can provide an educationally-superior alternative to traditional lectures [15] and provides the opportunity to test students in real business situations and new methods to evaluate each student's learning [16] but is very unlikely to get rid of teachers [17]. Some studies [18] have shown that when teachers are given opportunities to thoughtfully engage in the design of educational technology, they showed tremendous growth in their sensitivity to the complex interactions among content, pedagogy, and technology.

Thus, embarking on the development of an e-learning system for an academic institution in a rural setting is a welcome development. Indeed, adopting ICT in curriculum deliver is a welcome development in information system with a number of benefits [19, 20]. Notwithstanding the e-learning widespread adoption in education, utilising it for teaching in a rural or remote environment can pose a challenge when the ICT facilities are not readily available to both the teachers and learners.

In a rural setting, e-learning may be adopted offline if the Internet facilities are not readily available. In the absence of regular Internet network in a rural area, the intranet facilities of an institution can be used to provide access around the institution to run the e-learning software. Thus, the absence of a steady Internet network would not be a barrier to utilising e-learning for teaching purpose.

Table 1. *Learning Structure [18].*

Student
Teacher
Community
School
ICT
Information system
Learning model
Content Design

A new teaching method may have to be learned in order to effectively use technology as suggested in [21]. It has been shown that students' perceptions are likely to be influenced by teachers' perceptions and use of learning technologies in their teaching approaches [22] and teachers who are willing to re-evaluate traditional instructional methods have begun to discover that by broadening their range of teaching to include the use of new technologies, more effective learners will be produced [23]. Consequently, this study developed an e-learning platform similar to the one reported in [6] for use in a rural setting. The case study here is the Federal Polytechnic Ilaro, Nigeria, a polytechnic campus. The developed model was proposed to connect a teacher to give a lecture to multiple audiences of students in various locations on the institution campus where there is intranet access. Information and communication facilities were provided to give access to the academic community and the teacher or lecturer uses the facility to deliver the learning material (content design) to the student following the flow in Table 1.

2. Materials and Method

The model for the e-Learning system was developed using OPNET modeler, a commercial platform provided by Riverbed Technology with the network infrastructures shown in Figure 1 which describes the typical network layout deployed using eight base station positioned to provide access around the academic institution. The equipment and materials employed for the deployment of this model are as given in Table 2.

Table 2. *List of Equipment used in the deployment.*

i.	HPE ProLiant DL380 G9 2U Server - E5-2620 V4 8 Core 2.10GHz - 16GB Installed DDR4 SDRAM 2X 1TB Hard disk
ii.	17 inch monitor
iii.	24-port POE Cisco Network Switch
iv.	8 unit of rocket M2 wireless Radio with omni directional antenna
v.	Cat6E outdoor cable and connector
vi.	5 kVA UPS to provide power backup

The HPE ProLiant server (refer to Table 2) was used to run the software developed on Moodle platform to allow access to users over the established network. The monitor served as an interface to the user of the server or administrator. The 24-port switch was used to provide interconnectivity to the server and the server room wireless base station as depicted in Figure 1. By this, a point to point network to the remote stations located around the campus

was established. A total of eight (8) access points was modeled as shown in Figure 1. Each base station represents an access point location on the campus or model that will provide intranet access to the e-learning platform. Each access point was connected to the server room via the Cisco switch (where the server containing the e-learning platform resides) as students (users) connect from each base station to access the server and share information.

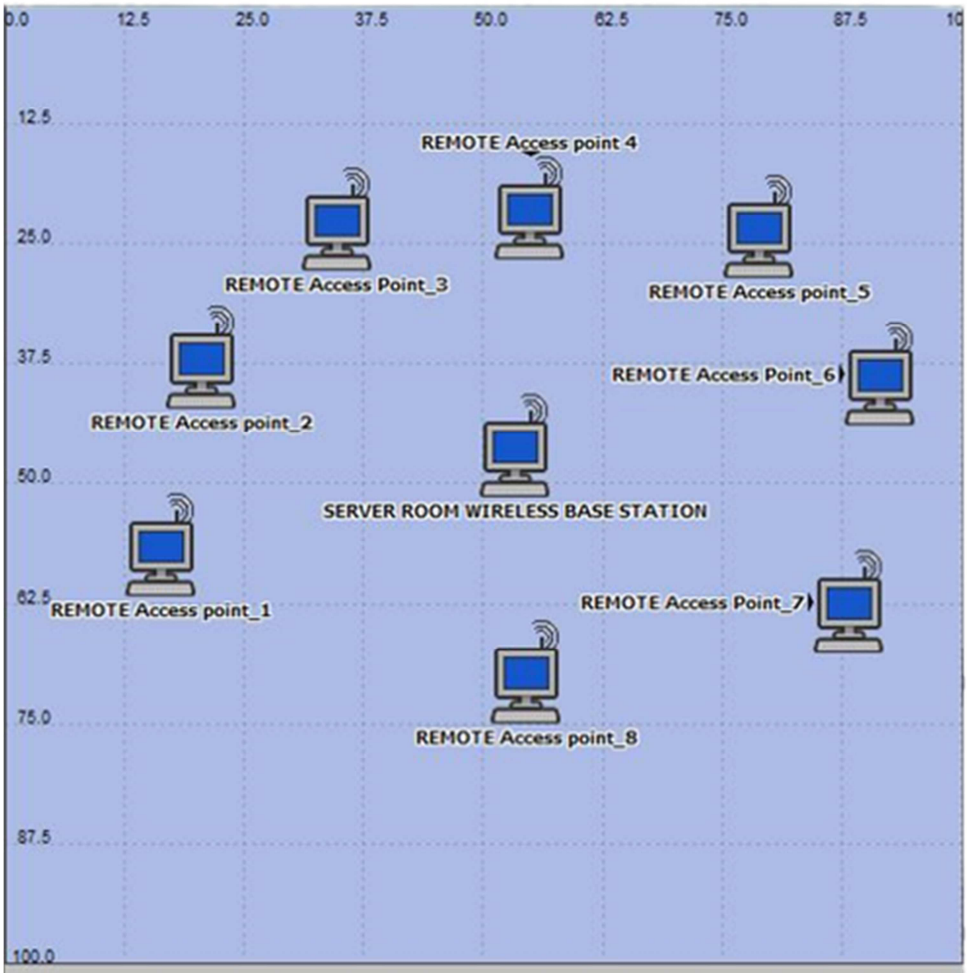

Figure 1. *The intranet e-learning system model.*

3. System Setup and Operation

The e-learning system was setup to support the service of webpages on both the intranet and the Internet. The software resided on the Linux operating system which is more efficient when deploying a server base network. The lecturer and student access the e-learning platform from any location on campus through the intranet or the Internet if the lecturer or student is off campus or outside the coverage area. The advantage when on campus or within the coverage area is the fact that the Internet is not needed to have access to the e-learning platform, which makes it adequate for rural or remote use where Internet access is not available.

For the operation of the system, the server was switched on and allowed to load the required services to support the developed platform then users using a browser on their respective devices were prompted to initiate a connection to the nearest access point. When the connection was established the platform requested the user name (Matriculation number for students) and password of the student or teacher then it provided access to the platform on authentication. Once signed in, the user would have access to the electronic materials made available for the respective class and be able to download and submit assignment and engage in activities as directed by the teacher or lecturer.

The home page is the first line of call where information about the institution is displayed and also the login option for user to click when he/she wants to log in to the system. After a successful login, the landing page is the dashboard where a student or staff will be able to access the course registered or permitted to create or modify on the part of the lecturer (instructor). The students access the lecture after picking the course registered for and then engage in class activities such as assignment, Chat, Books, SCORM, quiz, feedback session or visit a URL for a video on the subject matter. This follows the pattern of the sitemap in Figures 2 and 3 which describe the site map and how to navigate in the e-learning system for a lecturer and a student respectively.

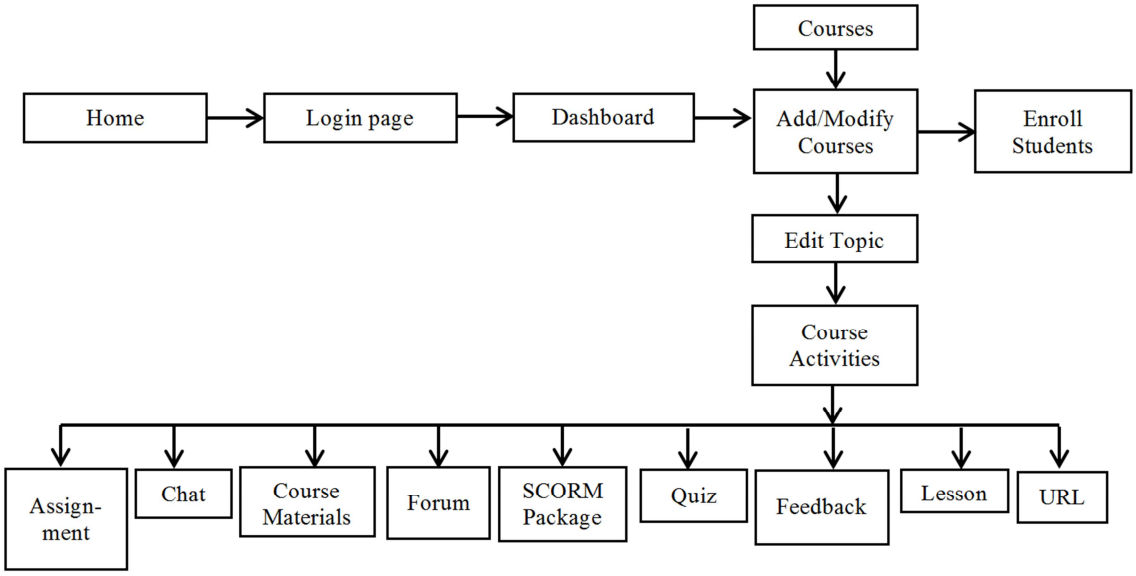

Figure 2. *Site map for Lecturer/Instructor.*

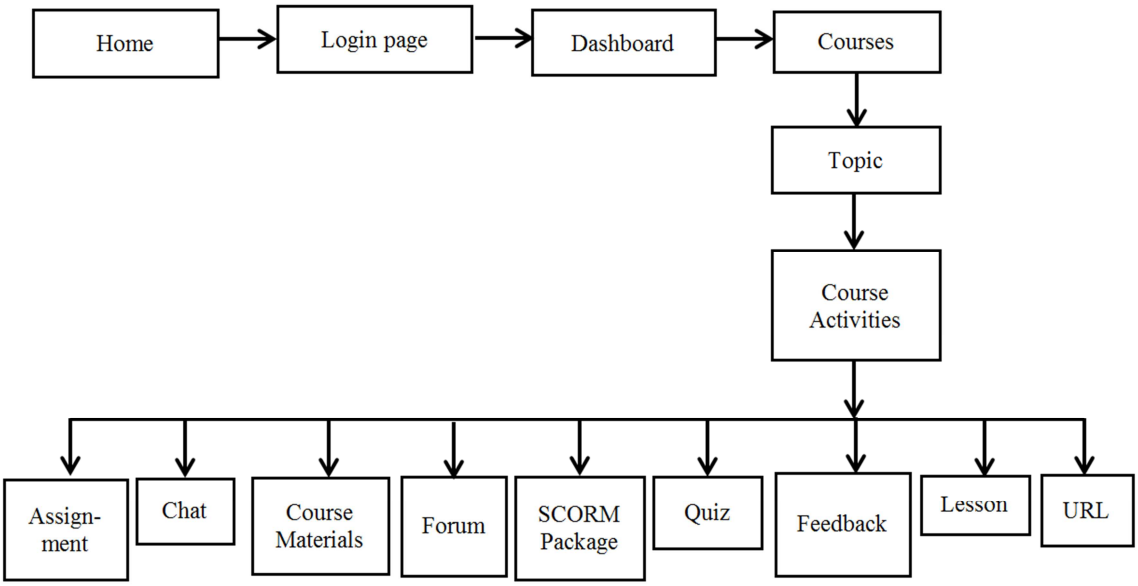

Figure 3. *Site map for Student/Guest.*

After a successful session the user can logout of the system. Provided there is wireless access at the locations covered, the user can also move within the location without any interruption in the access to the platform as the users roam within the eight-access point within the academic community.

Each base station was connected wirelessly using point to point link between the server base station and the remote base stations. This aligns with the e-learning structure highlighted in Table 1.

4. Simulation and Results

Using Opnet modeler the e-learning model was simulated to determine the performance based on the arrangement in each base station load and was considered and compared with its activity to the server. The recorded activity from the simulation is as shown in Appendix 1 (a) to (h) for each of the remote access points. The results obtained showed the activity of the model from the remote wireless access point to the main base station where the e-learning server is located. Each figure comprises of a throughput and a load sketch when acquiring access to the server on the intranet.

When logged on to the Polytechnic website, a user gets to the homepage shown in Figure 4. From here he/she would put in the registered username and the respective password. When finally logged in (dashboard in Figure 5), the e-learning platform directs the user according to the sitemap on Figures 2 and 3.

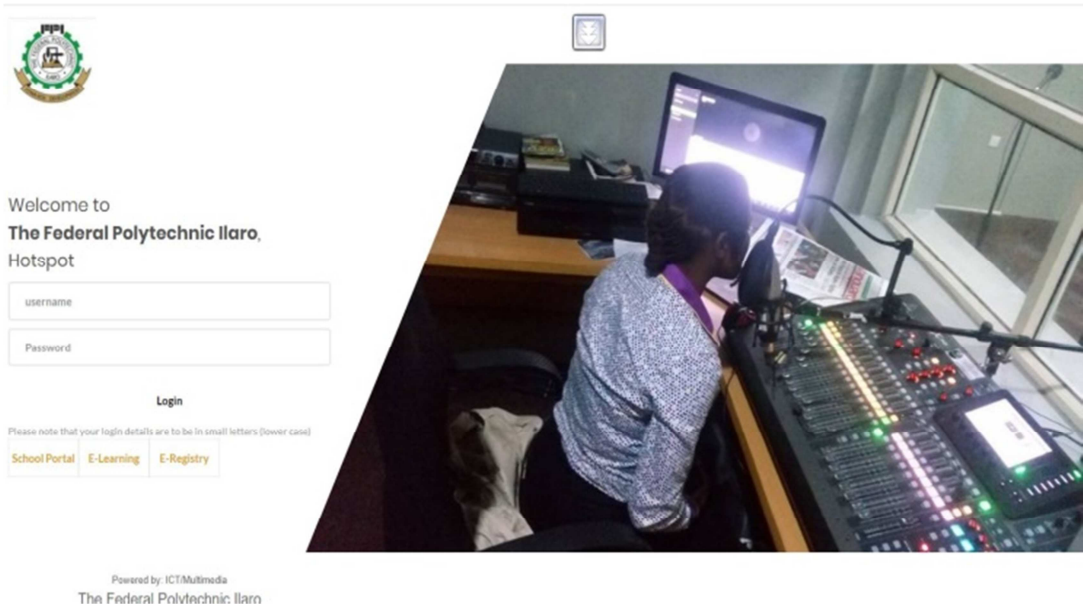

Figure 4. *Intranet Homepage for e-learning platform.*

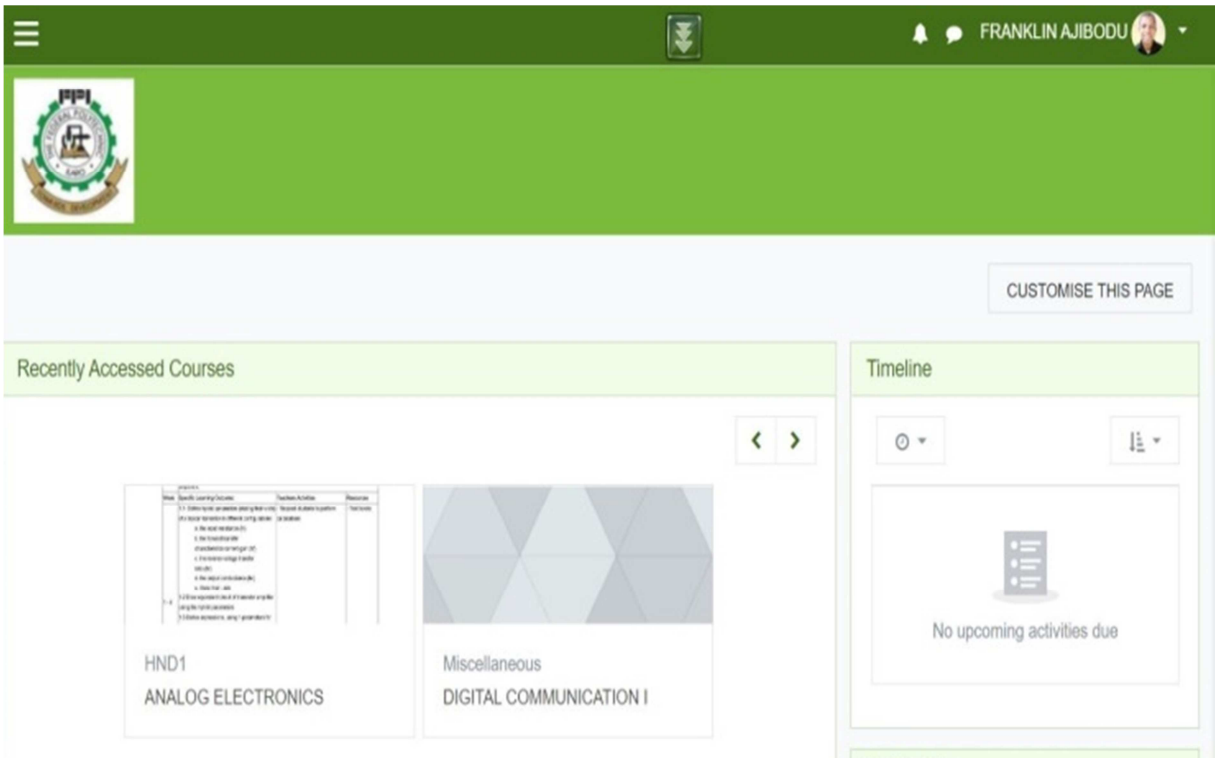

Figure 5. *Login dashboard for e-learning platform on the intranet.*

5. Discussions

The results and model showed that exchange of information flows between the server room and the access points. In this model, the e-Learning platform operates on the intranet irrespective of the teachers or learners' location on campus because its deployment uses wireless connection and every access point is linked to the same server. A class was created on the developed platform. The e-Learning application was used to load (store) course contents. A curriculum corresponding structure was used and lasted for 14 weeks similar to ref. [24]. A course was created for the Higher National Diploma I (HND I) class of the Department of Electrical and Electronic Engineering with the course title Analogue Electronics as presented in Figure 5. Students' registration was carried out by utilising the individual student's email address and the class was populated as approved by the Polytechnic Management. This is presented as shown in Figure 6. Eighty-four (84) students were registered based on approved carrying capacity. Assignment was created by the lecturer and submitted through the

platform by the students. Subsequently, marking and assessment were carried out and feedback provided to the individual students.

The model also provided room for roaming within the academic community. By extension, a student can be in the hostel and still have access to the lecture material based on this setting. Student classwork and assignment can be submitted within acceptable set time slot without the use of Internet. Opportunities to share information and engage in forum or chat room on the platform to exchange ideas and solution to an exercise are also provided when a student is within the academic community or intranet coverage area. The model was tested in a class as shown in Figure 6. Eighty-four users were registered into the test class as shown on the Figure 6. The implementation showed that students were able to access the platform, submit assignments, and engage in interactive discussion while using the intranet–based e-learning platform. The results indicated that e-learning was a success in the considered rural community academic environment and this agrees with the views presented in refs. [25-27].

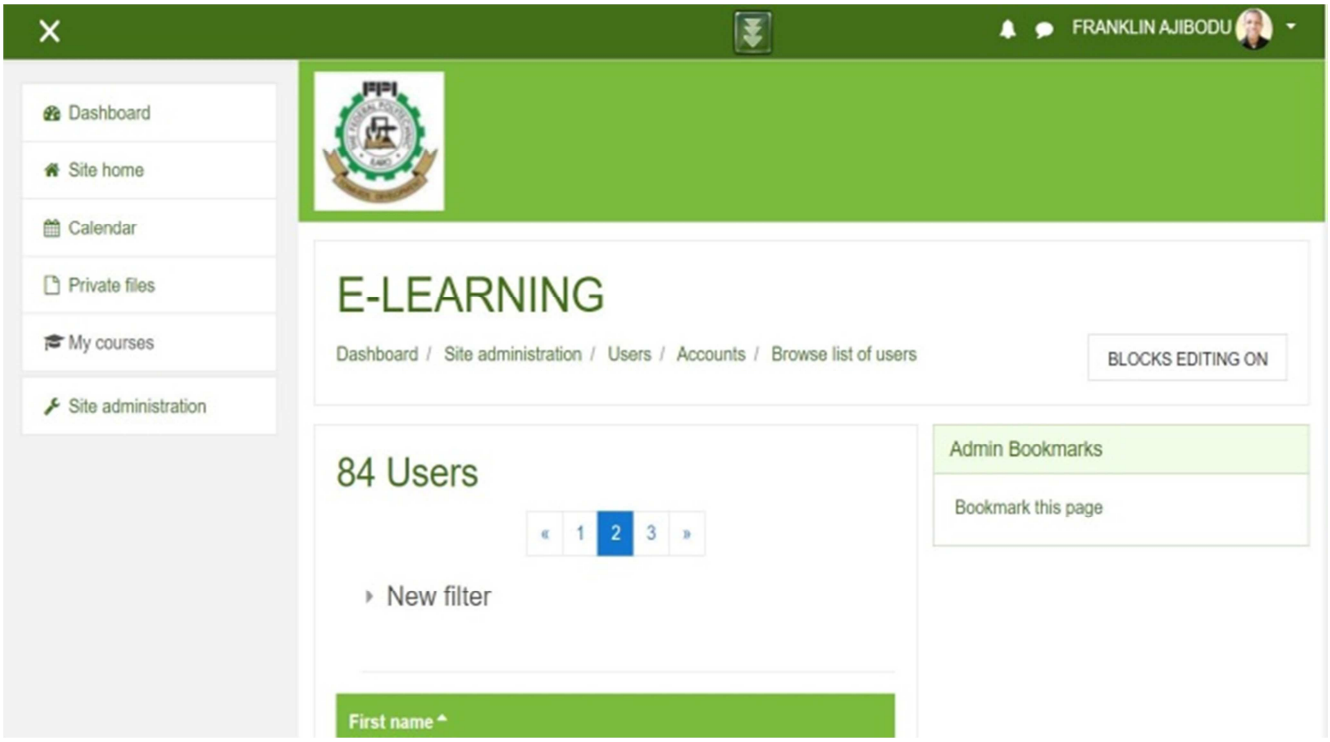

Figure 6. *A test class for the e-learning platform on the intranet.*

6. Conclusion

This study has developed an e-learning system on both intranet and the Internet using Moodle. The developed system was hosted on an existing academic institution server. The intranet-based e-learning platform serves as an aid to teaching and goes a long way in collaborating with the traditional teaching method. This by extension gives room to blended learning where more interaction can be done in and out of the class due to the availability of rich content provided by the e-learning platform such as quiz, Chat, Books, SCORM and feedback session. Multimedia content can be added to give live presentation of subject matter. This platform was designed to be more of learner–oriented which will allow easy learning process.

The developed system promised to positively affect the level of access of knowledge delivery on institutions and colleges especially in rural settings. The test case conducted at the Federal Polytechnic Ilaro, Ogun State, Nigeria campus using this model showed that if implemented in the rural or urban settings it will enhance learners experience and allow the blend of traditional learning with the use of multimedia and electronic content. It will only operate in the covered area by the access points. Further, if implemented in urban settings, the developed e-learning system can be used to reduce cost of purchasing Internet bandwidth as more of the job can be done on the intranet.

Conflict of Interests

The authors declare no conflict of interests in this research work.

Acknowledgements

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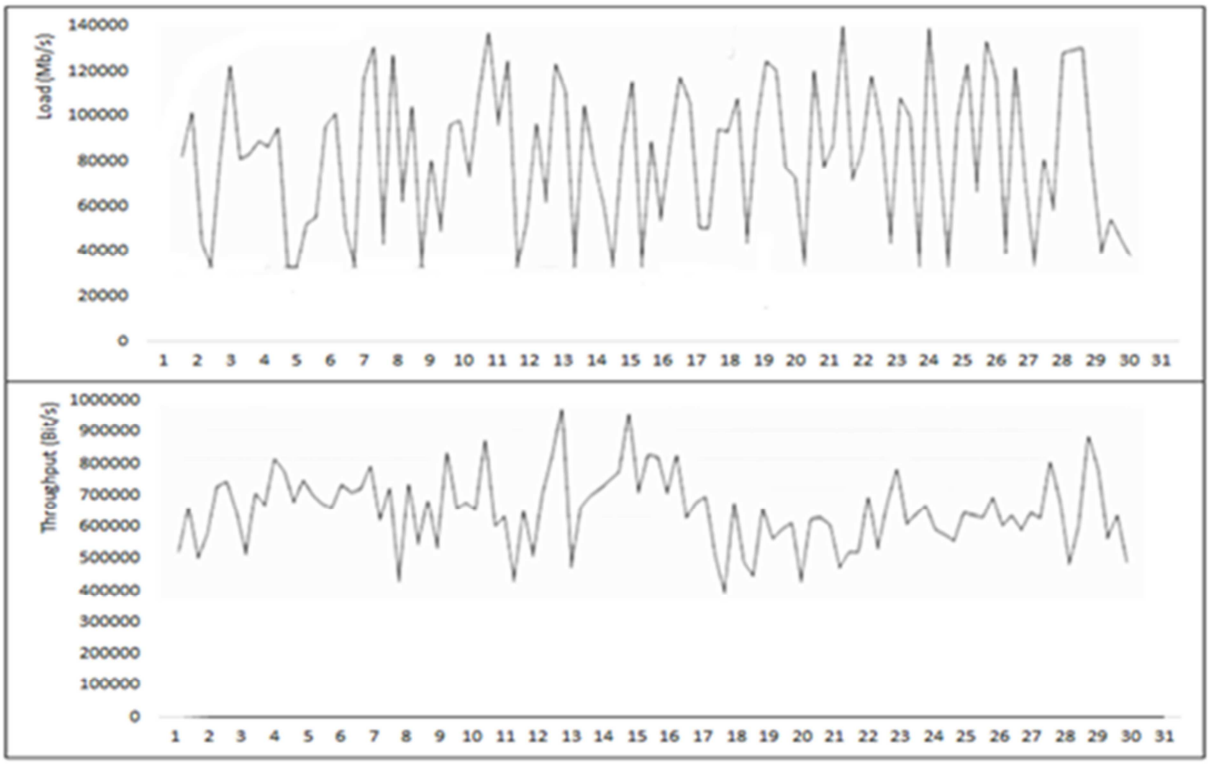
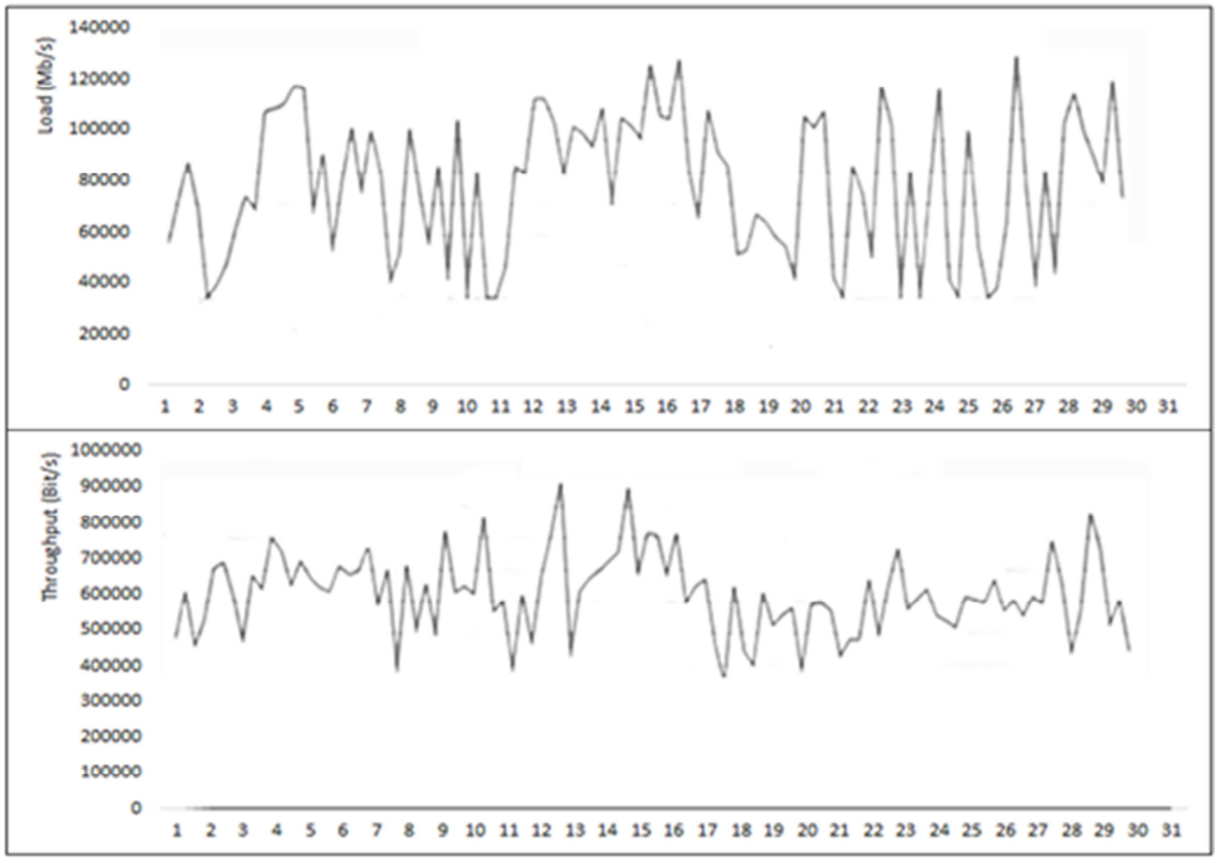
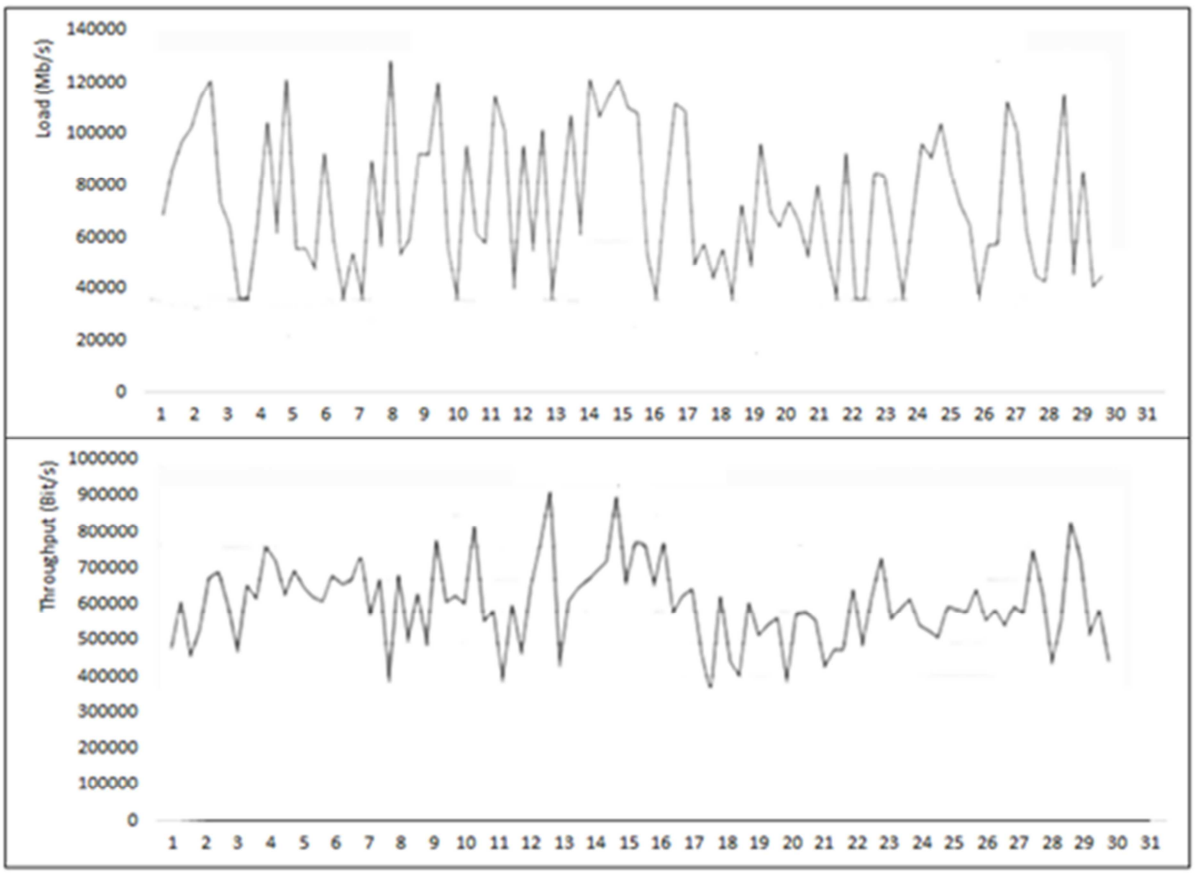
Appendix



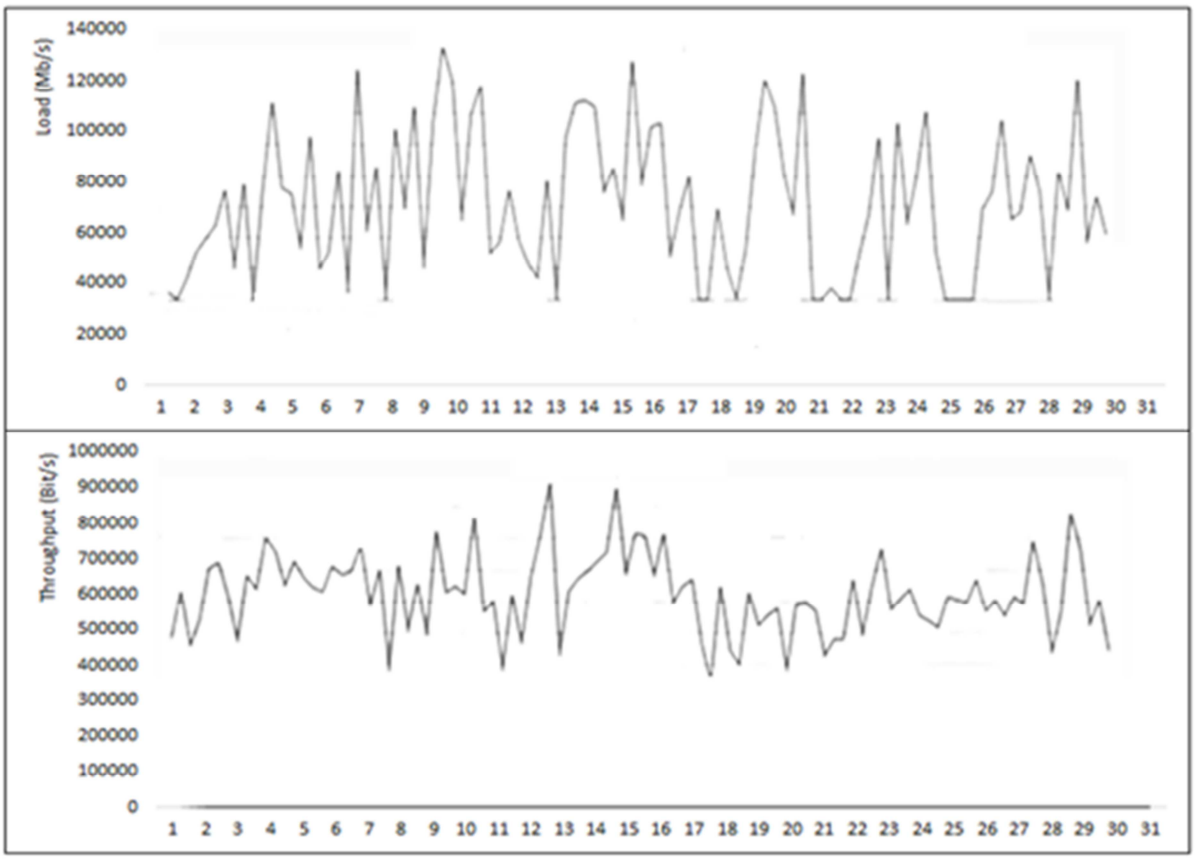
(a): Access point 1 load in bit/sec and the throughput at the server base station



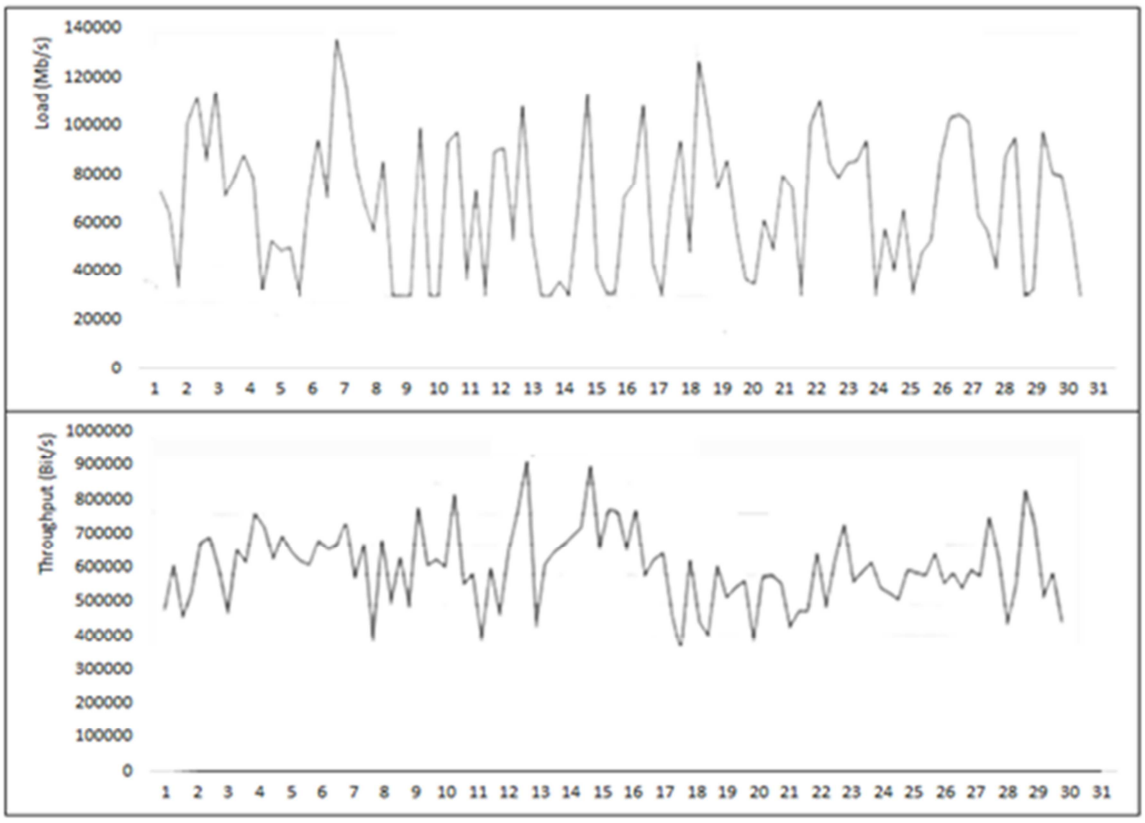
(b): Access point 2 load in bit/sec and the throughput at the server base station



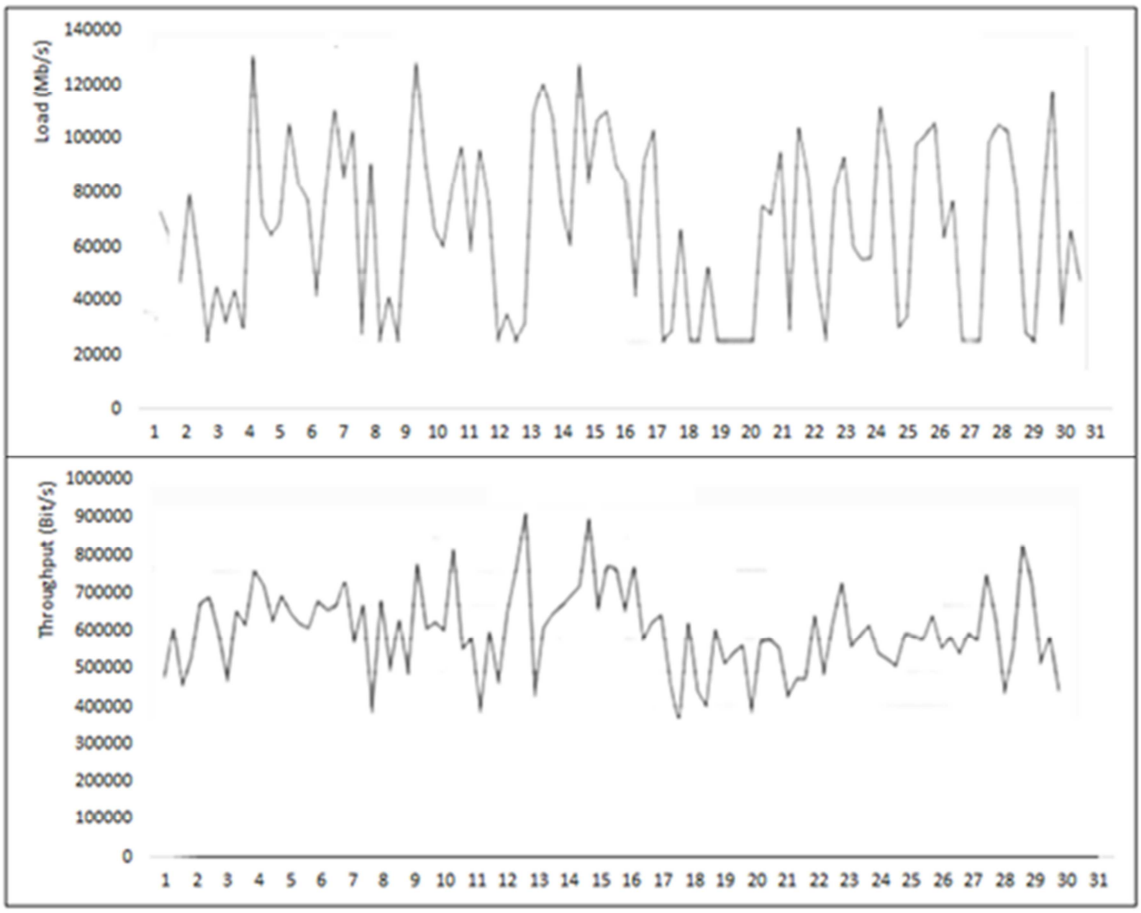
(c): Access point 3 load in bit/sec and the throughput at the server base station



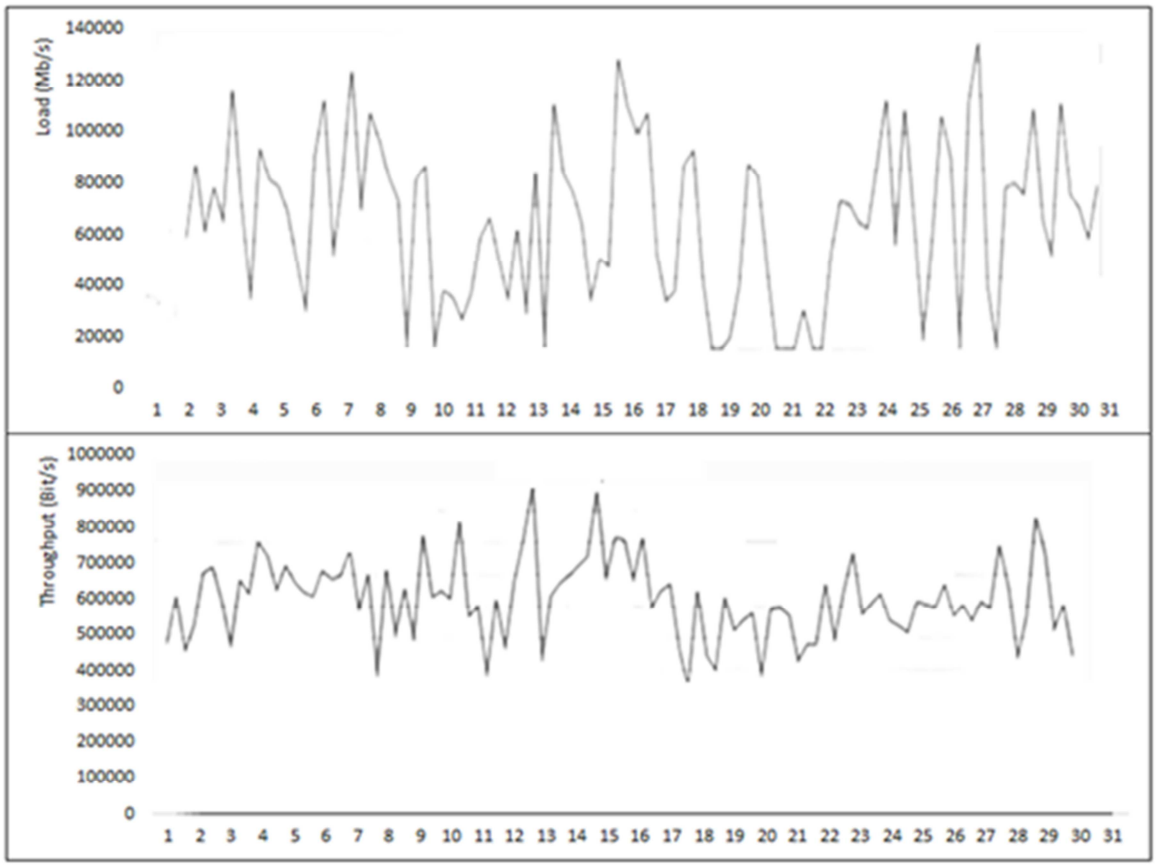
(d): Access point 4 load in bit/sec and the throughput at the server base station



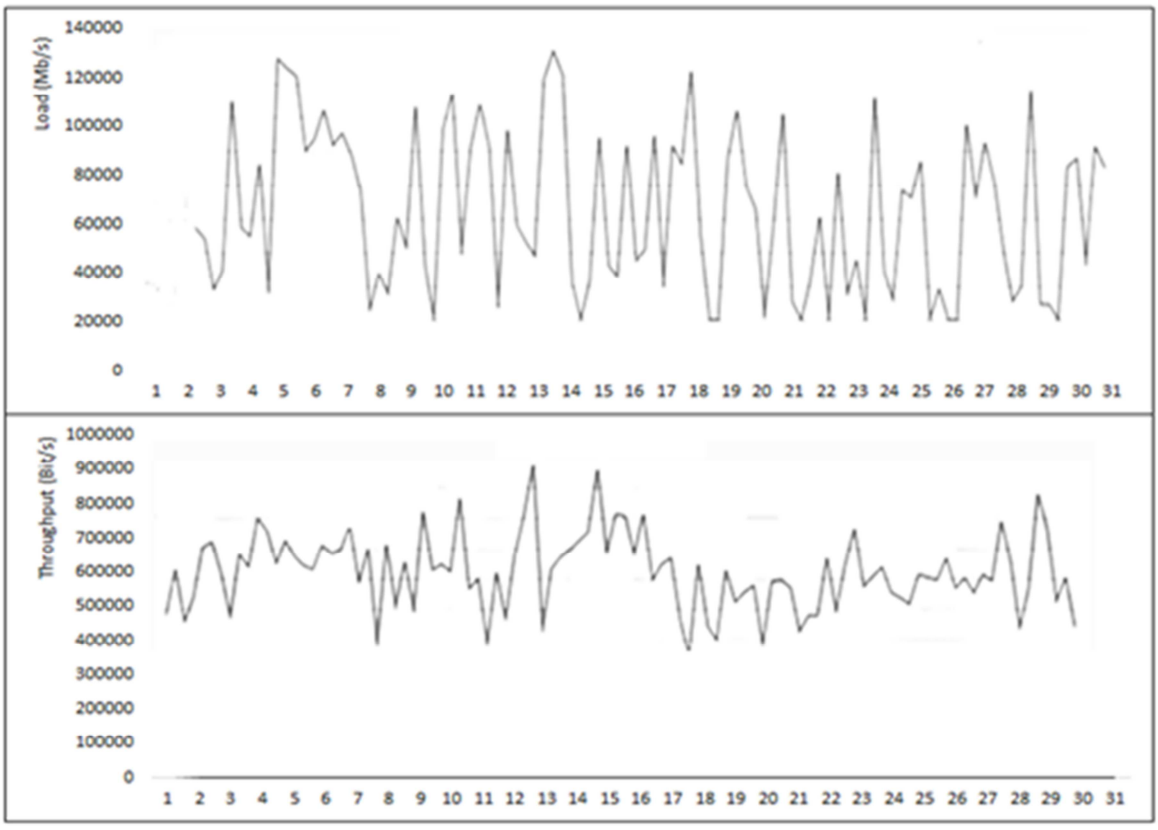
(e): Access point 5 load in bit/sec and the throughput at the server base station



(f): Access point 6 load in bit/sec and the throughput at the server base station



(g): Access point 7 load in bit/sec and the throughput at the server base station



(h): Access point 8 load in bit/sec and the throughput at the server base station

Figure A1. *The recorded activity from the simulation for each of the remote access points.*

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