Development of a Web-based Intelligent Career Guidance System for Pre-Tertiary Science Students in Nigeria

Alao Kazeem A.  
Department of Computer Science  
The Federal Polytechnic, Bida, Niger State, Nigeria
Bolarinwa Ismaila A.  
Department of Statistics  
The Federal Polytechnic, Bida Niger State Nigeria
Kuboye Bamidele M.  
Department of Computer Science  
The Federal University of Technology, Akure, Nigeria
Ibam Onwuka E.  
Department of Computer Science  
The Federal University of Technology, Akure, Nigeria

ABSTRACT
The traditional approach to career guidance is a manual method that is ineffective and inefficient. The electronic approach provides an effective and efficient career guidance. This research therefore developed a web-based intelligent career guidance system that assists pre-tertiary science students in Nigeria to independently choose a career path at anytime and anywhere with the use of computer system or mobile/smart phones as applicants seek admission into various fields of study in Nigerian Higher Institutions (Universities or Polytechnics). The intelligent system uses student-driven parameters such as favourite science subjects combination, career interest inventory analysis result, and intelligent quotient test result for career recommendation. The web-based intelligent system was designed and implemented with principle of a rule-based expert system using forward chaining algorithm, the client-side/interface pages (front-end) were designed using “Bootstrap 3” front-end framework that contains HTML5, CSS3 and JavaScript. For the back-end, XAMPP was used. The system was implemented and evaluated using 200 pre-tertiary science students; they took the career choice tests and provided their feedback for the evaluation of the system performance. The feedback shows that the recommended career by the system is 95% accurate and relevant, 70% satisfactory, and 80% adequacy of information on career guidance by the system.

Keywords  
Back-end, Career Guidance, Front-end, Intelligent System, Pre-tertiary.

1. INTRODUCTION
An artificial intelligence system is a computer program that functions the same way that a biological brain does, only that it functions in an electronic way instead of by activating neurons [12]. [6] defines artificial intelligence as the science and engineering of making intelligent machines, especially intelligent computer programs. Typical example of an artificial intelligence system is an Expert System (ES). Intelligent system can be referred to as any system with artificial intelligence. Intelligent systems are poised to fill a growing number of roles in today’s society in areas like factory automation, medical care, education, entertainment, visual inspection, character recognition, intelligent transportation, human identification using various biometric modalities. An Expert System is an interactive computer-based decision tool that uses both facts and heuristics in solving difficult decision making problems, based on knowledge acquired from an expert [2].Also, [10] said the programs that attempt to emulate the behavior of human experts are known as Expert System. Expert system is used in different sectors like, medicine, agriculture, mining, education, industry, accounting and engineering. Depending upon the use, it is designed for specific purpose, for instance, in medicine and agriculture it is used for disease diagnosis and drug prescription, in education for learning and career guidance purposes, in accounting and management expert system is used for sales forecasting. In education, intelligent systems are found to be versatile tools in career guidance and counseling, such a tool is an expert system. Expert system approach is useful to help human expert (career counselors), also as a verifiable and successful tool for the computerization and automation of the reasoning of human career counselor, by exploring the expert system features such as questioning ability, reasoning power, providing explanations, providing alternative solutions, and particularly the rule-based expert system that captures human knowledge using the IF—THEN rules in a rule-based knowledge base. Approaches to career path guidance and recommendation can be manual, which is known as human guidance and counseling, and electronic which is known as computer-based guidance and counseling. However, there are some limitations and challenges with manual approach. Some of the identified limitations/challenges of manual approach to career guidance and counseling are:

(i) Non-Availability: Non-availability of human career counselors in some secondary schools which results in students choosing wrong career.

(ii) Scarcity: Though human career counselors are found in some secondary schools, but the limited number or scarcity of full time human career counselors has made it difficult to cater for the large population of students in those schools.

(iii) Non-Accessibility: Non-accessibility to human career counselors at anytime and anywhere as a result of period of attendance to students by human career counselors, which is restricted to the working hours of the day, this makes it so difficult for students to frequently have contact with the human career counselors.

(iv) Professionalism: With time, human career counselor reasoning speed, competency and efficiency decreases, and with increase in number of tertiary institutions and the introduction of new fields of study in these institutions, the details provided by a human career counselor may not be sufficient to assist several admission seekers choose a field of study rightly.
(v) **Commitment:** Some human career counselors are not committed or diligent and can sometimes be unapproachable, also counselors are humans with their own emotions, personal responsibilities and pressures, therefore, the tendency of emotional eruption and absence from the office when needed is inevitable.

This research therefore provides an electronic approach, a web-based intelligent system, a form of expert system that works exactly like a human career counselor in reasoning, and the system provides a platform that assists and supports in the decision making process of pre-tertiary science students seeking admission into Nigerian tertiary institutions to independently choose a career path by interacting electronically with an online career counselor at anytime, anywhere and on any device (desktop, laptop, mobile phones, smart phones).

2. **REVIEW OF RELATED WORK**

A Decision Support/Expert System for Guiding Fresh Students in Selecting a Faculty in Comal University, Pakistan was developed by [8]. The rule based DSS was developed using CLIPS Language. The DSS/Expert System measured the student’s capabilities and abilities, and recommends suitable faculty/major based on the results of the module tests. The limitation is that it is a stand-alone and customized DSS/Expert System. Also, one criterion used for recommendation cannot give high data mined results. Also a Web-Based Career Guidance Information System for Pre- Tertiary Institutions Students in Nigeria was developed by [2].

A career quiz on interest/hobbies/skills was formulated and put in the database that was created using WAMP (Windows Apache MySQL PHP) server. The web-based career guidance system improved on the existing manual system, helps pre-tertiary students in Nigeria get a good understanding of themselves, and base on the quiz results, best career path was made. The limitation of the system is that it used just a criterion, which might not give high data mined results. Also [4] developed a system known as Career Master: A Decision Support System (DSS) for Guidance and Counselling in Nigeria. The system is composed of a database with students’ personal information, study test questions and answers used for the IQ assessments. The system was able to determine the students’ IQ strength which was used in conjunction with the counsellor’s advice, parent advice, and friend’s advice to recommend a suitable career path. The limitation is that it is a stand-alone system and can only be used by human counsellors; also students cannot decide independently on career choice as a result of parents’, friends’ advice that formed part of parameters used for recommendation. Also [10] observed that with today’s increasing number of colleges and courses, the details provided by human experts may not be fully sufficient to judge whether a college/course will suit for a particular student. They designed a customized, online Expert System for career guidance for higher secondary school students in India, for the selection of their undergraduate courses in various Colleges at the Pondicherry Engineering College, India. The system used jSoup parsing technique to acquire web pages information about Colleges/Courses at the Pondicherry Engineering College, India. The web pages information was used to develop a knowledge base, constructed using IF------THEN rules, the knowledge base is classified into two categories: the University admission requirements and the student’s preferences. Colleges/courses were recommended on the basis of the details provided by the students. The limitation of the Expert System is that it is a customized System, can only be used to recommend colleges/courses for admission seekers into Pondicherry Engineering College, India. The expert system also lack intelligence quotient test that measures students’ intellectual capabilities for compatible college/course recommendation. As observed by [9], shortage of human and time resources has led to the choice of unsuitable careers resulting in widespread poor performance at the work place. A stand-alone, customised career guidance using expert system approach was used by [9] to dispense career guidance to the youth in a cheap and quick process. They designed a model that was developed and implemented with Visual Studio and MS-ACCESS, the model consists of (personality analysis module and college entrance criteria module), the modules host the knowledge and rules that are based on Myers-Briggs Typology Indicator (MBTI) model. The limitation is that it is a stand-alone, customized Expert System, that cannot be used anytime, anywhere, and which can only be used to guide high school students in Kenya. The expert system lacks intelligence quotient test that measures students’ intellectual capabilities that are vital for recommending career path. A web-based career guidance system for secondary school students in Malaysia was developed by [5] to provide alternative and an improvement in the capacity of traditional method of conducting career guidance to students. Her system was developed with the information obtained from career guidance experts and guidance teachers; the information gathered was integrated and evaluated to create a knowledge base. A database of students’ profile and career test on student’s interest and personalities was created; the system was constructed and implemented using PHP, JavaScript and MySQL. The limitation is that it is a customized Expert System which can only be used to guide secondary school students in Malaysia. The expert system lacks intelligence quotient test that measures students’ intellectual capabilities that are vital for recommending career path. In the opinion of [11], students must be provided with rich guidance and counselling services, so that they can discover relevant courses where they stand better chance, not just to graduate as at when due, but to come out with better performance. A human counsellor-driven, stand-alone system for career guidance through admission procedures in Nigerian universities using artificial neural networks was developed by [11], to be used by human counsellor for career path recommendation to students. Their system used data from two federal universities in Nigeria through questionnaire that was served the final year students of these institutions, the system explored the O level, UTME and Post-UTME performances of the respondents, Multilayer Perceptron Topology was used for data arrangement, the system was implemented with Visual Basic. The limitation is that the system is stand-alone, that cannot be used anytime, anywhere, and can only be used by human counsellor for career path recommendation to students, and the system is not applicable to non-science departments. In today’s education environment, where it is very hard to choose career option in a right way, machine learning practices can provide significant contribution to users for opting the right education domain to shape their career [3]. A stand-alone decision support system for determining right education career choice was developed by [3] to support decision making process of students that want to shape their career in a right way. Their system has Career Advice Model (CAM) that was implemented with Java programming language. The CAM is based on machine learning techniques and rule based Decisions Support System, the CAM has the major components of an expert system (User Interface, Inference Engine, Knowledge Base). Myers Briggs
Type Indicator (MBTI) model was employed to capture and analyse the academic ability test and personality test. FUZZY LOGIC was used to generate the personality type of the student. The limitation was that it is a stand-alone system that cannot be used anytime, anywhere.

3. RESEARCH METHODOLOGY
The review and study of the existing related intelligent/expert systems in career guidance was investigated. A face-to-face interview was conducted with Career Masters in some secondary schools. Three student-driven parameters (Three Favourite Science Subjects Combination, Career Interest Inventory Analysis Result, Intelligent Quotient Test Result) for independent career path recommendation were considered. The data used in formulating the various career choice tests questions for this research was obtained by interviewing career counselors and adaptation of questions on career interests inventory and intelligent quotient.

For the Three Favourite Science Subjects Combination, the number of possible combinations from six basic science subjects (Mathematics, Physics, Chemistry, Biology, Agricultural Science, Geography) was obtained by using “Combination Formula”

\[
\binom{n}{r} = \frac{n!}{r!(n-r)!}
\]

where \( n = 6 \) and \( r = 3 \). Databases were created for all science-based courses, six basic science subjects, career interest inventory questions, and intelligent quotient test questions. Each favourite science subject combination was used to recommend compatible courses from the database of all science-based courses. The students were subjected to questions related to skills, interests, hobbies, talents, and with the answer provided by the students, a career interest inventory analysis result was obtained, which was used to deduce careers or courses that the students are naturally inclined to and comfortable with from the result of recommended courses from favourite science subject combination. A test of I, which is test of intelligent quotient (I. Q) on verbal reasoning, numerical reasoning, and logical reasoning was conducted, and the result was obtained by using Intelligent Quotient formula

\[
I = \frac{100M}{C}
\]

where \( M = \text{Mental Age} \) and \( C = \text{Chronological Age} \)

The intelligent quotient result was used to determine if a student is Highly Intelligent (I > 100), Averagely Intelligent (I = 100), and Intelligently Delayed (I < 100). The result obtained was then used to suggest and recommend compatible courses from the result of recommended courses by Career Interest Inventory Analysis Result.

4. SYSTEM DESIGN
The new system was designed based on the operational principle of rule-based expert system, which involves the use of computer intelligent systems, and electronic interaction with career counsellor via computer hardware and software on a client/server (web-based) system. An Expert System is composed of primarily these major components: knowledge base, working memory/database, inference engine, and user interface. Figure 1 below shows the typical Expert System Architecture.

(a) Knowledge Base: The knowledge base contains the domain knowledge useful for problem solving. In a rule-based expert system, the knowledge is represented as a set of rules. Each rule specifies a relation, recommendation, directive, strategy or heuristic [7]. The knowledge base contains the encoded/modelled expert human knowledge (expertise). The rules in the knowledge base are typically structured as IF------THEN construct, known as “production rule”, of the form: IF <antecedent> THEN <consequent>. The antecedent is the condition that must be satisfied. When the antecedent is satisfied, the rule is triggered/fired. The consequent is the action that is performed whenever the rule fires.

(b) Working Memory/Database: The database includes a set of facts used to match against the IF (condition) parts of rules stored in the knowledge base [7].

(c) Inference Engine: This is the main processing component of the expert system that is responsible for gathering information from the user. It seeks relationships from the knowledge base by interpreting, examining and evaluating the rules in the knowledge base to provide answers, predictions, suggestions from the rules in the knowledge base. When rules are examined by the inference engine, actions are executed if the information supplied by the user satisfies the conditions in the rules.

(d) User interface: The user interface is the means of communication between a user seeking a solution to the problem and an expert system. The communication should be as meaningful and friendly as possible [7]. This is the platform by which the user interacts with the expert system. A dialogue is conducted by the user interface between the user and the system.

4.1 Mathematical Model of the System
A student just finished senior secondary school at age \( t \) and needs a science based course of study to be filled in JAMB form. However, a career master considers: (three favourite science subjects, career interest inventory, and I.Q. test) to recommend a course of study for the student. With the application of set theory, we have domain Sets:

Student’s Age, \( t = \{15, 17, 18, 19, 20, \ldots , n\} \) . . . (3)

JAMB Science-based Courses, \( J = \{j_1, j_2, j_3, \ldots , j_k\} \) . . . (4)

Favourite Science Subjects, \( S = \{s_1, s_2, s_3\} \) . . . (5)

Career Interest, \( P = \{p : p = \text{Career Interest Result}\} \). . . (6)

Intelligent Quotient Test, \( Q = \{q : q = \frac{100M}{C}\} \). . . (7)

\( M = \text{Mental Age (Level of Intellectual Performance)} \) and 

\( C = \text{Chronological Age} \)

By applying the principle of “elements satisfying a condition” in set theory, each parameter/factor on the domain sets gives:
Step 1:
Recommended Compatible Courses from \( j \subseteq J \) by \( s \subseteq S \)

\[ X = S(x) = \{x_1, x_2, x_3, \ldots, x_i; i < k\} \ldots (8) \]

\[ \Rightarrow \]

(List of science-based courses filtered out from \( J = \{j_1, j_2, j_3, \ldots, j_k\} \) by \( S = \{s_1, s_2, s_3\} \))

\[ X \subseteq J \Rightarrow S(x) \subseteq J \]

Let \( J = \{j_1, j_2, j_3, \ldots, j_k\} \) = (List of all JAMB Science-based Courses) = \{Medicine and Surgery, Nursing and Nursing Science, Pharmacy, prosthesis and orthopaedic technology, biomedical technology, biomedical engineering, medical rehabilitation, public health technology, medical laboratory science, biochemistry, applied biochemistry, science laboratory technology, physics, engineering physics, physics with electronics, geography and geoscience, geography and regional planning, agriculture, agricultural engineering, agricultural and management engineering\)

Let \( S = \{s_1, s_2, s_3\} \ldots \) \( (9) \)

= (Physics, Chemistry, Biology)

= (Three favourite science subject selected by student)

Therefore, Recommended Compatible Courses from \( j \subseteq J \) by \( s \subseteq S \)

\[ X = S(x) = \{x_1, x_2, x_3, \ldots, x_i; i < k\} \ldots (10) \]

\[ \Rightarrow \]

(Medicine and Surgery, Nursing and Nursing Science, Pharmacy, prosthesis and orthopaedic technology, biomedical technology, biomedical engineering, medical rehabilitation, public health technology, medical laboratory science, biochemistry, applied biochemistry, science laboratory technology)

Step 2:
Recommended Compatible Courses from \( x \subseteq X \) by \( p \subseteq P \)

\[ Y = P(y) = \{y_1, y_2, y_3, \ldots, y_m; m < i\} \ldots (11) \]

\[ \Rightarrow \]

(List of science-based courses filtered out from \( X = S(x) = \{x_1, x_2, x_3, \ldots, x_i; i < k\} \) by \( P = \{p\} \))

\[ Y \subseteq X \Rightarrow \]

\[ P(y) \subseteq X \]

Let \( P = \{p\} = \) (Pure Medical)

= (Career Interest Inventory Result)

Therefore, Recommended Compatible Courses from \( x \subseteq X \) by \( p \subseteq P \)

\[ Y = P(y) = \{y_1, y_2, y_3, \ldots, y_m; m < i\} \ldots (12) \]

\[ \Rightarrow \]

(Medicine and Surgery, Nursing and Nursing Science, Pharmacy)

Step 3:
Recommended Compatible Courses from \( y \subseteq Y \) by \( q \subseteq Q \)

\[ Z = Q(z) = \{z_1, z_2, z_3, \ldots, z_n; n < m\} \ldots (13) \]

\[ \Rightarrow \]

(List of science-based courses filtered out from \( Y = P(y) = \{y_1, y_2, y_3, \ldots, y_m; m < i\} \) by \( Q = \{q\} \))

\[ Z \subseteq Y \Rightarrow \]

\[ Q(z) \subseteq Y \]

Let \( Q = \{q\} = \) (Intelligent Quotient Test Result)

Therefore, Recommended Compatible Courses from \( y \subseteq Y \) by \( q \subseteq Q \)

\[ Z = Q(z) = \{z_1, z_2, z_3, \ldots, z_n; n < m\} \ldots (14) \]

\[ \Rightarrow \]

(Nursing and Nursing Science)

The above mathematical model was converted to a data-driven, forward chaining algorithm.
4.2 Forward Chaining Algorithm
Forward chaining algorithm is a pattern matching algorithm that provides a generalized logical description of an implementation of functionality (inference engine) responsible for matching data or facts against productions (rules) in a production rule system. It is primarily used to determine which of the system’s rules should fire based on its data store. This involves assigning values to attributes, evaluating conditions, and checking to see if all the conditions in a rule are satisfied.

4.2.1 Forward Chaining Algorithm

General Format of Forward Chaining Algorithm
According to Griffin (1987) the general format of forward chaining algorithm is:

While values for attributes remain to be input:
- Read values and assign to attributes
- Evaluate conditions and fire rules whose conditions are satisfied
- Execute actions

Step 1  ̸⇒  Attributes: X₁, X₂, ..., Xₙ
Step 2  ̸⇒  Conditions: C₁, C₂, ..., Cₙ
Step 3  ̸⇒  Rules: R₁, R₂, ..., Rₙ
Step 4  ̸⇒  Actions: A₁, A₂, ..., Aₙ

4.3 System Architecture

Figure 2: Architecture of the Web-Based Intelligent Career Guidance System

KEY:
1. User supplies favourite subjects through the user interface.
2. The inference engine captures, evaluates and examines the supplied favourite subjects.
3. The inference engine matches the captured, evaluated and examined favourite subjects with the appropriate rule in the knowledge base.
4. The inference engine fires/triggers/executes the matched rule in the knowledge base.
5. The fired/triggered rule selects the relevant courses from all science courses in the working memory and also stores the selected relevant courses in the working memory.
6. User supplies appropriate career interest inventory through the user interface.
7. The inference engine captures, evaluates and examines the supplied career interest inventory.
8. The inference engine matches the captured, evaluated and examined career interest inventory with the appropriate rule in the knowledge base.
9. The inference engine fires/triggers/executes the matched rule in the knowledge base.
10. The fired/triggered rule selects the relevant courses from the stored relevant courses in (5) above and also stores the selected relevant courses in the working memory.
11. User supplies answers to intelligent quotient questions through the user interface, and result of intelligent quotient is calculated.
12. The inference engine captures, evaluates and examines the result of intelligent quotient.
13. The inference engine matches the captured, evaluated and examined result of intelligent quotient with the appropriate rule in the knowledge base.
14. The inference engine fires/triggers/executes the matched rule in the knowledge base.
15. The fired/triggered rule selects the relevant courses from the stored relevant courses in (10) above and also stores the selected relevant courses in the working memory.
16. The selected and stored relevant course(s) in (15) above is/are displayed to the user through the user’s interface.

4.4 Input Design
The input to the system from the client/user side is majorly the user’s actions and responses on the web pages of the system website. The actions and responses involve the user’s selecting the relevant and appropriate answers to questions on career choice tests on selection of favourite science subjects, career interest test, and Intelligent Quotient (I. Q) test.

4.5 Output Design
The output is what the user will see on the screen, it contains the outcome of the processed data/input. The output design is projected inform of interface which is interactive with the users, the interface is projected using the Hypertext Transfer Protocol (HTTP).

4.6 Storage Design
The system has a fully dynamic and functional database. The database was created using XAMPP and queried using MySQL. The Career Guidance System consists of eight databases with the table names: user_records Table, subjects Table, courses Table, career_interest_quiz Table, iq_questions Table, career_interest_test Table, iq_questions Table, subject_interest Table, and iq_questions Table.
The user_records table consists of the registration/login information about the users. The subjects Table consists of the six basic science subjects (Mathematics, Physics, Chemistry, Biology, Agricultural Science, Geography) studied in secondary schools. The courses Table consists of all science based courses studied in the universities. The career_interest_quiz Table consists of career interests inventory questions. The iq_questions table consists of intelligent quotient questions on verbal reasoning and numerical/logical reasoning. The universities table consists of all the universities in Nigeria. The recommendations table consists of the recommended course(s). The description Table consists of brief description on each of the science based course.

5. SYSTEM IMPLEMENTATION
The implementation was carried out on a system running Microsoft Windows 7 Ultimate platform/Microsoft Windows 8 platform. Being a responsive web application, the client-side/user/web interface pages were encoded and implemented using “Bootstrap 3” front-end framework for (cross-platform/responsive-web). The “Bootstrap 3” contains HTML5 (Hyper Text Markup Language), CSS3 (Cascade Style Sheet), and JavaScript. For the back-end, XAMPP was used as web server with support for PHP as a scripting language and MySQL for working memory functional database.

5.1 System Modules
The system is designed in various modules with various buttons and links to navigate through the entire system. The major operational modules of the system are explained below and as shown in appendix B.

The Home Page: The home page is the first page that a user sees when the application is launched as shown in figure 5 of appendix B. It contains brief information about the system, and consists mainly of Login button for existing user, Register button for new user, Learn more button to get further information about the system.

Registration Page: Access to the web-based career guidance system requires users’ authentication and authorization. Since users access the system remotely, therefore a built-in security system forces users to register and login first. To register, a user supplies the information via an html form as shown in figure 6 of appendix B.

Login Page: Existing or registered user can login by supplying valid username (e-mail/phone number) and password details into an html form and submitting it as shown in figure 7 of appendix B. The user will be logged on if the authentication is successful.

User Welcome Page: After a successful login, the welcome page shown in figure 8 of appendix B is displayed, requesting user’s response to attempt/re-attempt the career quiz. If the user selects ‘YES’ button, the career quiz session begins, if ‘NO’ button is selected, the system Main Menu in figure 18 of appendix B is displayed.

Favourite Science Subjects Combination Page: This page as shown in figure 9 of appendix B allows the user to select three favourite science subjects combination out of six basic science subjects studied in secondary school.

Career Interest Inventory Test Questions Page: This page as shown in figure 10 of appendix B allows user to select a particular career interest inventory out of many.

Intelligent Quotient Questions Pages: These pages as shown in figure 11 of appendix B allow user to undertake Intelligent Quotient Quiz and the assessment is based on verbal reasoning, numerical reasoning and logical reasoning.

6. RESULTS AND DISCUSSIONS
6.1 Output of the New System
These output pages as shown in figures 12 and 13 below are the final result of the recommended relevant courses based on the adopted three criteria or factors. A click on any of the recommended courses displays information on brief description about the course and O’Level subjects requirements for the course. Also, a click on the ‘YES’ button allows the user to re-attempt the career quiz, while a click on the ‘NO’ button takes the user to the feedback page in figure 14.
6.2 System Performance Evaluation
In order to evaluate the performance of the developed web-based intelligent career guidance system, the system was implemented with test bed for 200 users (students) as partly shown on figures 15 and 16 and asked them to provide their valuable feedback. The motive of the evaluation was to check:
(a) The accuracy and relevance of the recommended courses by the system to users’ level of performance in the career interests inventory test and intelligent quotient test.
(b) The level of users’ satisfactions on the recommended courses by system.
(c) The adequacy of valuable career guidance information provided by the system.
Figure 14 below shows the developed web-based intelligent career guidance system user’s feedback page.

![Figure 14: Web-Based Intelligent Career Guidance System User’s Feedback Page](image)

Figure 14: Web-Based Intelligent Career Guidance System User’s Feedback Page

6.3 Interpretation of Results
Table 1: Results obtained from users’ feedback

<table>
<thead>
<tr>
<th>FEEDBACK</th>
<th>YES</th>
<th>NO</th>
<th>YES (%)</th>
<th>NO (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCURACY AND RELEVANCE</td>
<td>190</td>
<td>10</td>
<td>95</td>
<td>5</td>
</tr>
<tr>
<td>SATISFACTION</td>
<td>140</td>
<td>60</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>ADEQUACY OF INFORMATION</td>
<td>160</td>
<td>40</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

It can be seen from the table 1 and figure 17, that the performance of the system as rated by the users (students) shows that the recommended courses by the system is 95% accurate and relevant, 70% level of satisfaction, and 80% adequacy of the information provided on career guidance by the web-based intelligent career guidance system, these results demonstrated the effectiveness and reliability of the web based career guidance system.
7. CONCLUSION
This research work has explored the challenges faced with the manual method of career guidance and the few available electronic career guidance systems. It has also provided solutions to some of the identified challenges by the development of a web-based intelligent career guidance system with the operational principle of a rule-based expert system, that provides a platform where students can independently choose a career path by interacting electronically with an online career counsellor at anytime, anywhere and on any device (desktop, laptop, mobile phones, smart phones), with the use of student-driven parameters like favourite science subjects combination, career interest inventory analysis result, and intelligent quotient test result for right career path recommendation.

The system was tested, implemented, and evaluated using a sample of 200 pre-tertiary science students; they registered and took the career choice test. The result of the system evaluation shows that the recommended courses by the system is 95% accurate and relevant, 70% level of satisfactions, and 80% adequacy of the information provided on career guidance by the web-based career guidance system.

8. RECOMMENDATIONS
Today, in our society, the importance of guidance and counseling with respect to career choices is often neglected, overlooked and undervalued. As a result of this, many students have fallen into the pitfall of choosing wrong careers, and this is responsible for many dropouts in our tertiary institutions. Therefore, the deployment of student-driven web-based intelligent career guidance system for pre-tertiary students is recommended to adequately assist and support in the decision making process of choosing a career as they seek admission and prepare to study in tertiary institutions, so that, students can have independent decision on choice of career, and discover relevant courses where they stand better chance not just to graduate as at when due, but to come out with better performance. Also, it is recommended that the level of computer literacy, particularly at the secondary school level, has to be stepped up if adequate utilization of the intelligent career guidance system is to be maximized.

Future enhancement of this research work could be carried out to incorporate non-science courses for the benefits of non-science pre-tertiary students and to accommodate more student-driven parameters such as personality analysis that describes those qualities that make up a person’s characters so as to obtain more data mined career path recommendation.

9. ACKNOWLEDGMENTS
Appreciation goes to Tertiary Education TrustFund (TETFUND), The Management of Federal Polytechnic, Bida, Niger State Nigeria, The Directorate of Research and Publication of The Federal Polytechnic, Bida, Niger State, Nigeria for the financial support received to carry out this research under the Institution Based Research (IBR).

10. REFERENCES
Fresh Students in Selecting a Faculty in Gomal University, Pakistan. Industrial Engineering Letters, Vol. 1, No. 4.


11. APPENDIX A

Figure 4: Flowchart of the Web-Based Intelligent Career Guidance System
12. APPENDIX B: SCREEN SHOTS OF THE WEB-BASED INTELLIGENT SYSTEM MODULES

Figure 5: The home page of the Web-Based Intelligent Career Guidance System

Figure 6: Sample of how a user fills in registration form
Figure 7: Sample of how a registered/existing user supplies login information

Figure 8: User welcome page
Figure 9: Sample of Favourite Science Subjects Combination Page

Figure 10: Sample of Career Interests Inventory Test Questions Page
Figure 11: Sample of Intelligent Quotient Test Questions (verbal reasoning) Page

Figure 18: Web-Based Intelligent Career Guidance System Main Menu Page