

Cloud Computing Accessibility Evaluation Tool: a tool for assessing level of ICT Integration in Education

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ABSTRACT: Advancements in technology have somewhat frequently had an impact on industrial development, hence affecting even the most traditional systems like education. Cloud Computing is one of the global technology development and its implementation in education can be an effective way to solve existing problems and achieve educational objectives at minimal cost. Governments today are still facing challenges in the provision of quality education to learners using Information and Communication technologies. However, though the application of an Integrated cloud computing environment model can be used as a pathway towards achieving accessible Information Communication Technology in education, there is still a need for a tool that can be used to assess the level of accessibility of ICT Integration in schools to inform areas which need to be improved for optimum accessibility. This paper assesses the metrics, parameters and sub parameters that can be used to develop the Cloud Computing Accessibility Evaluation (CCAET) tool. Governments and other stakeholders need to assess the level of accessibility of Information Communication Technology Integration in schools before investing in the integration process. The purpose of this paper was to develop a Cloud Computing Accessibility Evaluation Tool for assessing the level of accessibility of ICT Integration in education.

KEYWORDS: Cloud Computing Environment; ICT Integration; Accessibility; Cloud Computing Accessibility Evaluation Tool

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I. INTRODUCTION

Technology advancements have quite often impacted on industry development, hence affecting even the most systems like education. Cloud computing is one of the emerging global trends in ICT development and its implementation in education can be an effective way to solve existing problems and achieve educational objectives at minimal cost [1]. [2] [3] ICT provides the suitable platform to universities and colleges for smooth running of educational activities and appropriate research. With Cloud Computing, organizations with innovative ideas for new application services do not need to make large capital investments in hardware and software infrastructures [4].

The application of Cloud Computing in education not only relieves educational institutions from the burden of handling complex IT infrastructure, their management as well as maintenance activities, but also leads to substantial cost savings [3]. The Cloud thus promises to deliver accessible, reliable and flexible computing solutions to the education sector and enable it to compete more effectively with other bigger organizations [5].

Cloud computing can reduce the effort of acquiring and using these resources by providing technology that offers better services with minimal cost implications [6]. The application of an Integrated cloud computing environment model (ICCEM), which is a mix of ICT technologies, cloud technologies and human capacity training for managing ICT integration can be used as a pathway towards achieving accessible ICT Integration in education [6].

II. STATEMENT OF THE PROBLEM

Governments today are still facing challenges in provision of quality education to learners using ICTs. The incorporation of ICT in education can be used by governments and institutions to achieve quality education in schools. To actualize ICT integration into education, Governments and other stakeholders have usually undertaken the initiative of providing hardware's loaded with software's to schools.

However, they are still facing challenges in providing education as ICT Integration in education requires establishment of infrastructure, acquisition of software and hardware technologies and their recurrent configuration, management, updating and provision of technical professional support. In addition the cost that comes with acquisition, maintenance of hardware and software, as well as the development of human capacity skills makes ICT integration in education not accessible to users. The purpose of this study was to develop a Cloud Computing Accessibility Evaluation Tool (CCAET) for assessing the accessibility level of ICT Integration in education.

III. OBJECTIVES OF CLOUD COMPUTING ACCESSIBILITY EVALUATION TOOL

The main objectives of the cloud computing accessibility evaluation tool are:

- i. Allow cloud computing accessibility metrics, their parameters and associated sub parameters to be determined
- ii. Enable respondents to give their feedback regardless of their geographical locations
- iii. Display results to respondents showing level of cloud computing environment accessibility based on various metrics

IV. METHODOLOGY

Fig 1 shows the steps followed in developing the tool. The study adopted design science research approach [5]. This approach was used to perform a background research, collect data inform of requirements and design the cloud computing accessibility evaluation tool.

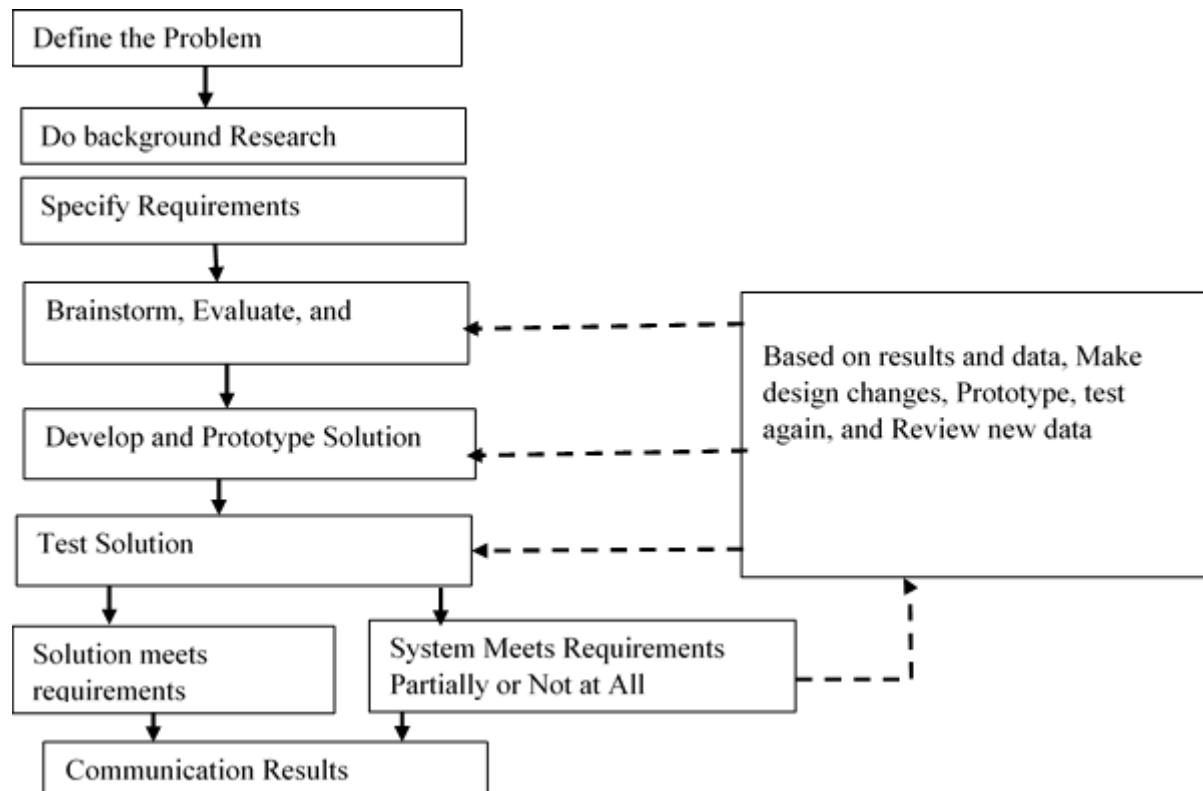


Fig. 1. The Design science design model [5]

The study used the data collected about ICT technologies, Cloud technologies and Human capacity that manages the ICT technologies and used them as the metrics of measure. It also identified the parameters that gave specific level of each parameter as well as their sub-parameters. The entire development procedure for the system was based on Incremental Model of software development. The system was broken down into modules

or subtasks. During the initial module development, an initial version (first increment) of the system was developed. The subsequent modules were then built on the initial version with incorporation of finer details of the functionalities of the system until the complete and perfect system was achieved.

V. METRICS FOR CLOUD COMPUTING ACCESSIBILITY EVALUATION TOOL

Table 1, summarizes of the metrics for developing the cloud computing accessibility evaluation tool. Cloud Computing Accessibility Evaluation Tool (CCAET) is to be used in assessing the accessibility level of Cloud Computing Environment towards ICT integration in education. The tool is web-based and it uses several metrics drawn from the study.

Table 1: Metrics of the tool

Metric	Associated weight
Human Capacity(HC)	0.1599
ICT Integration Technologies (ICT)	0.2399
Cloud Computing Technologies (CC)	0.2399
Internet (I)	0.3603

Accessibility Equation:

$$\text{Accessibility} = \text{HC} (.1599) + \text{ICT} (.2399) + \text{I} (.3603) + \text{CC} (.2399) = 1.00$$

Where CC is Cloud Computing Technology, HC is ICT Human Capacity, ICT represents ICT Integration Technologies while I is for the Internet

Accessibility level can be measured in continuum scale starting from “no” accessibility to maximum accessibility. Taking the case of no accessibility to be zero (0) and maximum to be one (1) and assuming that each variables is either there (available) or not, accessibility can thus be modeled as either 1 or 0.

The zero accessibility, HC=ICT=I= CC = 0

Therefore Accessibility = 0 +0+0 + 0 = 0

This implies that there is no ICT integration taking place in schools due to lack of technologies and human capacity that can manage the integration process in education. This is considered a minima case of (0).

However for the case of minima case:

The Maxima case, when HC=ICT= CC=I=1.0, then

$$\text{Maximum Accessibility} = 1(.1599) + 1 (.2399) + 1 (.3603) = 0.1599 + .2399 + .2399 + .3603 = 1$$

This implies that when Human capacity, ICT integration technologies, cloud computing technologies and Internet are in place, then there is maxima accessibility. However, when any metric varies, the accessibility level towards ICT integration in primary education. This can be expressed as a percentage on a continuum scale (0-100%)

These metrics were used in the design of a cloud computing environment accessibility evaluation tool (CCAET). The accessibility level will vary from one school to another depending on the availability of human capacity skills, ICT integration technologies available, presence of Internet connection (determined by speed) and cloud computing technologies in use.

VI. ARCHITECTURAL DESIGN OF CCAET

The architectural design of the CCEAT showing the components is as in Fig.2. It shows how functional decomposition is used to decompose large systems into subsystems with some have shared functions or services.

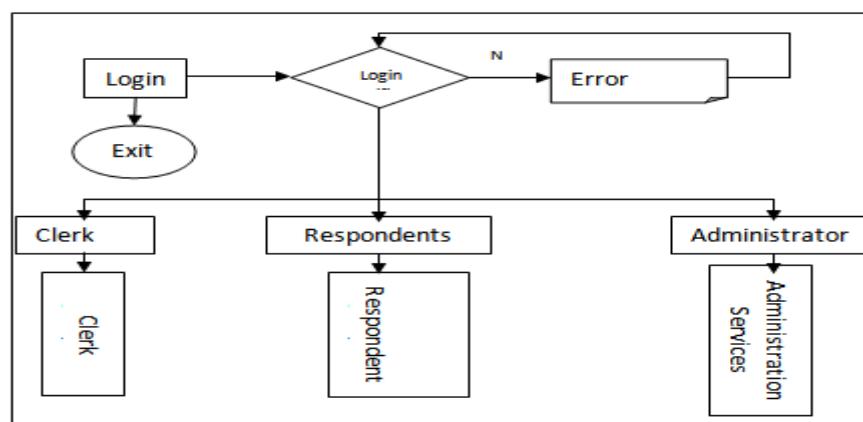


Fig. 2. Architectural Design

VII. WORKING OF THE CCEAT

The cloud computing evaluation accessibility tool is used to assess the level of cloud computing in ICT integration in education. The incorporation of cloud computing can be a cost effective way of delivering quality education in schools. The operation of the tool is as illustrated with the screen shots. The operation of this tool is explained below using the screen shots from the tool.

The Metrics Window of the CCEAT

The Metric window allows the user to enter new metric to the tool and update existing metrics. Fig. 4 summarizes the metrics window of the tool.

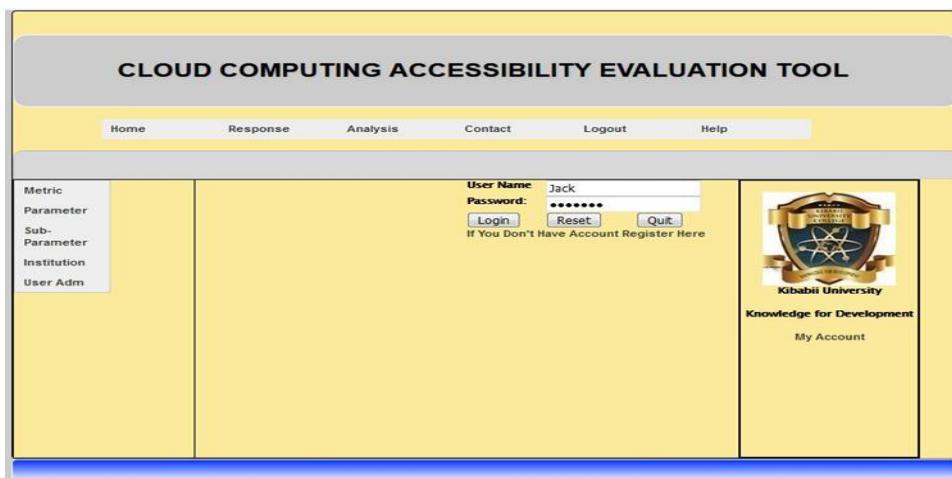


Fig.4. Metric Window

Parameter Window

Another important submenu is Parameter that enables user to design parameters associated on each metric that will be used to measure each metric. Fig.5 shows the parameter window.

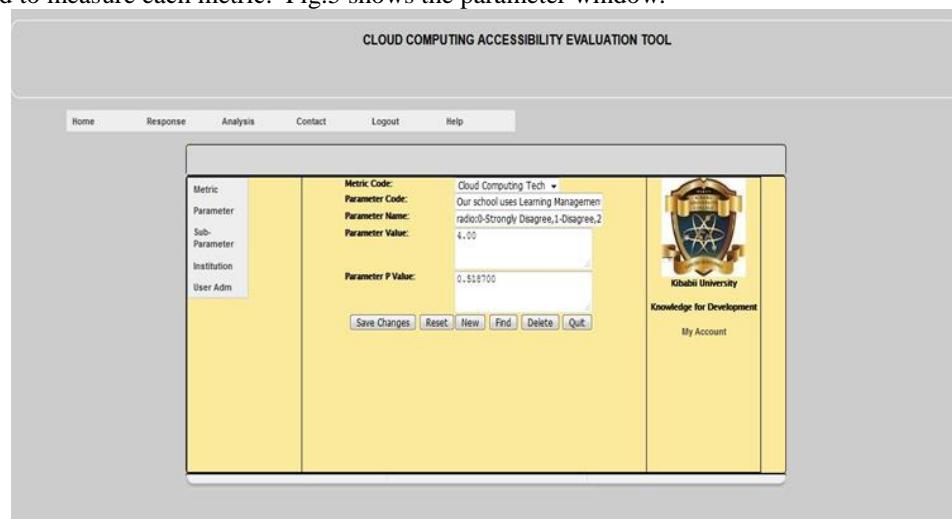


Fig.5. Parameter Window

Each parameter is associated with a given metric. Metric code is required that uniquely identify the metric as defined in Figure 4.

Sub Parameter Window

Another important sub menu is the sub parameter window. This window provides a way that the user will be able to capture sub parameters associated with each parameter as in Fig.6.



Fig.6. Sub Parameter Window

Institutional Menu

Institution menu is another important functionality offered by the system as in Fig.7. This submenu enables users to capture all the details about the school where the level of cloud computing accessibility towards ICT integration is to be measured.

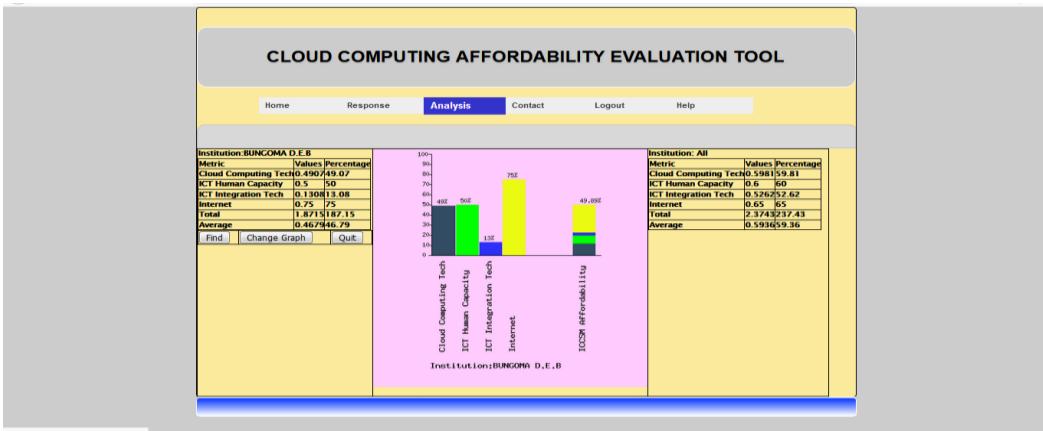
Metric	Response Code:	RSP/0006
Parameter	Institution:	BUMILA PRIMARY
Sub-Parameter	Metric:	All
Cloud Computing Tech	Computing Power (IaaS)	<input checked="" type="checkbox"/> Cloud Processing <input type="checkbox"/> Local Computers for Processing
	Processor Type	<input checked="" type="checkbox"/> Google Drive <input checked="" type="checkbox"/> Hard Disk <input type="checkbox"/> CDs <input type="checkbox"/> Flash Disks
	Storage	<input type="radio"/> Strongly Disagree <input type="radio"/> Disagree <input type="radio"/> Neutral <input type="radio"/> Agree <input type="radio"/> Strongly Agree
ICT Human Capacity	Our school uses Learning Management System	<input type="radio"/> Set Up a New Computer <input type="radio"/> Check Set Up of existing Computers
	Basic Hardware Skills	<input checked="" type="checkbox"/> Use of anti-glare Glass on monitors <input checked="" type="checkbox"/> Care of Hardware and Software <input type="checkbox"/> Use of protective keyboard covers <input type="checkbox"/> Safe Disposal of Equipments <input type="checkbox"/> Best practice when using ICT equipments <input checked="" type="checkbox"/> Effect of e-waste on environmental
	Green Computing Skills (Select Skills you have been Trained)	<input type="radio"/> There is enough time to Develop ICT skills and Knowledge <input type="radio"/> There is enough Training
ICT Integration	Technical Training Skills	<input type="radio"/> Strongly
	Our School always use laptops and computers in	<input type="radio"/> Strongly

Fig. 7. Institution Window

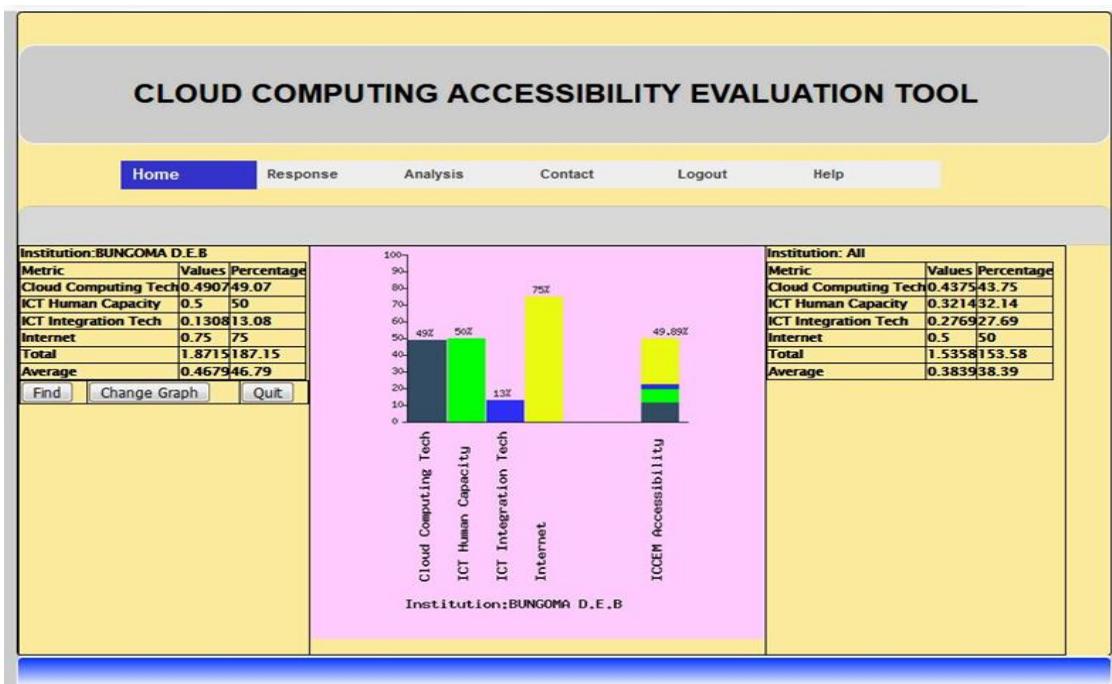
In this window, a user is expected to save response for the feedback to be registered. A user is provided a question that requires responses from the respondents. Some response may require one option while others may require multiple responses.

The Analysis Window

The analysis option presents the user with analysis report window that will allow users to obtain reports on analyzed response as in Fig.8.

**Fig.8.** Analysis Window

The analysis window shows the actual figures of consolidated metrics value and the average. It also shows a graphical representation of metrics values for a given school Fig.9 as well as for all schools in the system Fig. 8.

**Fig.9.** All Institutions

VIII. CONCLUSION

The Cloud Computing Accessibility Evaluation Tool developed gives a clear assessment of the level of accessibility of ICT integration in the schools. It can also be used to analyze the accessibility of all schools in a region by providing an overall percentage of accessibility. A level of 100% implies that there is the optimum accessibility to ICT integration in education. A level of 0 (zero) implies that there are no ICT technologies, cloud technologies and ICT human capacity in the organization. This tool can therefore be used to provide direction to the areas that require support so as to achieve a high level of accessibility during ICT integration in education that is cost effective for the government or institution.

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