A Framework for Development of Transcript Evaluation and Harmonization System in Cross-Border Education

Emadomi Moses Igbape, Nelson Okooza and Goddidit Esiro Enoyoze,

Abstract— **Following recent trends in international education, collaboration and globalization, there has been high mobility of academic staff, students and professionals across nationalities. Consequently, adhering to Quality Assurance (QA) best practices and standards in cross-border education and modalities for harmonizing certificates have continued to draw concern from government, industry and other stake-holders in international education. Interpreting and evaluating academic transcripts from various higher institutions across different nationalities pose serious challenges as a result of the diversities in grading systems of various nationalities. This absence of regional or global uniform grading system has created a gap in the interpretation of international transcripts and certificates. This necessitated the development of a viable framework for transcript evaluation system that is a resource to international credentials evaluation bodies. This paper has presented a Data-centric architectural framework for the development of a generic application for transcripts interpretation, evaluation and harmonization for cross-border higher education.**

***Index Terms*—Globalization, Internationalization, Cross-border higher education, Grading system, Transcripts harmonization, Architectural framework, Data Visualization. Data-centric architecture**

I. Introduction

In recent years, two trending issues have emerged that have serious implication for global economy and education. (i) Globalization, which is the worldwide effort and interaction of the public and private sector toward economic, financial, communication, cultural etc. integration through allowing and easing the cross-border movement and transfer of people, capital, data, goods and services. Globalization is required to ensure economic growth as well as to tackle the increasing global challenges and threats mankind is facing, such as the pollution of air and oceans, e.g. through micro plastics and the threat of global climate change [1]. This is mainly a function of the ability of the nations to share and exchange human capital resources. No nation can develop beyond the quality of its available human resources. (ii) Internationalization can be interpreted as the efforts of companies to do business in one or more foreign countries. This can include activities such as the sourcing, producing and selling materials, components, goods and services. Companies internationalize by entering into arm-length agreements with businesses abroad, by creating joint-ventures with other foreign strategic or financial investors or with local partners to conduct business jointly in one or more countries, or by setting up own subsidiaries, e.g. procurement or sales offices, or operational sites through foreign direct investment [1].

In the recent past, especially since the mid 1980s, there has been high mobility of students, academic staff and professionals in quest of better standards in the face of internationalization and globalization, which gave rise to new delivery methods and cross-border education providers. [2]. It is noted that the extent to which the wealth creation and economic development benefits of globalization can be achieved and the success of internationalization are largely dependent on the quality of human capital in circulation globally. It is a known fact that the quality of human resources in a nation is a function of the quality of its education system [3].

Furthermore, the lack of comprehensive framework for coordinating various initiatives at international levels, together with diversities and unevenness of the QA and accreditation systems at the national levels, create gaps in the QA of cross-border education [2].

By implication, the caliber of students, academia, and professionals migrating from one nation to another depends on the quality of the education system of that nation. One major issue is the harmonization of certificates and transcripts from such immigrants. Although other factors such as course content, mode of delivery, learning facilities and quality of teaching contribute immensely to the quality of graduates, classification of degrees and certificates is one major obvious yardstick for determining or rating the quality of certificates. This classification process is hinged on grading system in use by the relevant education authorities or regulatory bodies in the different nationalities. There is therefore the tendency to misinterpret certificates or transcripts from other institutions in a different nationality.

A rather common practice is for the international certificates evaluation agency to communicate with the authoring institution via surface or emails for clarification on the grading system or the exact implication of the grading scale. More often than not, some mails are either not received by the institutions, or received but not attended to promptly, or that responses exceed deadlines. In any of the instances, the purpose for which the transcript or certificate requires verification can be defeated.

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It is of the view that it amounts to a herculean task trying to unify grading systems globally. This is because the education systems of different nationalities are so diverse because of cultural, religious, economic and political diversities. However, there are numerous available online and mail enquiries, [4]. [5], by international credentials evaluation bodies, cross-border students and professionals as well as industries attest to the fact that there is credentials evaluation impasse in cross-border education.

This work presents a technically feasible framework for creating a platform that can translate the content of a transcript and interpret it in the operational grading scale and classification of the recipient institution or university. The paper has examined various grading systems of selected nationalities and approached its architecture from data visualization perspective, which guaranteed a clearer understanding and basis for comparing the different grading systems and fair rating of certificates and transcripts from other nationalities. This approach serves as a faster and more accurate alternative to mails enquiries, and provides an architectural framework for the development of a system for evaluating, interpreting and harmonizing international certificates and transcripts.

The architectural framework provided in this work shows that it is technically feasible to translate a transcript from one grading system to another when approached from data visualization perspective.

II. BACKGROUND TO THE STUDY

A. Grading Systems

Grading in education is the process of applying standardized measurements of varying levels of achievement in a course. ... The Grade Point Average (GPA) is calculated by taking the number of grade points a student earned in a given period of time. Since the advent of course system of education in tertiary institutions world-over, Cumulative Point Average (CGPA) has been in use as an Assessment Instrument instead of Cumulative Weighted Average Mark (CWAM). Consequently, mapping of percentage marks into an n-grade points system which is required to generate the much needed CGPA has become necessary. Countless methods of mapping have been witnessed across different tertiary institutions. There are many opinions about grading systems. Every training institution that is required to assess its trainees has its own format of grading system since a grading system is a platform for the application of Assessment Instruments [6]. In many countries, the higher education regulatory bodies take responsibility for setting up grading systems and monitory compliance to ensure that standards are not compromised. In Nigeria for instance, Nigerian Universities Commission (NUC) regulates grading system for universities, National Board for Technical Education (NBTE) regulates grading system for Polytechnics and technical colleges, while National Commission for Colleges of Education (NCCE) regulates grading system for Colleges of Education. There are other regulatory agencies for the various professional bodies in the country like Law, Medicine, Engineering, Nursing etc.

Tables I-VI shows grading scales of some selected countries.Table I [7], Shored the grading system used in Nigeria. Table II [8] shows the college grading system used in USA, while Tables III – VI [9] show the grading system used in Austrilia, Canada, Poland and UK respectively.

TABLE I
NUC GRADING SCALE (NIGERIA)

AS Range	Letter Grade	Value Point	Description
70 - 100	A	5	Pass
60 – 69	B	4	Pass
50 – 59	C	3	Pass
45 – 49	D	2	Pass
40 – 44	E	1	Pass
0 – 39	F	0	Fail

TABLE II
COLLEGE GRADING SCALE (USA)

AS Range	Letter Grade	Value Point	Description
90 - 100	A	4.00	Excellent
85 – 89	B+	3.50	Very Good
80 – 84	B	3	Good
75 – 79	C+	2.50	Above Average
70 – 74	C	2.00	Average
65– 69	D+	1.50	Below Average
60 – 64	D	1.00	Poor
Below 60	F	0.00	Failure
	W	0.00	withdrawal
	I	0.00	Incomplete
	TR	0.00	Transfer Credits
	AU	0.00	Audit

TABLE III
AUSTRALIA GRADING SCALE (AUSTRALIA)

AS Range	Letter Grade	Value Point	Description
80 - 100	A+	7	High Distinction
70 – 79	A	6	Distinction
60 – 69	B	5	Credit
50 – 59	C	4	Pass
	D	3	Conceded Pass
0 – 49	F	0.5	Fail

TABLE IV
CANADA GRADING SCALE (CANADA)

AS Range (%)	Letter Grade	Value Point	Description
80 - 100	A		A/B
70 – 79	B		B-/C
60 – 69	C		C-/D
50 – 59	D		F
0 – 49	F		F

TABLE V
POLAND GRADING SCALE (POLAND)

AS Range (%)	Letter Grade	Value Point	Description
70 - 100	A/A+	5.0	
60 – 69	B/B+	4.5	
50 – 59	C/B	4.0	Credit
40 – 49	D/C+	3.5	Pass
35 - 39	C	3.0	Conceded Pass
0 – 34	F		Fail

TABLE VI
UK GRADING SCALE (UNITED KINGDOM)

AS Range (%)	Letter Grade	Value Point	Description
70 - 100	A		First
60 – 69	A-/B+		Upper Second
50 – 59	B		Lower Second
40 – 49	B-		Third
30 - 39	C		Pass
0 – 29	F		Fail

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B. Conversion from One Grading System to another Grading System

Because of the different grading systems being used by different institutions from one country to another, there is the need to convert the CGPA earned in one grading system to another grading system. This requirement is particularly necessary when graduates from different institutions are seeking admission into other institutions whose grading systems are different from the graduates' Alma-Ata. [6]. The approach to grading systems conversion used is based on the premise that for every earned Cumulative Grade Point Average (CGPA), there is an equivalent Cumulative Weighted Average Mark (CWAM). Therefore, given a CGPA for any graduate, the equivalent CWAM can be calculated as follows:

Calculating the value of $CWAM_e$ from the lower end of the range, we have;

$$CWAM_e = M_L + \left[\frac{CGPA_e - CGPA_L}{CGPA_U - CGPA_L}\right][M_U - M_L] \ldots\ldots (1)$$

Calculating the value of $CWAM_e$ from the upper end of the range, we have;

$$CWAM_e = M_U - \left[\frac{CGPA_U - CGPA_e}{CGPA_U - CGPA_L}\right][M_U - M_L] \ldots\ldots (2)$$

We can note that from equations (1) & (2), it is obvious that the grading system of the graduate MUST be specified from where the values of the parameters in these equations can be derived. This is why all certificates MUST contain the details of the grading system of the institution that awards the degree for which the certificate is issued. [6].

Numerous online enquiries abound on this issue of how to convert from one grading system to another grading system. Of note is the discussion on this subject [4].

The edited transcript of the academic discussion is as follows:

Q: "I'm trying to figure out the equivalence between grade schemes in different countries."

Some of the responses are outlined as follows:

According to some Google results:

1. If you are a U.S. citizen, you need a GPA of 3.2+ (it varies, some say 3.2 and some others say 3.6, etc) to apply for a position in the UK (job or university) where the prerequisite is to have a minimum grade of 2:1.
2. In UK 2:1 is earned if you have a 60-69% of the points. I've read that 2:1 is the same as 67%.
3. In Spain we use a grading scheme of 10 points. So according to (2), to have a UK 2:1 you need to have 6-6.9 points.
4. If you are Spanish and have 6.7, when converting it to GPA the result is 1.5.

However, if you take the above points and treat them as a math equation, the final result will be GPA 1.5 = GPA 3.2, which doesn't make any sense.

```
GPA 3.2 = UK 2:1
UK 2:1 = Spain 6.7
Spain 6.7 = GPA 1.5
```

Replacing now...

```
UK 2:1 = GPA 1.5
GPA 3.2 = GPA 1.5
```

Q: "My question is if someone has a better explanation on converting grades obtained in different countries."

Note that a standardized grading system was attempted in the EU (with some extra countries) in connection with the Bologna Process, with the ultimate goal of facilitating internationalization amongst European countries. But it died out due to the resistance from many different institutes. When the standardized grading system introduced with the Bologna Process was trashed later on (at least in Sweden), the solution was to supply a diploma supplement, for instance upon enrolment in exchange program, where statistics (how many students were enrolled, how many passed with what grade etc) for each course the student has taken is denoted.

To sum it up, what the grades are supposed to reflect typically gets lost in translation. Trying to convert them back and forth does not make any sense, and even if it did, there is no guarantee that ***country A*** and ***country B*** will value a certain grade ***G*** from a ***country C*** the same way. In clearer terms your 6.7 Spanish GPA might not weigh equal when judged by the American and the British authorities/companies.

- "If you apply to an institute with 4+ GPA from a Swedish engineering school, they don't even bother to reply (personal experience)." Of course; saying you're 4+ means you're one of the worst students!
- the irony is that a 4+ GPA from my program in Sweden is actually pretty good. Unfortunately my faculty did not make it clear how our grading system works, and our German friends figured everyone knew about/used the same grading system as them. ***The moral of the story is, whenever you send/submit a transcript/GPA always attach some form of a diploma supplement, so that they can judge the grades accordingly.***

There is no clear answer for conversion between grading schemes in different countries. Sure, you could numerically try to convert using ratios and proportions as you are currently trying to do but they don't really mean anything because of the following two salient reasons:

1. **Grade Inflation and Deflation:** Grades mean differently in different institutions across different disciplines and in different courses. For instance, certain highly ranked universities in the USA are very well known for grade inflation. A 3.5 overall GPA is what almost everyone gets. On the other hand, certain other highly ranked universities suffer from grade deflation where getting a 3.0 GPA in certain courses and in certain majors is very different. Hence, merely using some base metric to convert between grading schemes of different countries is not a very good idea.
2. **Differential grading within the same country:** Not every country has a standardized grading system. For instance, India has at least 5 different grading schemes that I am aware of including but not limited to absolute CGPA's on a 4.0 scale, a percentage system on 100 and a relative CGPA system on a 10.0 scale.

Don't convert between different grading schemes unless it is explicitly mentioned what minimum grades you need for your own country. Just apply and hope for the best.

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In Spain, examinations are graded in 0-10 (with 0 being failing everything and 10 a perfect score), but then the actual marks for each subject *at universities* is in a 4 degrees scale: 0-fail, 1-pass, 2-remarkable, 3-outstanding, 4-outstanding with honors. Marks are weighted by the number of credits (equivalent 10-hour blocks of study, including class attendance, labs, and estimated self-study) of each subject.
People with non-Spanish degrees have to convert their marks to this 4 point system, with the help of the following algorithm (in pseudo-code; you can find how to use it, for instance, in this form from the Spanish Council of Scientific Research); (https://sede.csic.gob.es/servicios/formacion-y-empleo/bolsa-de-trabajo/modelo-declaracion-notas-medias)

```
Ti = 0;
Mi = 50+50*(SMi-Nmin)/(Nmax-Nmin)
if Mi >= 50 and Mi < 69.9 then Ti = 1
else if Mi >= 70 and Mi < 89.9 then Ti = 2
else if Mi >= 80 and Mi < 99.9 then Ti = 3
else if Mi > 99.9 then Ti = 4
```

and the final average is the total sum of the weighted average (Ci times Ti) divided by the total sum of credits (ΣCi), where:

- Nmax = maximum note in the source system
- Mmin = minimum note that gives a pass in the source system
- Ci = number of of credits for subject *i*
- SMi = source mark for subject *i*
- Mi = intermediate 0-100 mark (with 50 being the first note that gives a pass)
- Ti = final mark in the Spanish system

You can use that kind of intermediate step to go from any mark system to any other. The only thing you have to change is:

- Nmin and Nmax; it even works for system such as the German, where Nmax = 1,0 and Nmin = 4,0
- the brackets and marks for converting from the 100-point system to the target system.

The above discussion establishes that the dilemma of conversion from one grading system to another is a global problem.

C. Architectural Design Consideration.

In computer-based systems development, architectural design represents the structure of data and program components that are required to build a computer-based system. It considers the architectural style that the system will take. The structure and properties of the components that constitute the system and the interrelationships that occur among all architectural components of the system. Clearly, software architecture must model the structure of a system and the manner in which data and procedural components collaborate with one another [10].

The Data-centric Architecture used in this work has a permanent and primary core: Data. Applications and services are ephemeral; they live as long as they are useful. But Data is always there [11]. It is based on the philosophy that data is the central asset of any organization and it is constant, while the application around it may come and go. The data will be around and valid long after the consuming applications are gone. Therefore the storage and classification of data is the primary step of the process and precede the given application.

III. MODELING APPROACH

Real life problems encountered with the implementation of degrees classification by the Nigerian Universities Commission (NUC) between 2017 and 2019 motivated this study to a great extent. To resolve the implications of the grading system policy change on academic information processing, innovative concepts were formed with research idea that showed potential to improve actual human and organizational capabilities.

Of particular interest is the implication of the NUC policy change on cross-border education provision. The commission was inundated with series of enquiries, particularly from international organizations and foreign universities on the status of the four point grading scale in view of the degrees issued using the five-point grading scale [5]. Moreover, some levels in the universities would be running the four-point grading scale while other levels would be running the five-point grading scale within the same university. This scenario inspired the idea of a system that can implement a multiple grading system on the same data set.

We also carried out extensive review of available related literature, periodicals, technical materials, forms, operating documents, various policies of regulatory agencies and government publications to identify key concepts and formulate research objectives and suitable solution to resolve the impasse. Earlier efforts have been made, but of particular interest is the earlier work on conversion from one grading system to another grading system [6]. There are a number of architectural styles in software engineering, such as Blackboard, Client-server (2-tier, 3-tier, n-tier), Component-based, Data-centric, Event-driven (or implicit invocation), Layered (or multilayered architecture), Micro services architecture, Monolithic application.

Data-centric architectural framework was adopted against the traditional application-centric approach. This is largely due to the envisaged exponential growth of transcript data in the system. Data is stored in a centralized place, in the form in which it was originally captured and only given an appropriate structure by the analysis process actually using it. This approach allows room for more dynamic data analysis and can react much more quickly to the rapid changes within a business, and by implication, education industry. In this kind of architecture, the storage and classification of the data are the first step of the process, and precede the creation of any given application.[11]. Thereafter we established the technical feasibility of the solution by developing a prototype system using the grading systems in Nigeria and other three nationalities chosen randomly as shown in Fig. VII.

IV ARCHITECTURAL FRAMEWORK

The need for a platform that can evaluate and interpret certificates and transcripts from international institutions is obvious. This requirement is particularly necessary when graduates from different institutions are seeking admission into other institutions whose grading systems are different from the graduates' Alma-Ata. [6]. Secondly, the experience of NUC lends credence to the necessity for this platform.

There are various other online academic discussions on the issue of conversion from one grading system to another.

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These attest to the fact that there is need for certificates and transcripts from one nation's education system to be clearly understood and rated by another nation's education system.

The Spanish Council for Scientific Research presented an algorithm for converting marks from foreign universities to the Spanish 4-point grading system [12]. Similarly, Omotosho (2013), presented an approach to convert from CGPA to CWAM. With this approach, the CGPA must have been computed in the grading system of the authoring institution [6].

In this work, an approach that implements conversion from one grading system to another grading system from a data visualization perspective is presented. It is observed that a common feature of all grading systems studied is assessment of students' academic performance which embraces Continuous Assessment (CA) (Class Work, Laboratory Work, Field Work, Assignments etc) and Examinations. This assessment of students' performance translates into a score, usually expressed in percentile or any other ratio which is usually convertible to percentile. With this, any course (with appropriate credit unit) taken by a student has an Assessment Score (AS). This AS is the basis for grading and CGPA or CWAM computation. AS in percentile can be graded in any grading system.

Table VII illustrates sample AS and their corresponding grades in other grading system.

TABLE VII
AS AND CORRESPONDING GRADES.

AS	GS I	GS II	GS III	GS IV	GS V	GS VI
40	E	F	F	F	D/C+	B-
50	C	F	C	D	C/B	B
60	B	D	B	C	B/B+	A-/B+
70	A	C	A	B	A/A+	A
80	A	B	A+	A	A/A+	A

The concept of Multiple Grading System (MGS) presented in this work conceptualizes a database architecture that visualizes AS as input data and applies any desired Grading System (GS) to the data. With this approach, there is no need to compute CCGPA or CWAM first or do a conversion of AS. The parameters for any of the GS are set up in the Grading System Configuration (GSC) table in the database. So for each value of AS given, its grade equivalent can be determined in the desired GS. Thereafter, the platform can compute the CGPA in that GS.

The common practice in course credit system is to map AS into an n-grade points system which is required to generate the needed CGPA. There are as many methods doing this as there are Grading Systems. The number of grade point, 'n' varies from institutions to institutions depending on the GS in use. In Nigerian tertiary institutions, the value of 'n' varies between 4 and 7.

To implement this system, certain parameters are desirable such as; Course Code, Credit Unit (CU), AS, Grade Name, Grade weight "n", Value Point (VP)

The following Java Script codes can be used to implement the mapping of AS into grades and to compute grade weights using either n-points or weighted average marks.

The input values are considered from the level of Class Work (CW) and Semester Examination (SE) perspective. Where input is considered at the level of AS only, Var CW and Var SE could be ignored.

```
function jsFunction(obj){
    //todo: variables for value point calculations
    var  newobject=obj;
    var  tr = $(obj).parent().parent();
     var cw =  $(tr).find("td input.cw").val();
     var se =  $(tr).find("td input.se").val();
     var AS= $(tr).find("td  input.AS").val( (parseInt(cw)      +
            parseInt(se)));
    var grade;
    var remarkvalue
    var a = parseInt(cw) + parseInt(se);

    if(AS<0 || AS>100){
       alert("Value should be between 0 - 100");
       $(tr).find("td input.cw").val('0');
       $(tr).find("td input.se").val('0');
       $(tr).find("td input.AS ").val('0');
       $(tr).find("td input.grade").val(' ');
       $(tr).find("td input.AS").focus();
    }
    for (var k=1;k<=gradelength;k++){
       if(a>=allgrades[k]['lb'] && a<=allgrades[k]['ub']){
          grade=$(tr).find("td
             input.grade").val(allgrades[k]['gl']);
       }
```

A. Conceptual Design

The objective of the entire concept is to be able to interpret a transcript issued in one GS in another GS so as to be able to classify a degree using another GS. For this study, we have used six different grading systems as indicated in Tables I to VI

The general procedure adopted is to attach weights to grades. For example, in a 5-point grading system, A = 5 points, B = 4, C = 3, D = 2, E = 1, F = 0. As can be seen from the grading scales presented in tables I to VI, some grading scales do not have clearly defined letter grades and weights for each grade classification. It is also observed that the intervals between range of scores that are used to determine letter grades are not uniform. Some computation of CGPA procedures would vary considerably from one GS to another GS. The approach presented here is to convert the actual percentile scores from one GS into grades in another GS, then the computation of CGPA can be done using the procedures of the recipient GS.

A number of data tables and their relationships are conceptualized in this system as indicated in Figure I.

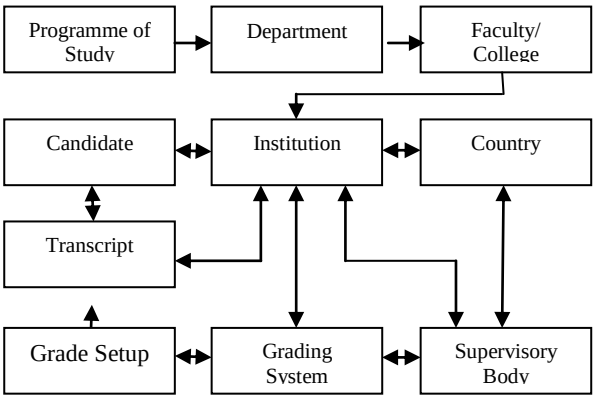

Fig. I. Identification of Tables and their Relationships.

Figure II presents the identified entities, their attributes and relationships in the system.

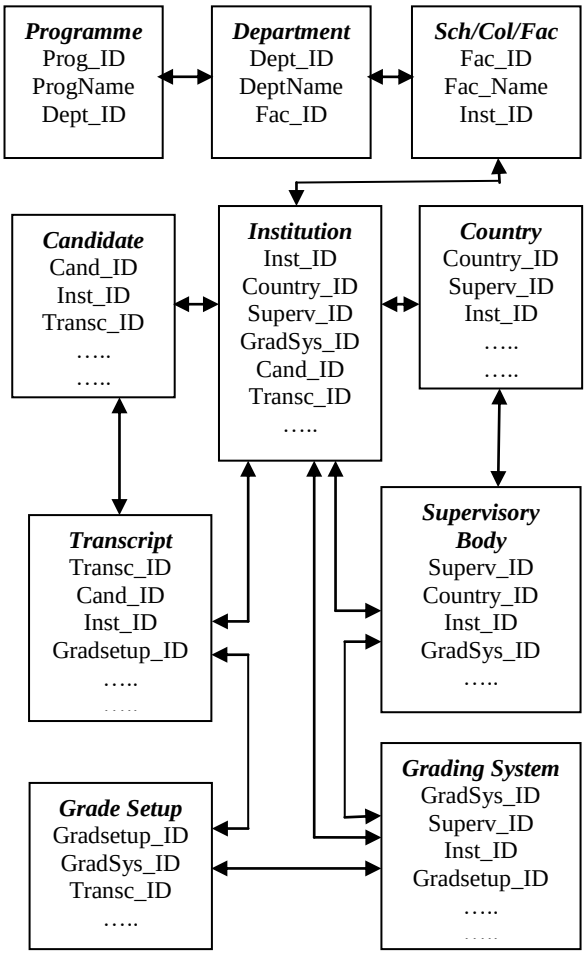

Fig. II. Identification of entities relationship.

Tables VIII to XVII present the classification of attributes in the system.

TABLE VIII
COUNTRY TABLE

⊕	Country_ID Varchar(15) (PK)
⊕	Country_Name Varchar(30)
⊕	Region Varchar(30)

TABLE IX
SUPERVISORY BODY TABLE

⊕	Superv_body_ID Varchar(15) (PK)
⊕	Superv_Body_Name Varchar(30)
⊕	Country_ID Varchar(15) (FK)

TABLE X
GRADING SYSTEM TABLE

⊕	Gradsystem_ID Varchar(15) (PK)
⊕	Gradsys_name Varchar(30)
⊕	Superv_body_ID Varchar(15) (FK)
⊕	Superv_Body_Name Varchar(30)
⊕	Institution_ID Varchar(15) (FK)

TABLE XI
GRADES SETUP TABLE

⊕	Gradesetup_ID Varchar(15) (PK)
⊕	Gradsystem_ID Varchar(15) (FK)
⊕	LetterGrade Varchar(6)
⊕	Grade_Point Num(5,2)
⊕	LowerBound Num(3)
⊕	UpperBound Num(3)
⊕	Grade_Description Varchar(20)
⊕	PassMark Num(1)

TABLE XII
PROGRAMME OF STUDYTABLE

⊕	Prog_ID Varchar(15) (PK)
⊕	Prog_Name Varchar(30)
⊕	Dept_ID Varchar(15) (FK)

TABLE XIII
SCHOOL/COLLEGE/FACULTYTABLE

⊕	Sch_Col_Fac_ID Varchar(15) (PK)
⊕	Sch_Col_Fac_Name Varchar(30)
⊕	Institution_ID Varchar(15) (FK)

TABLE XIV
DEPARTMENT TABLE

⊕	Dept_ID Varchar(15) (PK)
⊕	Dept_Name Varchar(30)
⊕	Sch_Col_Fac_ID Varchar(15) (FK)

TABLE XV
INSTITUTION TABLE

⊕	Institution_ID Varchar(15) (PK)
⊕	Institutiont_Name Varchar(30)
⊕	Country_ID Varchar(15) (FK)
⊕	Inst_Address Varchar(50)
⊕	Inst_Category Varchar(30)
⊕	GradSys_ID Varchar(15) (FK)

TABLE XVI
CANDIDATE PERSONAL TABLE

⊕	Cand_ID Varchar(15) (PK)
⊕	Matric_No Varchar(15)
⊕	Dept_ID Varchar(15) (FK)
⊕	Sch_Col_Fac_ID Varchar(15) (FK)
⊕	Prog_ID Varchar(15) (FK)
⊕	Surname Varchar(30)
⊕	OtherNames Varchar(35)
⊕	DoB Date(8)
⊕	Nationality Varchar(30)
⊕	Gender Varchar(10)
⊕	MaritalStatus Varchar(10)
⊕	Contact_Address Varchar(50)
⊕	PhoneNumber1 Varchar(15)
⊕	Email Varchar(30)

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TABLE XVII
TRANSCRIPT TABLE

⊕ Transcript_ID Varchar(15) (PK)
⊕ Cand_ID Varchar(15) (FK)
⊕ Instution_ID Varchar(15) (FK)
⊕ Sch_Col_Fac_ID Varchar(15) (FK)
⊕ Dept_ID Varchar(15) (FK)
⊕ Prog_ID Varchar(15) (FK)
⊕ Semester Varchar(1)
⊕ Session Varchar(10)
⊕ GraduationYear Varchar(10)
⊕ Code1 Varchar(8)
⊕ Unit1 Num(2)
⊕ AssessScore1 Num(5)
⊕ Grade1 Varchar(8)
⊕ Remark1 Varchar(30)
⊕ … … …
⊕ Code20 Varchar(8)
⊕ Unit20 Num(2)
⊕ AssessScore20 Num(5)
⊕ Grade20 Varchar(8)
⊕ Remark20 Varchar(30)
⊕ TCU Num(4)
⊕ TCU_Passed Num(4)
⊕ TVP Num(4)
⊕ GPA Num(8)
⊕ Remark Varchar(30)
⊕ Cum_TCU Num(4)
⊕ CumTVP Num(4)
⊕ Cum_GPA Num(6)
⊕ Cum_Remark Varchar(50)
⊕ FinalGrade Varchar(30)

B. E valuation of Grades

The sample grade setup and GS tables required for the evaluation of grades are shown in Tables XVIII and XIX.

TABLE XVIII
SAMPLE GRADE SETUP TABLE

ID	GRADE LETTER	GRADE POINT	LOWER BOUND	UPPER BOUND	DESCR	PASS MARK	GS ID
1	A	5	70	100		1	1
2	B	4	60	69		1	1
3	C	3	50	59		1	1
4	D	2	45	49		1	1
5	E	1	40	44		1	1
6	F	0	0	39		0	1
7	A	4.00	90	100	EXCEL	1	2
8	B+	3.50	85	89	VGOO	1	2
9	B	3.00	80	84	D	1	2
10	C+	2.50	75	79	GOOD	1	2
11	C	2.00	70	74	AB	1	2
12	D+	1.50	65	69	AVE	1	2
13	D	1.00	60	64	AVE	1	2
14	F	0.00	0	59	BE AVE	0	2
15	A+	7	80	100	POOR	1	3
16	A	6	70	79	FAIL	1	3
17	B	5	60	69	H-DIST	1	3
18	C	4	50	50	DISTN	1	3
19	D	3			CREDIT	1	3
20	F	0.5	0	49	PASS C PASS FAIL	0	3

TABLE XIX
SAMPLE GRADING SYTEMS

ID	GRADING SYSTEM
1	NUC GS (NIGERIA)
2	COLLEGE GS (US)
3	AUSTRALIA GS

The various grading systems are setup administratively and used for evaluation of grades. Institutions administrators can create institutional profiles on the system and select the appropriate grading system applicable to them.

Transcripts containing the actual assessment Scores in percentiles are uploaded by the authoring institution. This data is accessed by the recipient institution and processed. Using the information contained in the grade setup table, (Table XVIII), the system produces a translated version of the transcript in the GS of the recipient University. Thereafter, the final grade (CGPA) is recomputed.

C. Data Flow Architecture

The sequence of operations and content presented in this work is predefined and generally linear. The sequence of interactions is predictable as illustrated in Fig. III.

In this section we present the architectural framework for the implementation of the conceptualized system. The prototype used to simulate the system was achieved through interfaces created to enable access to database system. The architectural framework as presented in Fig. IV is based on the three tier architecture concept [13].

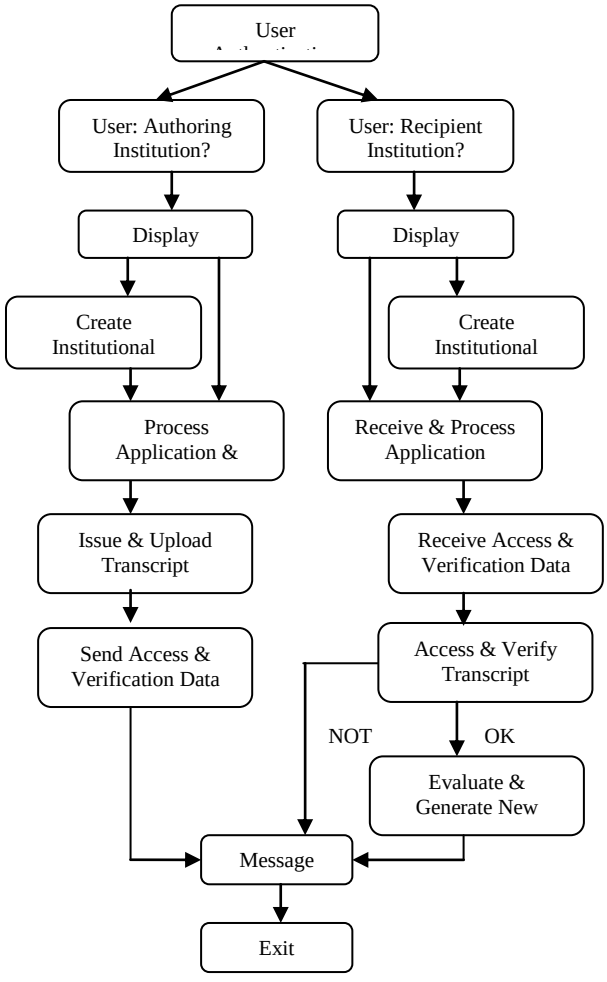

Fig. III. Data Flow Architecture

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Applications for the frontend users, and the logic/query processing layer can be created using technologies provided by the .NET development environment and the .NET framework Software Development Kit (SDK). PostgreSQL also provides development library for .NET programmers [14]. MySQL database engine and PHP Scripts can also be used to implement the system.

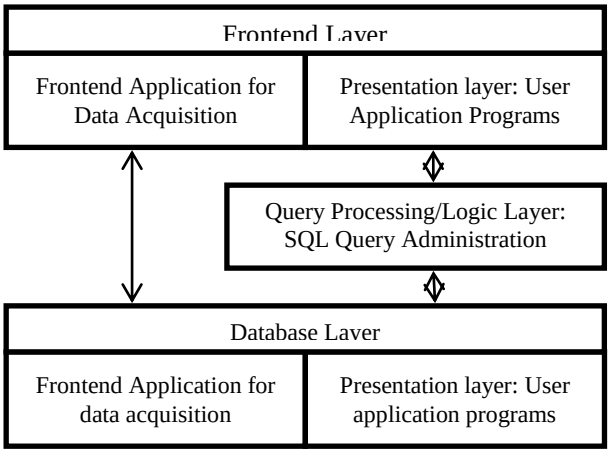

Fig. IV. System Architecture

V. CONCLUSION

This work primarily addressed the issue of translating academic transcript issued by one GS to another GS. This is necessary as a result of the high mobility of students, academic staff and professional in the present circumstance of internationalization, globalization and the consequent necessity for cross-border education. There are as many grading systems as there are education regulatory bodies globally. Consequently, understanding transcripts issued by international institutions becomes difficult. It is almost un-achievable to attempt to create a uniform global GS due to social-cultural, political, and economic diversities and their implication for cross-border education. The manual system of mailing transcripts, with accompanying legend for interpretation is slow and error prone. This accounts for the need for a system that can evaluate and interpret a transcript or certificate issued in one GS in another GS. This work presented a framework for the development of transcript evaluation system in cross-border education principally from a data visualization perspective. It is hoped that developers and institutions find this framework useful in developing applications.

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