Evaluating the Status of Teaching the Most In-Demand Programming Languages in the Sudanese Higher Educational Institutes

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Abstract : This paper is monitoring and evaluating the status of teaching the most in-demand programming languages in the Sudanese Higher Educational Institutes in Khartoum State, Sudan from the instructors' point of view and/or perceptions. Moreover, the paper presented the roles and reasons of Teaching of the Most In-Demand Programming Languages, the challenges and issues faced by the instructors.

This paper used the descriptive statistics and theoretical analysis approaches for collecting and analysing the data. The investigation was based on qualitative and quantitative design using questionnaires and semi-structured interviews. The research questionnaires were distributed to four hundred seventy three (473) possible respondents over elven (11) selected Sudanese Higher Educational Institutes (SHEI) in Khartoum State with only three hundred twenty-seven (327) usable questionnaires, yielding a response rate of sixty eight percentages (68%). Questionnaires focused on the 12 (twelve measures elements of the Most In-Demand Programming Languages (MIDPL) namely: Java Script, Python, HTML, CSS, Java, SQL, NoSQL, C#, Rust, Perl, GO and Kotlin.

The results of the analysis of the variance between the twelve (12) independent variables of the (MIDPL) and the status of the (SHEI) showed that the measures of elements were not fully teach in the Sudanese Higher Educational Institutes in Khartoum state, Sudan. Thus, it is recommended that the elements must be fully incorporated in the design of the Most In-Demand Programming Languages (MIDPL in Sudanese Higher Educational Institutes (SHEI.)

KEYWORDS : Demand, Programming, language, Sudan, Education, Institutions, Information, Technology, C#, Python, HTML, Java, Script, CSS, SQL, NoSQL, Rust, Perl, Go, Kotlin.

INTRODUCTION

Programming languages has been revolutionizing the world since the advent of the first software or a code-based project. Programming or coding has opened numerous new ways and paved the way for innovation in almost every industry. Today, with various types of coding languages available and modern tech-powered tools to assist something new and innovative is always around the corner. Moreover, programming is one of the most demanded skills today when it comes to recruitments in not only the IT and software field but also in non-tech organizations. Almost everything that you run or browse on your smartphone or laptop is powered by some coding language. In real-life instances and scenarios as well, coding languages have entirely revolutionized the way people live and perform specific tasks. (*https://www.geeksforgeeks.org, 31 Jul, 2021)*

. Sudan is a developing/under-developed country with an economy that has been performing well in recent years, despite adverse security conditions. The Sudanese government has put in place a number of economic reforms to liberalize the economy, to attract direct foreign investment (FDI), to boost international trade and to encourage foreign exchange (Rennack, 2005). The government also promotes privatization and state-enterprise restructuring programmes.

Sudan, officially the Republic of the Sudan, is a country in Northeast Africa. It shares borders with the Central African Republic to the southwest, Chad to the west, Egypt to the north, Eritrea to the northeast, Ethiopia to the southeast, Libya to the northwest, South Sudan to the south and the Red Sea.

Sudan is a country with vast resources, although these are mainly unrealized. However, there is now a sense of expectation and openness, and a feeling that there are better things to come. Consequently, it is anticipated that plenty of opportunities for economic development will arise, ushering in an expansion of economic activities amidst growing competition within and outside the country.

Sudanese Higher Educational Institutions are public and private education systems inherited by the government after independence were designed more to provide civil servants and professionals to serve the colonial administration than to educate the Sudanese, the vision is to participate, through its role in the field of higher education and scientific research, in the creation of a unified, developed and advanced Sudanese Nation and aspires to be independent both academically and financially, elevated in the different aspects of knowledge and to link the programs and research they offers with the requirements of permanent development in Sudan.

Impact of Programming Languages in the Real Life:

- ***Websites and Mobile Apps:*** *In this era of digital transformation, almost everyone has access to the internet and smartphones. The use of the internet is all about browsing websites and several kinds of mobile apps. Today, these websites and mobile applications have brought every activity and task to the fingertip of the users. Want to reserve a hotel, order food, connect with friends, find jobs, and book a cab, watch favorite shows or movies? Coding has enabled everything.*

- ***Microsoft Windows:*** *Everybody is aware of the potential of Microsoft Windows that powers almost every desktop and laptop device today. The core foundation of Windows is powered by programming languages only.*
- ***Digital Assistants:*** *Digital assistants are making the lives of people easier today by allowing them to find everything with just voice commands. Siri, Alexa, Google Assistant are some fine examples of the top digital assistants in use today. These devices use the latest technologies like artificial intelligence (AI), machine learning, the internet of things (IoT), and cloud computing.*
- ***Exploring Space:*** *Programming has been playing a big part in exploring space since its inception. Today, NASA is using coding languages like Python to explore, discover, and know more about the Earth and universe. The innovative solutions created by NASA are powered by Python. Developers at space organizations use coding to create programs that can find the kind of materials present in space at different locations, predict radiation on the moon for the safety of astronauts, as well as collect petabytes of crucial data to understand things about the Earth.*
- ***Solving Business Challenge:*** *Businesses of all sizes today need some sort of software solution to make their processes easier. For instance, the use of software and tools like SAP, Microsoft Office, Google Chrome, Antivirus, Media Player, Photoshop, Skype, Any Desk, etc. is main stream today. Every soft-ware has its unique set of features and benefits to solve different challenges and improve the way people work. All these possibilities are the boon of coding languages. Chrome helps people to browse any website on the internet, Antivirus software helps in protecting computer systems from viruses, Skype helps in enabling internal and external communications, etc.*
- ***Transportation & Accommodation:*** *A few years ago, it was tough to get a cab at the right price and at the right time. But with the advent of transportation apps like Uber, things have completely changed. Today, there are several online services a available, using which people can quickly hire the vehicles of their choice at a reasonable price. Moreover, there are also functionalities to track the ride, time, find help when needed, and rate & review the journey. All these services are also enabled by programming languages. Traveling and finding the desired accommodation at the destinations was another challenge for tourists.*

Challenges in using Critical Thinking

- ***Multithreading*****:** *the ability of a program or an operating system to enable more than one user at a time without requiring multiple copies of the program running on the computer.*
- ***Closures:*** *the combination of a function bundled together (enclosed) with references to its surrounding state (the lexical environment)*
- ***NP-Complete:*** *The complexity class of decision problems for which answers can be checked for correctness, given a certificate, by an algorithm whose run time is polynomial in the size of the input (that is, it is NP) and no other NP problem is more than a polynomial factor harder*
- ***Security:*** *The protection of information systems against unauthorized access to or modification of information, whether in storage, processing or transit, and against the denial of service to authorized users, including those measures necessary to detect, document, and counter such threats.*
- ***Encryption:*** *is a way to conceal information by altering it so that it appears to be random data.*
- ***Identity management:*** *is all about managing the attributes related to the USER, group of users, or other identity that may require access from time to time.*
- ***Measuring Hardness':*** *hardness test is typically performed by pressing a specifically dimensioned and loaded object (indenter) into the surface of the material you are testing*

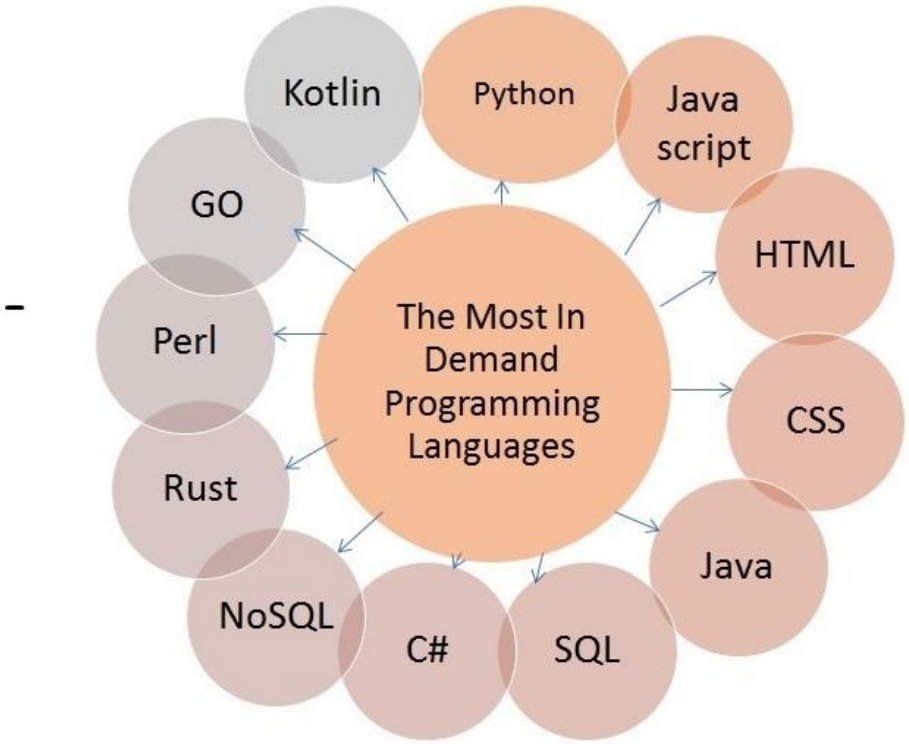
THE PROBLEM

Despite the growing literature in the area of the most in-demand programming languages in the Sudanese Higher Educational Institutes it is not known why the teaching of Most In-Demand Programming Languages in the Sudanese Higher Educational Institutes very shallow. Could it be a reflection of the fewer acknowledgements for the roles and importance of the in-demand programming languages adoption in the Sudanese Higher Educational Institutes?

*Based on the problem raised the following hypothesis was raised: "**Status of teaching most in-demand programming languages in the Sudanese Higher Educational Institutes influences by the adaptation of the programming languages Elements"**.*

RESEARCH MODEL

*The following research model (Figure:1) was developed based on the effect of the twelve independents variables of the Most in-demand programming languages (**MIDPL**) in the Sudanese Higher Educational Institutes (**SHEI**) identified in the literature in order to assist the study in answering the above question.*


Kotlin
Python
Java script
GO
HTML
Perl
The Most In Demand Programming Languages
CSS
Rust
Java
NoSQL
C#
SQL

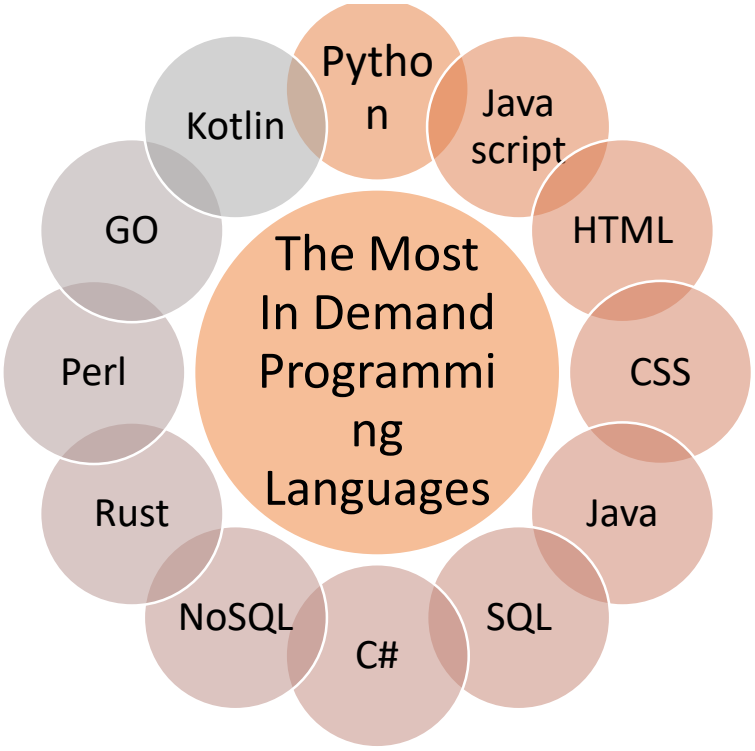

Kotlin
Python
Java script
GO
HTML
Perl
The Most In Demand Programming Languages
CSS
Rust
Java
NoSQL
C#
SQL

Figure: 1 MIDPL Research Model

LITERATURE REVIEW

This section provides a review of the conceptual literature which will inform the frameworks of the study. The literature review for the study includes the definition of the terminologies used in the study such as Programming Language, Java Script, Python, HTML, CSS, Java, SQL, NoSQL, C#, Rust, Perl, Go, Kotlin, Reliability Testing, Kaiser-Meyer-Olkin Test, these themes contributes to the foundation for this study.

- ***Programming languages:*** *Critical thinking an educational program that aimed at developing critical thinking but not* ***the correlative disposition to care about the dignity and worth of every person, he asserted,*** *"would be deficient and perhaps dangerous" (Ennis 1996: 172).*
- ***Java Script:*** *is the most common coding language in use today around the world. This is for a good reason: most web browsers utilize it and it's one of the easiest languages to learn. JavaScript requires almost no prior coding knowledge — once you start learning, you can practice and play with it immediately.*
- ***Python:*** *Python is a general-purpose programming language that empowers developers to use several different programming styles (i.e., functional, object-oriented, reflective, etc.) when creating programs. Several popular digital tools and platforms were developed with Python, including YouTube, Google Search and iRobot machines.*
- ***HTML*** *is a mark-up language, which means that it is responsible for formatting the appearance of information on a website. Essentially, HTML is used to describe web pages with ordinary text. It doesn't have the same functionality as other programming languages in this list and is limited to creating and structuring text on a site. Sections, headings, links and paragraphs are all part of the HTML domain.*
- ***CSS*** *or cascading style sheets is usually applied in conjunction with HTML and governs the site's appearance. While HTML organizes site text into chunks, CSS is responsible for determining the size, color and position of all page elements.*
- ***Java:*** *is a general use and object-oriented programming language. In object-oriented programming, developers create objects that encompass functions and data, which can then be used to provide structure for programs and applications.*
- ***SQL:*** *Structured Query Language is a language that allows programmers to query and manipulate databases. As a domain-specific language, it is designed mainly for managing data within an RDBMS (relational database management system). Put simply, SQL can locate and retrieve data from a database, as well as update, add or remove records.*
- ***NoSQL:*** *or Non-relational SQL, was created to improve SQL's scalability while retaining the other language's ease of use. SQL utilizes relational database/stream management systems that keep data in tables and allows users to manipulate and extract data. NoSQL databases, on the other hand, don't use tables and can be more useful than their predecessors for specific applications, such as storing data in a hierarchical network or supporting large-scale, cloud-based applications.*
- ***C#:*** *stylized as C Sharp, this language belongs to the object-oriented family of programming languages. C# was released in 2002 by Microsoft and stands today as a much-loved improvement on the C++ coding language.*
- ***Rust:*** *according to Stack Overflow, Rust has consistently ranked at the top of the most-loved programming languages, with 86% of users claiming that they were interested in continuing to develop with it.*
- ***Perl:*** *isn't the most commonly used language on the market. In fact, just 3.1 percent of developers used it in 2020, and it didn't even make Stack Overflow's commonly used languages list for 2019. However, we are recommending it for a reason. If you're already well into your career, learning Perl could significantly boost your earnings potential.*
- ***Go:*** *Developed at Google in 2007. Go is a top-tier programming language. What makes Go really shine is its efficiency; it is capable of executing several processes concurrently. And as far as programming languages go, it has an extensive "vocabulary," meaning it can display more information than other languages.*
- ***Kotlin:*** *is a cross-platform programming language designed to develop apps.* ***It is being used by more than 60% of android developers****. Kotlin beholds fourth place among the fastest-growing programming language on several renowned indices.*
- ***Reliability Testing:*** *Refers to the extent to which a test measures without error. It is highly related to test validity. Test reliability can be thought of as precision; the extent to which measurement occurs without error (John DeLuca, 2021).*
- ***Kaiser-Meyer-Olkin (KMO):*** *The Kaiser-Meyer-Olkin (KMO) Test is a measure of how suited your data is for Factor Analysis. The test measures sampling adequacy for each variable in the model and for the complete model. The statistic is a measure of the proportion of variance among variables that might be common variance. The lower the proportion, the more suited your data is to Factor Analysis (Yadolah Dodge, 2010).*

RESEARCH METHODOLOGY

Descriptive statistics technique was used to analyse the data. The questionnaire technique of data collection will be used. Staff from elven (11) Sudanese Higher Educational Institutes' (Future University, Bahary University, Almogetrabien University, Sudan International University, Medical Science University, Khartoum University, Al Nileen University, Nile University, Al-Hayat College, Royal College, and Nabta College) in Khartoum state conducted purposively to select the participant of the questionnaire. Analysis of variance (ANOVA) used to answer the research question. The sampling frame population for the paper was 600 persons. Even though 473 questionnaires were distributed to the participants, only 327 questionnaires were successfully collected. Of the 327 (69%) questionnaires that were returned successfully only 173 (53%) copies were completely answered. The remaining of 154 questionnaires could not be included in the study due to incomplete data or poor responses.

RESULTS AND DISCUSSIONS

Respondents' Demographic Information

This part mainly presents the frequency distributions of demographics sample, which include Gender, Age, Nationality, Education level, Work experience, and Current Position in the Institute (see Table 1.1). The survey revealed the following demographic information about the respondents:

Table 1.1: Overall Demographic Statistics for Staff

Category	Response	Frequency	Percentage
Gender	Male	131	76 %
	Female	42	24 %
Age	21–35	73	42 %
	36–50	55	32 %
	Above 51	45	26 %
Nationality	Sudanese	172	99 %
	Other	1	1 %
Education Level	Diploma	10	6 %
	Bachelor's Degree	30	17 %
	Master's Degree	93	54 %
	PhD	37	21 %
	Others	3	2 %
Working Years in the institutes	1–2 Years	34	20 %
	3–5 Years	76	44 %
	>6 Years	63	36 %
Current Position in the institutes	Lab Assistant	22	13 %
	Teaching Assistant	57	33 %
	Lecturer	81	47 %
	Assistant Professor	6	3 %
	Associate Professor	4	2 %
	Other	3	2 %

Bartlett's Test of Sphericity

In Bartlett's Test of Sphericity, the significance value is p< 0.05 (Bartlett, 1937). In the case of this study, all the Bartlett's Test of Sphericity values were significant, that is p< 0.05, further confirming that these data are suitable for Factor Analysis (Table 1.2).

Table 1.2: KMO and Bartlett's Test

Construct's	KMO	Bartlett's Test of Sphericity
Java Script	.755	.000
Python	.669	.000
HTML	.839	.000
CSS	.725	.000
Java	.743	.000
SQL	.714	.000
NoSQL	.685	.000
C#	.725	.000
Rust	.793	.000
Per	.759	.000
Go	.750	.000
Kotlin	.782	.000

Multiple Regression Analysis

The purpose of multiple regression analysis is to help the researcher understand the association between more than two quantitative variables. In order to identify the association of the independent and dependent variables, multiple regression analysis was carried out. The regression equation is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_k + \varepsilon$$

Where Y is the dependent variable, X1, X2,… Xk are the k independent variables, ε is the error term, and β_0, β_1, β_2,…, β_k are the regression coefficients.

There are four principal assumptions which justify the use of regression analysis for the purpose of prediction: Linearity of the relationship between dependent and independent variables; Independence of the errors (no serial correlation); Multicollinearity and Normality of the error distribution (Field, 2005).

Table1.3: Results of Regression Model Analysis between Independent and Dependent Variables.

Variable	B	Std. Error	Beta	T	Sig.	VIF
Constant	*2.58E-016*	*.055*		*.000*	*1.000*	
Java Script	*.335*	*.059*	*.335*	*5.718*	*.000*	*1.113*
Python	*-.003*	*.061*	*-.003*	*.047*	*.962*	*1.293*
HTML	*.221*	*.058*	*.221*	*3.799*	*.000*	*1.199*
CSS	*-.139*	*.059*	*-.139*	*-2.349*	*.020*	*1.106*
Rust	*.075*	*.057*	*.075*	*1.307*	*.192*	*1.163*
SQL	*-.011*	*.057*	*-.011*	*-.193*	*.847*	*1.037*
C#	*.105*	*.062*	*.105*	*1.687*	*.029*	*1.249*
NoSQL	*.071*	*.065*	*.071*	*1.092*	*.276*	*1.365*
Java	*.321*	*.069*	*.342*	*5.7818*	*.000*	*1.212*
Perl	*-.004*	*.067*	*-.004*	*-.047*	*.982*	*1.213*
Go	*.231*	*.068*	*.244*	*3.819*	*.000*	*1.199*
Kotlin	*.087*	*.088*	*.081*	*1.292*	*.276*	*1.465*

(Table 1.3) shows the results of multiple regression analysis between Java Script, Python, HTML, CSS, Rust, SQL, C#, NoSQL , Java, Perl, Go, Kotlin and perceived teaching of Most in Demand Programming Languages in Sudanese Higher Educational Institutes'. The adjusted squared multiple correlation coefficient (adjusted R2) clearly explains 22% of the variance associated with the perceived teaching of Most in Demand Programming Language in Sudanese Higher Educational Institutes', (see Table 1.4). The F statistic is also significant (F = 8.331) (see also Table 1.4), which confirms that not all the variables make a significant contribution to fit into regression model. Four independent variables, namely Java Script, HTML, C# and Java, were found to be significantly associated with the perceived teaching of Most in Demand Programming Languages in Sudanese Higher Educational Institutes'.

As can be seen in (Table 1.3), the perceived teaching depends on only Java Script, HTML, C# and Java. The term 'Multicollinearity' has been coined to express the situation where the independent variables are higher associated with each other. The last column in (Table 1.3) shows that the highest VIF (Variance Inflation Factor) value is 1.465 which is below 5 and therefore there is no problem of Multicollinearity (Hair et al., 2006). Thus the predictor variables can be considered to be independent from each other.

Standard multiple regression can only accurately guess the relationship between dependent and independent variables if the relationships are linear in nature. Scatter plots are useful for showing relations between dependent and independent variables. The simple scatter plot was used to show a one-plot variable as a function of another. The residual plot dots were randomly distributed in some of samples of variables, thus sample plots reveals a linear relationship between the dependent variable and some independent variables, indicating that a linear regression model might be appropriate.

In (Table 1.4), the p-value is less than 0.001; therefore perceived teaching depends on at least one of the predictors. The R-squared value is 0.223, which means 22% of the variation in perceived teaching can be explain by all 12 predictors.

Table 1.4: ANOVA Table

Source	*Sum of Squares*	*Df*	*Mean Square*	*F*	*Sig.*
Regression	*044.542*	*007*	*5.645*	*8.331*	*.000(a)*
Residual	*203.458*	*248*	*.723*		
Total	*248.000*	*255*			

R2= .223, F = 8.331

The Kolmogorov-Smirnov test of normality in (Table. 4.34) shows a p-value of 0.012, which is more than 0.01, thus at 1% level the error terms can be considered normal. Furthermore, the Skewness value for the error terms was – 0.390, which is between ± 1, thus the error terms can be assumed to be distributed symmetrically.

Table 1.5 Tests of Normality

	Kolmogorov-Smirnov(a)			*Shapiro-Wilk*		
	Statistic	*df*	*Sig.*	*Statistic*	*df*	*Sig.*
Unstandardized Residual	*.063*	*268*	*.012*	*.979*	*268*	*.001*

FINDINGS

In conclusion, the results generated from the quantitative data analysis were both robust and statistically significant, leading the researcher to conclude that Java Script, , HTML, , Rust, , C#, NoSQL , Java, Perl, Go, Kotlin were supported the hypothesis, but Python, CSS, SQL, and SQL not supported and should be rejected.

The findings from this study revealed that key among the challenges associated with the perceived teaching of information seeking there is lack of Python, CSS, SQL. Furthermore, Java Script, , HTML, , Rust, , C#, NoSQL , Java, Perl, Go and Kotlin were among the key strategies which the respondents felt should be put in place to improve perceived teaching of most in demand programming language in the Sudanese higher educational institutes.

CONCLUSIONS AND RECOMMENDATIONS

Programming languages elements offer very powerful instruments to bring higher performance for teaching most in demand programming language. This research paper explore the experience resulting from these attempts worldwide, and implying the same practice in growth of teaching most in demand programming language in the Sudanese Higher Educational Institutes with a focus on the potential role of programming languages to enhance effectiveness, efficiency, and management of overall Sudanese's activities. The findings from this study should enable top management in the Sudanese Higher Educational Institutes to implement proactive approaches to improve perceived teaching programming language in order to improve the performance of teaching programming languages techniques.

*The Limitations of this study is the participant of our questionnaire survey conducted within a specific Sudanese Higher Educational Institutes or participants, the results of the study therefore may not be generalized to all other Sudanese Higher Educational Institutes (**SHEI**), the study was conducted in only specific Sudanese Higher Educational Institutes at (Khartoum State), the results may not be more accurate to all other Sudanese Educational Institutes.*

*Challenges for teaching most in demand programming languages in the Sudanese Higher Educational Institutes (**SHEI** includes lack of teaching Python, CSS, SQL and Perl in term of teaching most in demand programming languages.*

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