A Modified Standard Score Algorithm for Secondary School Recommender System

Bright, C.[1] and Onuodu, F.E.[2]
[1,2] Department of Computer Science University of Port Harcourt, Nigeria
Email: gonuodu@gmail.com[2]

Abstract— The drop in educational standard has resulted in low level of academic achievements among secondary school students. This decline in the delivery quality of education is the outcome of certain factors such as: poor funding, unqualified teachers, inadequate learning infrastructure and lack of teaching aids, inadequate school environment and ultimately the proliferation of schools. Education in our present-day country and state in particular at the secondary school level is rather seen as a profit-making venture replacing the primary aim of education which is to equip the young people with the required skills to fit into the society. The numerous factors that constitutes a high performing school are categorized into weighted indicators which are: availability of library, teacher qualification, teaching methodology, school environment, teacher working conditions and availability of laboratory and used to assign percentage weight which is used to make recommendation using Modified Standard Score algorithm. The proposed secondary school recommendation system is implemented using MYSQL and PHP making it an online application which would aid its users in choosing a secondary school for their wards to attend amidst numerous available options.

Index Terms— Modified Standard Score Algorithm, Indicators, Ranking, Recommender, Secondary School, System

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1 INTRODUCTION

Parents are confronted with growing array of options in choosing a good school. These choices can be exercised in many ways. The most usual way is choosing a school within the neighbourhood or other familiar places. Parents know their children close to home, qualities, shortcoming and territories of enthusiasm of their children. Parents also have the qualities that the family needs and accordingly need a school that will instill such qualities which they would need for their children.

The children spend most of their time at school, therefore, the school has a reasonable influence on the scholastic achievement of the child. This is done through the School's educational program, teaching style, teaching aid and relationship that exist in the school. The nature of training which a school conveys isn't just a component of the execution of the instructing staff only but also school environment as a rule [1].

A school's learning environment plays a crucial role in the learning result or scholarly accomplishment of the students. The result of how students perform or handle circumstance in the school relies upon the school environment[2]. It is generally recognized that students learn as they relate with the environment around them.

[3] is of the opinion that learning prompts a lasting change in conduct through training and experience. This point is additionally shown by the existing relationship between learning and school environment. [4] considers a relative lasting change in conduct as a result of taking in which results from knowledge, experience and sensitivity to the environment.

The school environment is the school premises which comprises of classrooms, examination hall, library, research laboratories and so on. The school administration and teachers which additionally makes school environment are the drivers and facilitators. The school environment is the major place students learn.

It ought to be comprised of great infrastructures, adequately trained teachers, great school executives and satisfactory teaching aids or instructional materials among others. Arguably, a superb school environment would result in an excellent academic achievement. Academic accomplishments of students which is a result of the school environment is of great concern to stakeholder and guardians specifically.

Note that the scholarly accomplishment achieved by a student is a measure of a very well organized continuous or examination. Great (2009) defined scholarly accomplishment as the expertise and information gotten from already instructed subjects that is measured by test marks given to students by the educator. It is the attainment of the short term or long term scholastic goals by a student [6]).

The general aftereffect of the secondary school condition on the scholarly achievement of a student can be negative or positive. [7] is of the sentiment that the accessibility and nature of instructive foundation and hardware, for example, the structures found in the school, study halls, seats, tables, labs and so forth results in high scholarly results an understudy accomplishes.

Notwithstanding accessibility of offices, talented hands are expected to utilize these accessible offices to help how scholarly exercises are done. Guardians and the overall population are stood up to with a regularly developing exhibit of school choices particularly in the tallness of fallen scholarly measures. There exists differed intrigue and what is normal as they set out on this look for the decision of a school.

Appropriate direction is hence required for a decision of school that concurs with customized interests. The general scholarly achievement a school accomplishes and the gauge of showing staff vital among the characteristic's guardians think about when making choice of school they mean for their youngsters to attend.

Selections of schools made by guardians are affected by their financial classes, educational foundations, and nearness to the

schools among other. Guardians whose pay is low select government funded schools which are increasingly reasonable thinking about their inclination of salary. As opposed to that, the working class pay worker and the high-class pay workers lean toward their children to go to non-public schools because of the apparent better instructive administration conveyance related with non-public schools which results from lower class measure, accessibility of all the more learning offices and a decreased instructor to understudy proportion.

The school guardians decide for their children is likewise connected with their word related status. Guardians who are better set need their children to go to private schools instead of state funded schools. In perspective on these shifted interests among guardians and the overall population everywhere, considering the various schools accessible, there is the need to plan and execute a data separating framework to control guardians to pick an auxiliary school for their youngsters and wards which runs with these fluctuated interests.

A Recommendation System is a software that utilizes information filtering techniques to predict the rating or preference that an individual of intrigue would provide for a thing to be utilized by the individual[8]. Recommender system help and expand this common social procedure that would have been experienced by guardians and different people of interest for settling on a decision of school. A secondary school recommender of this sort could be considered as a match making service for guardians and other interested individuals.

2 LITERATURE REVIEW

2.1 Related Works

[9] set up a recommendation system with a correlation between listener's favourite music and music features. Music labels from selected artist were analyzed and used to map an existing relationship between artist rated by user using the features of the music. Thus, a user's profile is built based on preference for the music of a specific artist and from this user preference a recommendation is made. The system however did not take into consideration the change in taste of the listener.

[10] designed RINGO, a music recommender system which is based on user similarities in the taste of music. It is a user based collaborative system filtering approach that matches a new user against the database of an old user who both share similarity in the taste of music to make recommendation for the new user. The system did not consider music that has not been rated by any user.

[11] designed an online food recommendation system that is used to recommend the kind of food a buyer can purchase. Buyer's or user's profiled or labeled based on preferred recipe. The recommender recipe where classified into user group, food categories and ingredients. User's select recipes from a recommended list and add them to a shopping list, and then all ingredients of the chosen recipe are added automatically and delivered to the buyer or user. The system however the food was limited to the recipes and a wide variety of food options were not considered

[12] designed a food recommendation system that makes use of an active learning algorithm and factorization matrix. Human computer interaction was used to collect long term user preference in terms of rating recipes and tags. Users provide short preference when requesting for recommendation, then the recommendation system makes use both short- term user preference and long-term user preference to generate recommendation for a new user. The long-term user preference is used by building a matrix factorization rating prediction model which is used to consider tags and rating. Each user is modeled against a recipe using vectors that represents their hidden and latent features. The inner product of the user and item vector are computed in order to estimate rating value of a user for a specific item. Within the range of the short-term preferences of the user, the system filters recipes according to the current preference of the user and then generates a recommendation for the user with the highest rating values. The issue of cold start and data sparsity was not duly addressed here.

[13] developed a recommender system that takes into consideration tourist expectations with emphasis on emotional needs in other to recommend desirable sites of interest or attraction. Images are used to represent expectation of tourist. These images are grouped into 3 formats through analyzing data, interaction and adaptation to expected changes of the image through interaction between roles and some unforeseen changes. This model how ever has its limitation in deducing user similarities required for rating and recommendation.

[14] created a movie recommender system that makes recommendation based on human emotions. The system observes a user as the user watches part of the movies and then analyzes possible facial expression based on the viewed movie which is stored in the database. This emotion data stored in the database is the compared with the emotion database of other users and then used to make recommendation. The system did not take into consideration the fact that emotions are momentary and can change as such changes ought to be reflected and used to make subsequent recommendations.

[15] proposed an e- commerce recommendation system which is based on a user's opinion for special shops that offer special items for sale. An item classification method is used to determine the degree of specialization of the shop. Users buying habit and history were not taken into consideration in this recommender system.

[5] proposed a novel e -commerce recommender system that focuses on the low consumption rate and loyalty problem of a customer through the customer implicit feedback. The system does not recommend items for buyers to buy.

[16] proposed a novel recommender system using collaborative filtering techniques for demand function and price modeling. The system maximizes the expected revenue of recommended products by finding the pair of items that will make the most of product purchased that will increase revenue. It does not however take the buyers interest as a major factor for recommendation.

[17] implemented a recommender system to reduce the effect long tail products have on recommender systems while maximizing recommender accuracy at the same time. However,

his approach was item based and not hybridized.

[18] designed an e- learning recommender system called the Altered Vista system. The system explored how learners' feedback from using learning resources using collaborative filtering techniques. This learning resources can be stored and made available to the learning community for immediate or future use. The learning resources however were not in clusters.

Question, Study and Interaction and Assessment (QSIA) recommender system designed by [19] that promotes formation and collaboration of learning groups. The system makes use of collaborative filtering algorithms which is called the buddy system. Learners can decide to take the advice of buddies or friends on a subject or use and anonymous collaborative filtering algorithm. Implicit attributes of users could not be captured by the system.

[20] proposed a recommender system that combines collaborative and content filtering algorithms to improve existing user's data to give a better recommendation. The issue of long tail problem was not addressed in this system.

[21] designed a recommendation service that collects and recommend web pages to users in a personalized why through a combination of benefits of the content and shared user's interest.

[22] proposed a recommender system that retrieves relevant information from long term memory and uses it in conjunction with the information stored in the short-term memory to make recommendation. This recommendation system did not require user ratings.

3 MATERIALS AND METHODS

3.1 The Existing System

Secondary school recommendation in Nigeria is based on the normal social process which includes by word of mouth, placement on bill boards, through websites, radio jingles or television adverts. Parents who are impressed by the academic achievements of their children/ wards can also recommend such school to their friends or relatives. Parents also decides on a school based on academic performance of students of the school especially during external examinations such as Junior Secondary School Certificate Exams (JSSCE), Senior Secondary School Certificate Exams (SSCE) and Unified Tertiary Matriculation Exams (UTME). They also take into consideration location and tuition fee when making a choice of school for their wards and children.

In the course of this research work, the Times Higher Educational Ranking System of Universities for 2019 published by Price Waters Cooperation was studied and adopted. The indicator for higher educational ranking has the following weighted indicators:

   i.   Teaching (The learning environment) = 30%

   ii.   Research (volume, income and reputation) = 30 %

   iii.   Citation (research and influence) = 30 %

        i.   International outlook (Staff Student and research) = 7.5%

   ii.   Industry income (Knowledge transfer) = 2.5%

Fig. 1. Architecture of the Existing System. (Higher Times Universities Methodlogy , 2018)
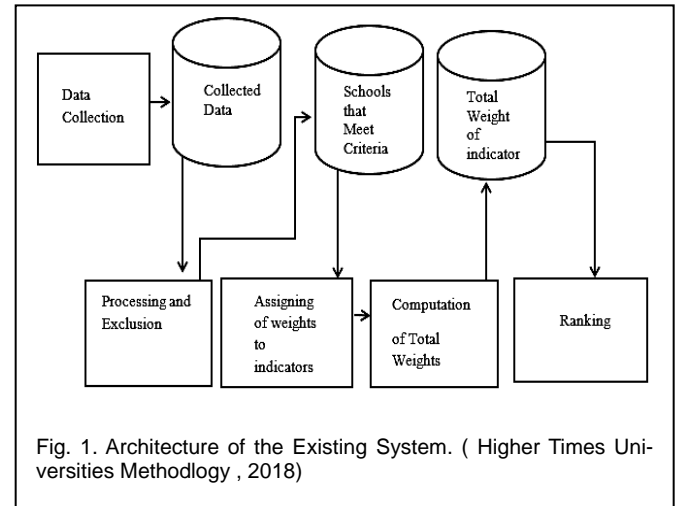
The drawbacks of the existing Framework includes:

   a.   No algorithm for computation of indicator and ranking.

   b.   There indicators are not applicable to secondary schools.

3.2 Proposed System

This ranking system is adopted to form a secondary school ranking system based on the following indicators and associated weights.

   a.   Availability of Laboratories =   12 %

   b.   Teacher Qualification   = 19 %

   c.   Teaching Methodology   = 14 %

   d.   Teacher working Conditions=   12 %

   e.   Student's Academic Performance   = 17%

   f.   Availability of Library   = 12%

   g.   Class room environment   = 14 %

The total weights of the indicators for each school are computed and the modified standard score is used to compute the final ranking which is used to make recommendations.

Modified Standard Score Algorithm

Step1: Set Sum of indicators to zero

Step2:   Set count of schools to zero

Step3: Add the percentage of 5 indicators for each school and assign to Sum

Step4: Add the total number of schools to be ranked and assign to count.

Step5: Compute the mean value of the percentage sum of indicators

Step6: Compute absolute standard deviation for all the % rankings

Fig. 2. Architecture of the Proposed System.
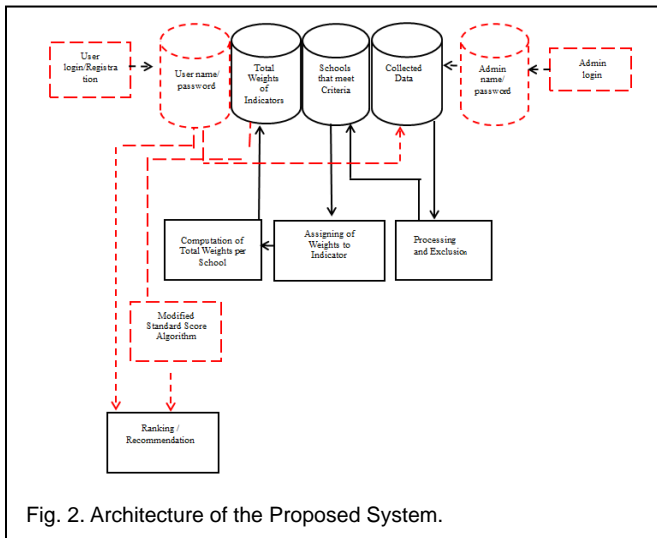
Step7: Compute modified standard score
Step8: Rank schools according to standard score value for each school.
Step9: Make recommendation based on school ranking position
Step 10: End.

$$\text{Modified Standard Score} = \frac{X_i - \mu}{ASD} \quad (1)$$

$$Asd = \frac{1}{Card(x)} \sum_i | X_i - \mu| \quad (2)$$

Considering 10 schools with the total of the percentage of indicators of library, teacher qualification, teacher working conditions, students' academic performance, laboratory standard and classroom environment as follows:

School A =   50%
School B =   41%
School C =   59%
School D =   70%
School E =   68%
School F =   72%
School G =   73%
School H =   87%
School I =   88%
School J =   90%

Arranging the total weight of the indicators of the schools in an ascending order, it becomes thus:

School B =   41%
School A =   50%
School C =   59%

• *Bright C. is currently pursuing masters degree program in Computer Science in University of Port Harcourt, Nigeria.*
• *Onoudu F.E. is currently a Senior Lecturer in the Department of Computer Science in University of Port Harcourt, Nigeria.*
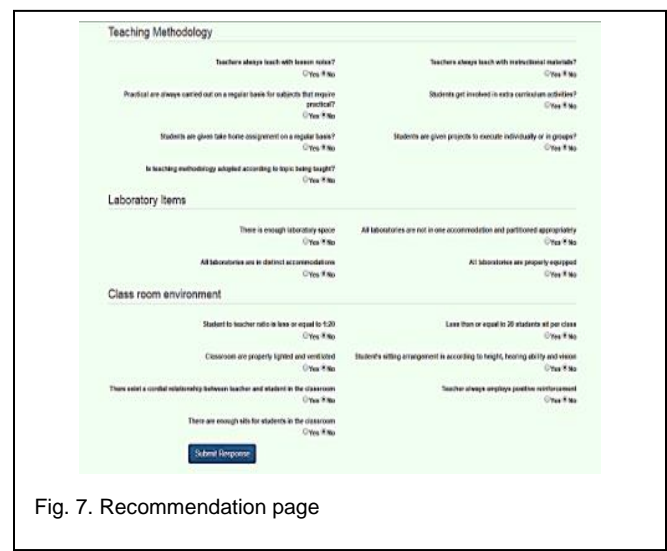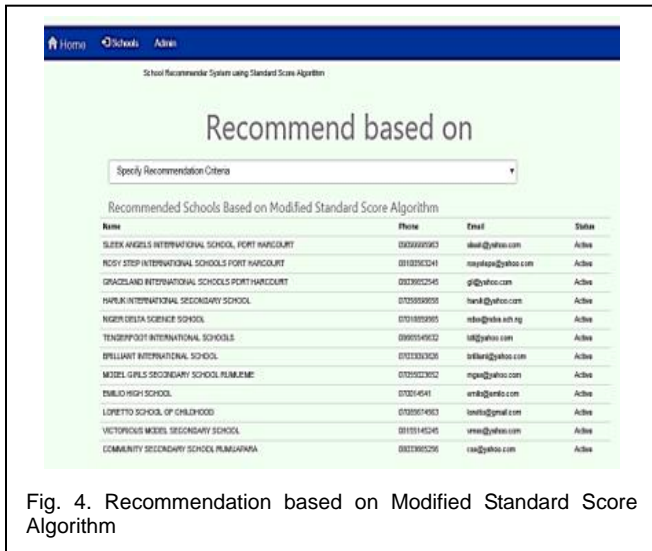
School E =   68%
School D =   70%
School F =   72%
School G =   73%
School H =   87%
School I =   88%
School J =   90%
Median = 70 + 72 / 2 = 71
Asd = 1/10 * |41-71| + | 50-71| + | 59-71| + |68-71| + |70-71| + | 72-71| + | 73-71| + | 87-71| + | 88-71| + | 90-71| = 122/10 = 12.2.   Asd = 12.2

Modified Standard Score for School A = 50-71/12.2= -1.72
Modified Standard Score for School B = 41-71/12.2= -2.45
Modified Standard Score for School C = 59-71/12.2= -0.98
Modified Standard Score for School D = 70-71/12.2= -0.08
Modified Standard Score for School E = 68-71/12.2= -0.24
Modified Standard Score for School F = 72-71/12.2=   0.08
Modified Standard Score for School G = 73-71/12.2= 0.16
Modified Standard Score for School H = 87-71/12.2= 1.31
Modified Standard Score for School I = 88-71/12.2= 1.39
Modified Standard Score for School J = 90-71/12.2= 1.55

3.3 Advantages of the Proposed System

a.   The problem of information overload is taken care of.
b.   Parents and other stakeholders have at their fingertips the necessary information required to make a choice of secondary school for their wards and children.
c.   General improvement in the standard of education as more schools would meet the relevant criteria for enlistment into the system

Fig. 3. Usecase Diagram
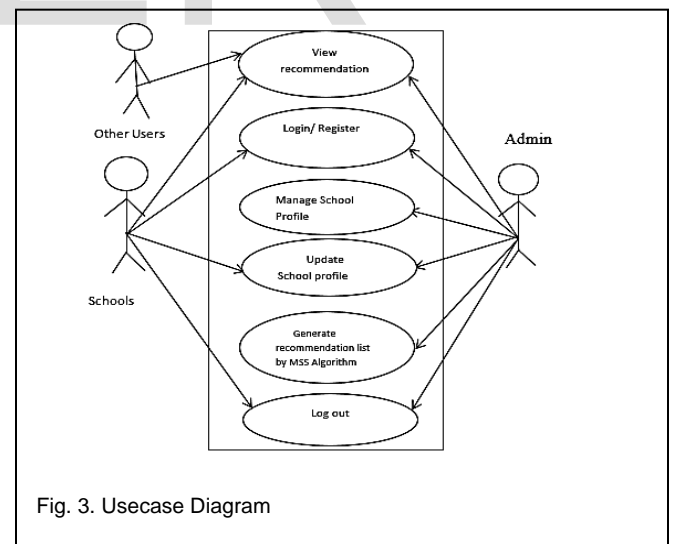
4   RESULTS AND DISCUSSION

Figures 4 to fig 7 are sample outputs from the system. Table 1 is a table of the performance of the system.

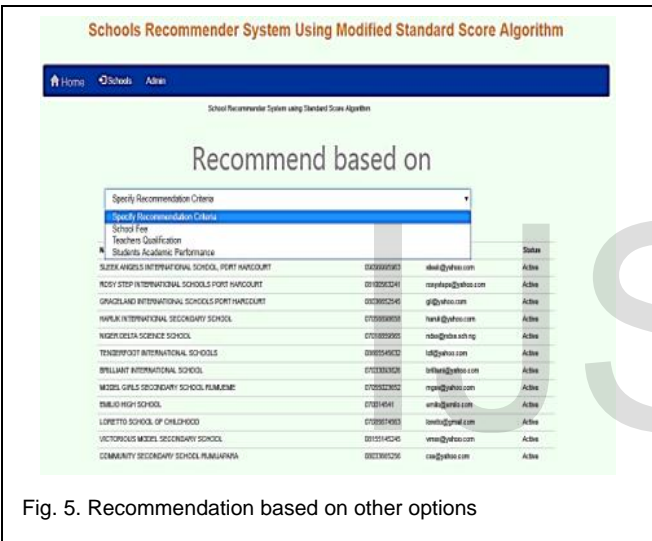Fig. 4. Recommendation based on Modified Standard Score Algorithm

Fig. 5. Recommendation based on other options
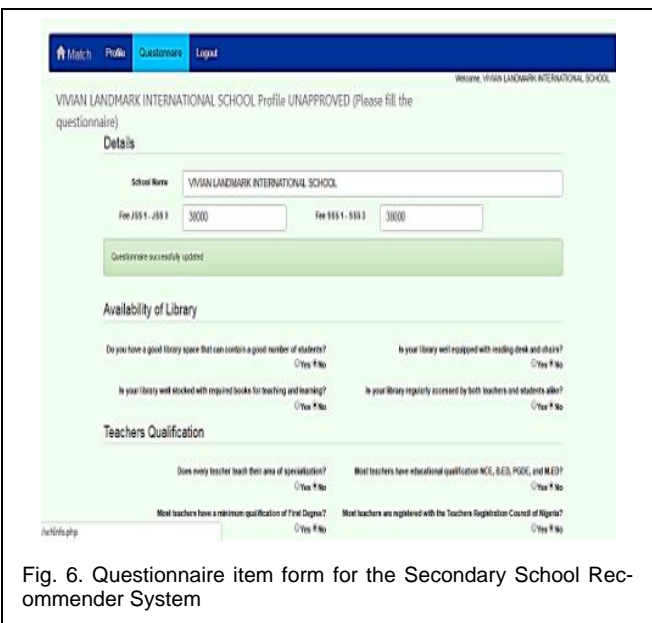
Fig. 6. Questionnaire item form for the Secondary School Recommender System
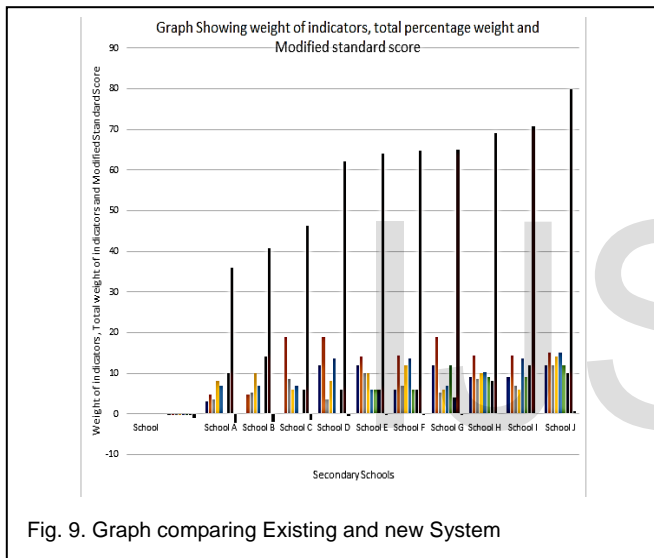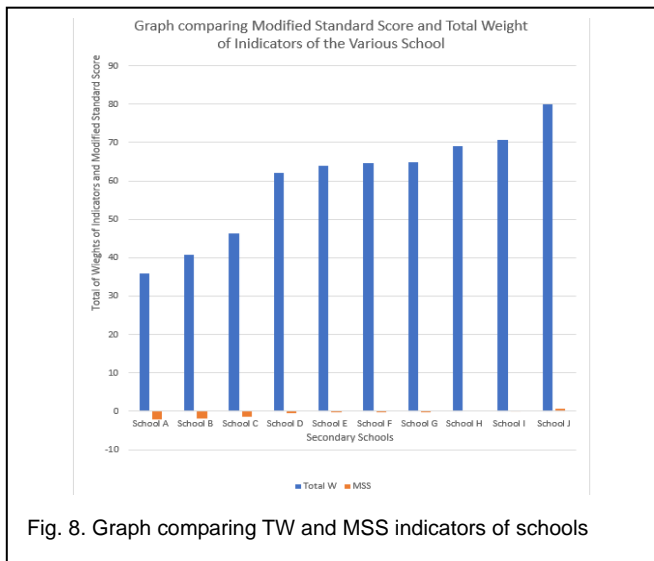

Fig. 7. Recommendation page

4.1 Performance Evaluation

Ranking using modified standard score algorithm instead of percentage weight of the indicator is more efficient and can handle a large amount of data.

Laboratory (12%): Lab
Teacher Qualification (19%): TQ
Teachers Working Conditions(12%): TWC
Teaching Methodology(14%): TM
Students' Academic Performance (17%): SAP
Library(12%): Lib
Class Room Environment (14%): CRE
Total Weight (100%)
Modified Standard Score" MSS

TABLE 1
RESULT OF THE PROPOSED SYSTEM

Sch	Lab	TQ	TWC	TM	SAP	Lib	CRE	TW	MSS
A	3.00	4.75	3.43	8.00	6.80	0.00	10.00	35.98	- 2.20
B	0.00	4.75	5.14	10.00	6.80	0.00	14.00	40.69	-1.88
C	0.00	19.00	8.57	6.00	6.80	0.00	6.00	46.37	-1.51
D	12.00	19.00	3.43	8.00	13.60	0.00	6.00	62.03	- 0.46
E	12.00	14.00	10.00	10.00	6.00	6.00	6.00	64.00	-0.33
F	6.00	14.25	6.86	12.00	13.60	6.00	6.00	64.71	-0.29
G	12.00	19.00	5.14	6.00	6.80	12.00	4.00	64.94	-0.27
H	9.00	14.25	8.57	10.00	10.20	9.00	8.00	69.02	0.00
I	9.00	14.25	6.86	6.00	13.60	9.00	12.00	70.71	0.11
J	12.00	15.00	12.00	14.00	15.00	12.00	10.00	80.00	0.73

Fig. 8. Graph comparing TW and MSS indicators of schools

Fig. 9. Graph comparing Existing and new System

5 CONCLUSION

The School Recommender System is an innovative way of guiding parents and the general public on the performance of school which is what is being looked out for when making the choice of school. Parents or other persons of interest may not have to visit schools or send their wards to experiment but can be guided duly by the recommender system as the concerns of parents and other persons of interest are taken into consideration in the course of the design of the system.

A modified Standard Score Algorithm for Secondary School Recommender System has been developed and enhanced. The important factors that makes up an ideal school were assigned indicator % weights according to degree of importance and the total indicator weight was used to calculate the rating of each school using the modified standard score algorithm.

Collaborative filtering algorithms in which the public can generally rate schools and then these ratings are used to generate the recommended system is suggested for future work. With the proliferation of schools, the Ministry of Education (MOE) can also set up a system to guide the general public when con-

fronted with the decision of a choice of school their young stars.

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