



## **Digital Collaborative Framework for Students' Industrial Work Experience Scheme and Sustainability in Federal Polytechnic Offa, Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author AOO designed the study, sorted out the data, managed the literature search, discussed the results, wrote the first draft of manuscript, and manuscript review. Author NOO wrote the protocol, sorted out the data, wrote the introduction, and manuscript review. Authors ATA and MKL managed the literature search, sorted out the data, and manuscript review. Author AOA wrote the protocol, sorted out and arranged the data, analysed the data, discussed the results, wrote the methodology and supervised the study. All the authors managed the literature search. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/AJRCOS/2021/v7i1130171

#### Editor(s):

(1) Dr. G. Sudheer, GVP College of Engineering for Women, India.

#### Reviewers:

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Complete Peer review History: <http://www.sdiarticle4.com/review-history/63676>

**Case Study**

**Received 22 October 2020**  
**Accepted 28 December 2020**  
**Published 13 January 2021**

### **ABSTRACT**

Graduate training is one of the core courses offered in all polytechnics systems in Nigeria, each polytechnic gives orientation programmes and deploys students for industrial training once a year. These processes of pen on paper method throw serious challenges because of time authorization and time frame. Placement of undergraduate students looking for relevant Industrial Training (IT) attachment is becoming worrisome. This research tends to provide a web based solution called Digital Collaborative Framework (DCF) for Students' Industrial Work Experience Scheme (SIWES)

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and sustainability in Federal Polytechnic Offa, Nigeria. This is to bridge the gap between educational institutions and the industries subject to training and re-training perspectives. The stakeholders can easily turn DCF into e-administrative tools, then allow students to get industrial placement relevant to their field of studies. The research proposed to develop a productive web application using Codeigniter Php framework. This research will serve as a cloud database to students, staff and other stakeholders and create access to examine, monitor and measure students' performance at the end of the (SIWES) scheme.

**Keywords:** *Students' performance; codeigniter; digital collaborative.*

## 1. INTRODUCTION

Students' Industrial Work Experience Scheme (SIWES) was established by ITF (Industrial Training Funds) in the year 1971 in Nigeria to fix the challenges toward improper skills acquisition by Nigerian students so as to improve employment of tertiary institution graduates. In this regards, graduates students could not easily find jobs due to the lack of working experience and communication gap between the Nigeria tertiary institutions and industries. Technical Education are the core process of polytechnics in Nigeria, as TVET (Technical and Vocational Education Training) is charged with responsibilities to provide knowledge and skills for employment which has been in existence for over 20 decades [1] invokes technical manpower to drive economic all over the world.

The global competitiveness of the Technical Education system has become one of great significance or asset fields for Technical Education adrenal [2,3,4] and the industrial growth depends on knowledge and skills. National Youth Service Corp (NYSC) started web service application in the early 2010 in Nigeria after several push through with local host application in 36 States NYSC orientation campuses. The undergraduate training is another prevailing challenges graving overall tertiary institutions in Nigeria since there is no centralised database service to bridge gap between the industries and Technical Education managers. In this scenario, the researchers are conceived to perform data mining [4] across participating departments in Federal Polytechnic Offa, Nigeria.

This study aims to develop a Digital Collaborative Framework (DCF) for the sustainability of Student Industrial Working Experience Scheme (SIWES) with intent to offer IT placement to all undergraduate students with respect to field of study and this create collaboration between industries and the management of Federal

polytechnic Offa for effective monitoring in Federal Polytechnic Offa, Nigeria.

Based on the existing findings on the Performance Evaluation of Students' Industrial Work Experience Scheme (SIWES) in Federal Polytechnic Offa, Nigeria which shows downward trend toward skills acquisition by students as a result of communication gap between tertiary institutions and industries; the question arises as to why our students are unable to find relevant placement for Industrial Training for adequate skill acquisition and monitoring ethics which is inefficient? Our empirical results show that SIWES depend on manual processes, exhibiting 100% face to face communication protocols for Industrial Training (IT) placement. With the existing large-scale paper based processes, all participating departments can be compared and contrasted with 'key performance indicators' and grading students' performances.

## 2. DCF-SIWES AS COMMUNICATIVE FIGURATIONS

The general concept of e-administration as introduced in this research work was considered as a Digital Collaborative Framework (DCF) for automated placement of students to relevant industry for effective skill acquisition. DCF in the life of student, society and young people according to [5] as well as the impact on skill acquisition, industrial experience and technical education [6] have been broad researched area engaged in a *comparative analysis* of NYSC policies that shows significant changes of skill, knowledge work experiences [7] and student skills gaps with respect to science and engineering industries [8,9]. More so, they identified prospects in access and use of Information and Communication Technology (ICT) for learning outcomes.

The role of ICT in this transformation process and its integration to carryout office functions toward managerial protocols, improving learning,

students learning center, processes under constant political discussion making, which is ranging from high expectation attached and needful to the next technological advancement [10] to profound conception of the ideology [11,12] to bridge that gap between tertiary institutions and scientific or engineering industry in Nigeria. In lure of this, there are few reference studies from an institutional perspective.

## **2.1 Placement Become a Major Problem for Undergraduates**

In many scenarios, connections between SIWES coordinators at departmental level and central coordination unit (Liaison Unit) were most sought among peers locally and most taken long process to shortlist student for SIWES practice for every first year programme which always comes up at the beginning of second semester. Parents or guardians' efforts to enroll their wards for skill acquisition based on school management approval is usually difficult or even problematic for the participating students, for the fact that the exercise always take-off during school session while departmental coordinator' efforts to extract qualified students within short time frame is always ethical. The adoption of digital technology as a web service makes every task easy for all stakeholders in line with [13] findings.

This technique-orientated view on social dynamics changed into defined by way of Elias [14] as figuration, in this regard, 'networks of affiliated members. This research is built on this, to introduce the concept of SIWES as communicative constructed unit set-up on Federal Polytechnic Offa campus, following the pattern approach by [15]. Universities and Polytechnics as organizations are built via the communicative practices of the stakeholders worried of their DCF capacity and media ensemble, as a result, be regarded as a DCF-SIWES. Affiliating concept from sociological research on governance, this research purely adopted the framework model of educational governance as narrated by [16], introduced to the National Youth Service Corp (NYSC) scheme context and contextualizes it to the role of ICT in bridging the gap between Nigeria tertiary Institutions and science or engineering industries going with author [17] fact. If adequately put in place to solve problems behind industrial attachment for undergraduate students, and the structure of the Federal Polytechnic Offa SIWES paper processes management system into consideration on the path of implementation plans.

The ITF is responsible for general management, provision of take-off materials for all tertiary institutions, and the tertiary institution district unit is charge with responsibilities to coordinate, manage, and provide information to all stakeholders within the each institution capacity buildings, facility management and administration as claimed by [18]. In this shared responsibility and the limited autonomy of the ITF district unit and its management lead to constant budget struggles concerning SIWES infrastructure. This structure leads to a schedule 'official duties' between participating students and participating staff for each institution.

The Federal Polytechnic Offa, Nigeria Principal Officer "The Rector" has fewer responsibilities and only receives some feedback from Unit head of ITF on campus. Supervisors and coordinators are hired across participating departments and distributed among the departments based on certain defined criteria from head unit. The influence of unit head as the principal staff of the institution on selection of participating staff depends on departmental coordinators. They are responsible only for a small budget, moderation, management, grading and evaluation of participating students as many decisions are made at the directorate of industrial liaising and placement office headed by principal officer on campus.

## **3. METHODOLOGY AND DESIGN**

The conceptual overview of the proposed Digital Collaborative Framework for Students' Industrial Work Experience Scheme in Federal Polytechnic Offa, Nigeria and its associate features are presented. This involves the core requirements that the SIWES application is expected to satisfy, a description of the modules and components of the SIWES productive server application and a typical use case of how the DCF-SIWES can be used for IT Placement and monitoring.

The first step in this phase was design layout, this guides users on level of interaction (behaviour, load, time) as part of software development and determines the functional and non-functional requirements. The system has passed functionality testing, usability testing, interface testing, compatibility testing, performance testing, security testing and under best web application testing tools to ensure it performs as designed. Next action is deployment to replace paper processes at Liaison unit on campus and introduce a new system to the entire staff through indoor training. The preferred

language for the design includes; HTML5, bootstrap 4, jquery and javascript chosen for system front and back end, this gives best user experience by considering system responsiveness and validation process. Therefore, an Apache Web Server Version 2.4.20 PHP Script was used for Database which is more compatible with Laravel 8.0 framework.

### **3.1 Requirements of the Digital Collaborative Framework for DCF-SIWES Productive Server**

The proposed DCF-SIWES is expected to allow the participants (institution staff, industrial staff and parents) of multiple stakeholders to monitor positively and assess students' performance in the training industries. This should be a gateway communication between the science and engineering industries and the polytechnic management. This may impact positively on student response to training. These outcomes of the DCF-SIWES surely demands that certain basic requirements and composition must be satisfied. In the case, the set of basic requirements that are more important to realising the DCF-SIWES include the following:

#### **3.1.1 Practicability of the DCF-SIWES prompts**

The participation of all stakeholders such as ITF Officers, industrial staff, institution staff, and parents in the SIWES placement and monitoring process during the industrial work experience period.

- This offers a viable and permissible way of collaborative monitoring after placement of students for industrial attachment among the multiple stakeholders so that the objective of bridging the gap between coordinating institutions and industries is achieved.
- This allows only those that have been designated as participants for SIWES programme for the year to collaborate as a team of stakeholders and as agreed with campus based industrial and placement units as they were authorized to exercise their duties which they have been assigned to play in the collaboration.

#### **3.1.2 Functionality of DCF-SIWES in low-resource settings**

- With the limited internet access data-bundle connectivity regarding both signal strength as well as bandwidth.

- Availability of electricity.
- Provision of web service to student in terms of cost of devices and internet data.

#### **3.1.3 Usability of the DCF-SIWES as for digital collaborative framework's applications (desktop and mobile)**

- The web service application *DCF-SIWES* should be compatible with all browsers.
- This design should be user friendly and usage of the DCF-SIWES should also be possible for parents with a low level of literacy or education as well as technically and logically simple.

#### **3.1.4 Privacy and data protection**

- The monitoring procedures on the students' performance in the training fields is only known to the few stakeholders (visiting supervisors, campus based ITF officers, and departmental coordinators) that have been enable and prioritize to be part of the support framework for the SIWES programmes as consented to by the participating students. This is done to ensure that the privacy of the students' record are preserved despite the readiness to subscribe to a multiple stakeholder-centric approach to monitoring of students during IT period.

#### **3.1.5 Support for DCF-SIWES data analytics**

- Aggregated data on students' grading, performance level should be available for the purpose of computing grade records and data analytics by industrial and placement office in order to determine the best approach to students' cases and do follow-up on cases that require special interventions.

### **3.2 Description of the DCF-SIWES Collaborative Framework**

The DCF for placement of students during IT season is regarded as a composite system that comprises a suite of stakeholders interaction data centered technology which are closely implemented and integrated to facilitate ITF resource negotiation between the students, staff and relevant industries (training industries, participating departments, parents, supervisors) to engender improved deployment of undergraduate students to sixteen weeks SIWES to a relevant IT industries. The key components

of the developed application named as DCF-SIWES are described as follows:

### 3.2.1 Computer System / Smartphone

The profiled stakeholders that are accredited and satisfied to participate in the SIWES programme of the year of a particular set of students will be able to collaborate, performs grading, share information, and monitor the progress of the participating students through a mobile browser or personal computer (laptop or desktop) that has compatible browsers as illustrated in Fig. 1. The mobile device, laptop or desktop service will access DCF-SIWES server and enable all primary host "ITF staff" to access data center, populate qualified students that will be participating in the current academic SIWES programme. The shortlisted students are allow to automatically access, offer letter to participating students subject to IT placement from DCF-SIWES server, and the coordination department on campus and their observations to account for qualified students from each departments and acknowledge participating staff in the selected departments in readiness for SIWES monitoring programmes.

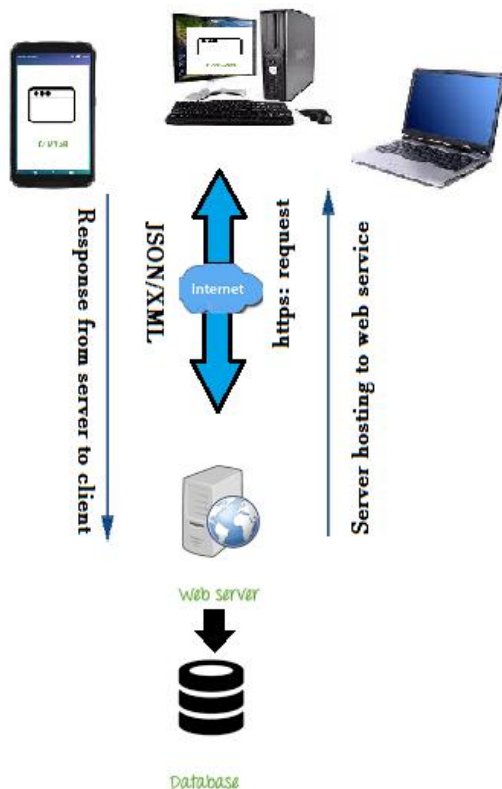


Fig. 1. Composition of web devices for to-from data transport web service

### 3.2.2 The internet access

These are IoT gateways that are available for SIWES participants to have access to DCF-SIWES from strategic positioned in strategic locations where there is internet service.

### 3.2.3 DCF\_SIWES cloud database

This is the central data repository that will store all information and requisite data to the placement procedures, monitoring, grading students' performances. This deals with date, time and location when SIWES programme commences and ends session are also stored per time. Equally, the prompt reminders service to stakeholders set to monitoring and grading notifications that were sent before expected actions are stored, also all instances of back up in respect of visiting schedules through negotiation by ITF officers and institution based supervisor are also stored. The grades acquired from both industrial based supervisor and visiting supervisor are collected over time will provide the basis for data analytics, performance grading and used to generate SIWES reports at the end of SIWES programme.

### 3.2.4 DCF-SIWES back-end data analytic services

This is a more flexible and provides a suitable for data analytics and information services that enable coordination of the DCF-SIWES placement offers to students. Relevant exchange information among stakeholders are sent from the back end to SIWES programme participants from time to time based on academic start and end session received from the DCF-SIWES dashboard.

## 3.3 A Typical Use Case and Application Scenario of the Digital Collaborative Framework

In this section, a typical use case of a student under SIWES supervision in need of IT placement, and a scenario of how the DCF-SIWES can be applied for placement and monitoring of the students during the SIWES programmes in the attached industry are presented. This is achieved by using descriptive narratives.

### 3.3.1 SIWES web service response to participating student case

The participants for SIWES (students, staff, parents and guardians) is predicated on the

existence of a populated and centralized cloud-based coordination service that runs online 24/7 to keep rendering information to SIWES participants and track of the documented media on schedule of individual participants in SIWES programme per section. The coordination service (web application) enable ITF staff and other stakeholders to send messages to students and trainers to communicate Liaison and Placement Unit on campus through DCF\_SIWES web application platform with respect to server request. That means an initial substantial effort from users from browser end in software development is required to achieve this. Once the request is made successfully, the following sequence of service requests to be realized:

1. The user device (smartphone, laptop, tablet, desktop) device configure with up-to-date browser is used to pull request from server. Student "A" will login with matriculation number and get server request to change login credential.
2. At the specified server time, the student device through browser is used to create authentication on web service and gain access to main menu.
3. The service prompt student to complete form 7 application for training attachment and proceed to form 8 application then finally submit.
4. On confirmation of request from server, student is required to print out industrial training IT letter and ITF form 8 which is to be submitted to head office for official approval. The content on letter proven that student "A" had successfully registered and enrolled for current session of IT.

### **3.4 SIWES web service Response to Participating Staff (Departmental Coordinator, Visiting Supervisor, Liaison Office staff) Case**

The selection process is determined by departmental coordinators, which means an initial substantial effort from staff from browser end in software development is required to achieve few step away.

1. The staff device (Smartphone, laptop, tablet, desktop) device configure with up-to-date browser is equally used to pull request from server. Staff login with their staff identification number and get server request to change login credential.
2. At the specified server time, the staffs based on role assigned by head of

directorate of industrial liaising and placement office on campus is charge with responsibilities to monitor SIWES of students, based on location deployed on duty.

- i. It is required for departmental supervisor to fill designated assignment working with the directives of liaison and placement head unit.
  - ii. Core ITF liaison unit is charge with responsibilities to moderate institution based supervisors, participating staff using service request assign to login credential.
3. The service prompt staff with supervisor roles to complete assessment form format during visitation to industry, likewise on request to access, grade student performance using student logbooks.
  4. On confirmation of request from a server, head unit of directorate of industrial liaising and placement office will be notified on prevailing duties carried out per visiting supervisors.

### **3.5 SIWES Web Service Response to Participating Industries Case**

The selection process is determined by ITF head quarter based on criteria, other SME is equally consider on local grant to take part in student training across states in Nigeria. The SME is charged with responsibility to train and retrain student on skill acquisition (see chapter two). The deployment of service from SIWES web server positioned industrial staff to access SIWES portal to grant requests.

1. The industrial based staff device (smartphone, laptop, tablet, desktop) known as industrial based supervisors required a device configure with up-to-date browser which is equally used to pull request from server.
2. At the specified server time, the industrial based supervisor to acknowledged nomination request as set by ITF campus based office known as directorate of industrial liaising and placement office, Federal Polytechnic Offa, Nigeria. This is set as collaborative agreement to take part on IT attachment for the current session.
3. The service prompt the industrial based supervisor roles to complete assessment form on delivery during visitation to industry and completion of SIWES programme as scheduled by school management.

#### **4. DCF\_SIWES IMPLEMENTATION FRAME WORK**

The research implementation frame work for the study entails several aspects, which includes selection of the study site, tenfold procedures and population of data to database, and coordinators from each department associated with SIWES programmes, ITF officers (head office and campus based), and the Federal Polytechnic Offa management. DCF-SIWES prototype development of web based application artifact and tools for realizing the digital collaborative framework, placement of student for IT and participants on the orderliness use of the developed DCF-SIWES prototypes. Lastly, it is highly important to obtain ethical clearance and seek support during data capturing to undertake the research. The research work is a Tertiary Education Trust Fund (Tetfund) grant-funded research with the grant application approved by Institution Based Research (IBR). More details on this aspect were highlighted in the research acknowledgement.

In the design of database for the DCF-SIWES, some field names were inherited as presented in Table 1 which stores the required information about participating students, internal staff, and industrial based supervisors in the database. In this case, a design of this module will involve designing a database structure for entering data of a new participant. Only participating stakeholders are considered for DCF-SIWES since cumulative grade points is required for selection process from coordinating office.

##### **4.1 Our Study Site**

The mining 20 departments within campus were selected for the execution of this study. The consent for collaboration with the ITF office on campus was secured and the data pool across departments was successful and published in Asian Journal of Education and Social Studies [19].

##### **4.2 Recruitment of ITF Staff**

In order to engage staff working at liaison and placement unit at the Federal Polytechnic Offa, collaboration was achieved with support of principal head unit on campus, placement of student for IT, ITF SIWES associated stakeholders, and industrial supervisors was done through the Federal Polytechnic Offa, Nigeria. Convenient sampling was used, as a

student's data and application was tested from device targets like Smartphone and laptop given different roles for participating staff. Therefore we are able to harvest around 6000 students across 20 departments.

##### **4.3 Our Prototype System Development**

This really required a significant initial effort to create a basis for engagement and work force with the participants in the study, and to experimentally validate the offer letters generated from DCF-SIWES for IT placement as proposed. The procedures for users to access the dashboard after registration was implemented and authentication is only allowed after creation of account as presented in Fig. 2. A back lock was designed to prevent SQL injection, phishing and any other possible hacking. Codeigniter framework has a conventional method of migration of user data into tables. Therefore the framework was initialized for full migration of the required database design from UI back end.

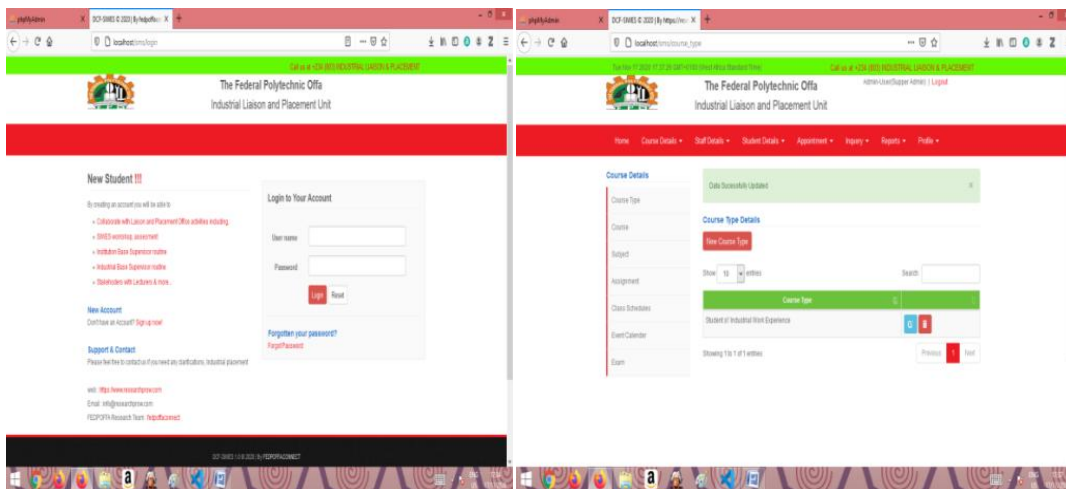
##### **4.4 Approach of Implementation**

The research work was carried out with design outline which entails rapid prototyping of the web solution through user-centric engagement with participants (ITF Staff, Industrial Staff, Parents, Departmental Coordinators). In order to identify the appropriate technology to achieve the type of big data collaboration that is envisioned to improve and sustain the SIWES programme on campus. The feedback from DCF initial exercise was fed back into the integration design process and workflow to produce a more robust digital solution that has been integrated and deployed for a field trial with the same set of data captured. In a null shell, this field trial of the application of DCF-SIWES now formed the basis to measure the SIWES programme outcomes on the research expected goals of the study and this is presented in Fig. 3.

In the Fig. 3, the portal area is presented, the admin, student, staff and industrial based supervisor dashboard after authentication, this was achieved using privilege check from back lock server. The highest order of priority begins with admin, follow by staff, industrial based supervisor and student respectively. Student role will give access to courseware, communication with all stakeholders on DCF-SIWES. Therefore functionalities and roles of each participant vary according to SIWES processes.

**Table 1. Prerequisite DCF-SIWES date field name used adopted for database schemas**

Field name	Data type	Description	Field size
Student, or Staff or Company ID	Numeric	Unique identifier with no duplicate for participating students in the database. Used as a record counter.	10
Matriculation Number	Alpha-numeric	This stores a set of variable character that act as a unique identifier for each student. It is also the primary key of this table field.	15
First name	Text	contains the student's first name	255
Last name	Text	contains student's surname	255
Other names	Text	Stores the student's other names	255
Phone Number	Numeric	contains the participating student's phone number	255
Ranking/Designation	Text	contains the participants' role	255
Gender	Text	contains the participating student's gender	255
Picture	Image	contains an image of the participating student	
Email address	Text	contains the e-mail address of the student	255
Department	Text	contains the participating student's department	255
Address (Residential or Company address)	Text	contains the participating student's residential address	255
Duration	Numeric	contains the amount of time a student studies in the university to attain his/her degree	255
School year	Numeric	contains the year a participating student is admitted in the polytechnic and the year enrolment for SIWES	255
SIWES Registration fees or School fees	Numeric	Contains a Boolean value to show if a participating student has paid the SIMS registration fee.	255
Annual school fees	Numeric	Contains a Boolean value to show if a participating student has paid his/her annual school fees.	255
Student Bank Name	Text	Contains a text value to collect participating student bank Name to process of training allowance	255
Student Account Number	Numeric	Contains a Boolean value to collect student bank Number to process of training allowance	255



**Fig. 2. System Development for user pre-authentication and post authentication**



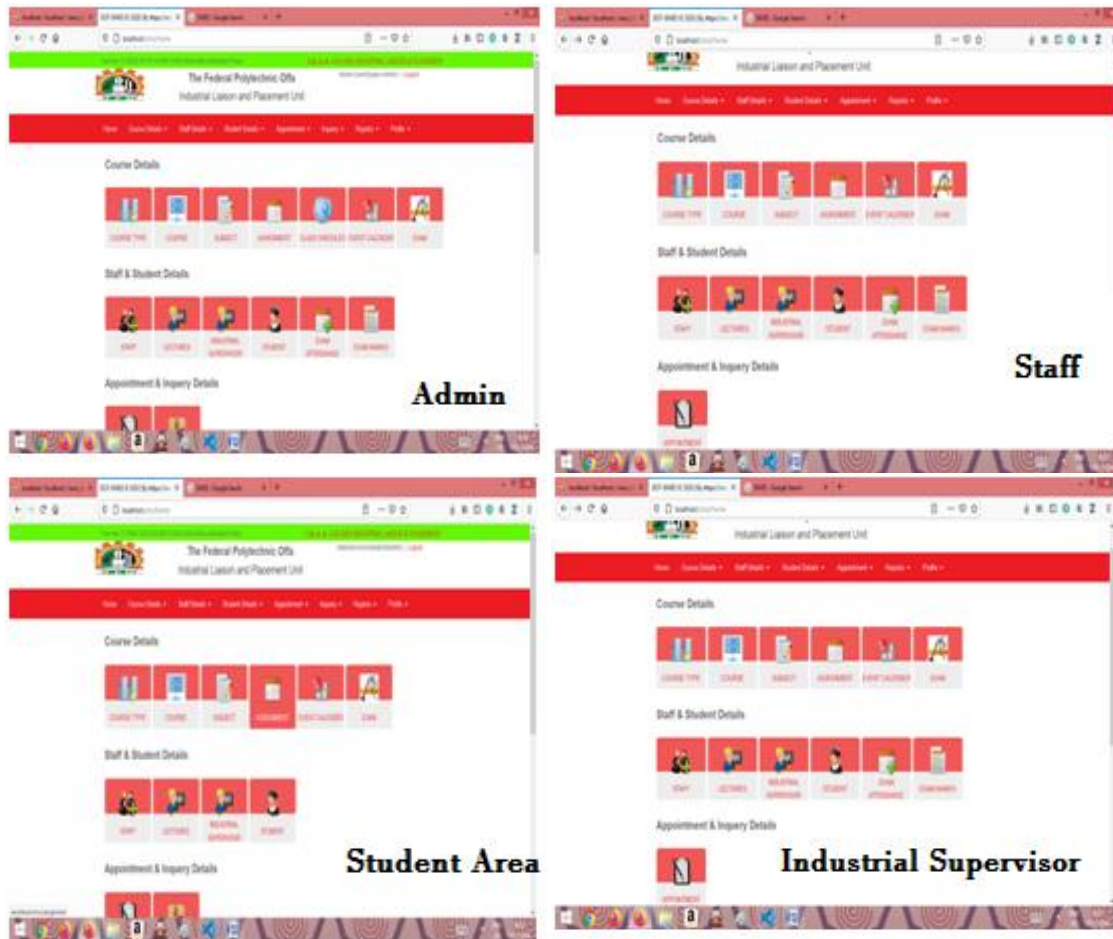


Fig. 3. Admin Portal area, staff portal area, student portal area and industrial portal

## 5. CONCLUSION AND RECOMMENDATION

In this research work, the digital collaborative framework (DCF) for Students' Industrial Work Experience Scheme and Sustainability in Federal Polytechnic Offa, Nigeria has been presented. The DCF established a new perspective for Industrial Training placement and monitoring by eliciting the participation of multiple stakeholders who can bring reform and transformation towards job skill acquisition and efficiency on students' IT performance. The DCF also allows a student to respond to field learning and understand the impact of IT on path of academic programme through monitoring. Therefore, these two concepts that define the DCF makes it more robust compared to existing manual processes. In future work, the researchers will strive to add more value by extend the frame work to other institutions in Nigeria.

Therefore, the study recommends the adoption and usage of DCF-SIWES solution for proper placement of students on SIWES. This will help to improve the Students' Industrial Work Experience Scheme, placement of IT students, thereby facilitate effective skill acquisition for participating students and reduce unemployment among the graduates.

## CONSENT

As per international standard or university standard, participant's written consent has been collected and preserved by the authors.

## ETHICAL APPROVAL

The consent for partnership was acknowledged and working in collaboration with head unit 'Liaising and Placement Unit, from the Federal Polytechnic Offa, and ethical clearance has been

received from the Directorate of Liaising and Placement Unit.

## ACKNOWLEDGEMENTS

The authors acknowledge the support of Nigerian Tertiary Education Trust Fund (TETFund) through its Institution Based Research Grant (Batch 5 RP Disbursement) that made the study possible.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Available: <https://www.journalajess.com/index.php/AJESS/article/view/30321>

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