

Design and Development of a School Timetabling System

(Paper ID: CFP/1330/2019)

Chinyama Raphael Tapa,
Dept. of Information, Communication and
Technology (ICT)
School of Education,
Information and Communications University,
Lusaka Zambia
chinyamatepa@gmail.com

Innocent Nsunga
Dept. of Information, Communication and
Technology (ICT)
School of Engineering,
Information and Communications University,
Lusaka Zambia
innocentnsunga@gmail.com

Abstract:

Timetabling is a challenge that affects almost every educational institution in Zambia ranging from preschool to university and thus requires to be solved effectively. The current system is manual which is usually done by a group of education experts. The task would take several days or even weeks before it is accomplished. Whenever this system is used collisions cannot be avoided and this has come to be noted by administrators in situations where classes collide.

Primarily, systematic allocation of time against subjects and teachers or lectures as the case may apply over a limited period to avoid collisions

remains a constraint to be solved over a onetime task in a manual system. This mammoth task can be reduced through computerizing the timetabling system. This can be by designing and development of a web-based school time table system to curb manual timetabling inefficiencies and flaws.

The objective of this study was to design and develop a web-based timetabling system where users will be able to allocate time, teachers and class effectively with minimal collisions. Several systems were reviewed to help better understand and be able to design the systems. Timetable experts were engaged to better understand how to create and construct a timetable.

1.0 INTRODUCTION

The manual timetabling system currently used in Zambia's educational institutions is quite costly as a large number of hours are invested in the timetabling process. Besides this, the manual time table system requires more human resource as many people and days of work are involved to accomplish the task.

This paper will strive to bring out the main reason why we should migrate from the current manual timetabling system to the improved integrated timetabling system to achieve simultaneous results, something that has never been achieved locally. This system is unique in the sense that not only is it able to schedule time for classes but also the content and assessments. What happens is that the time allocated to each subject tally with content so much that the system is able to determine when a particular topic must come to an end and there for determining when an assessment is to be administered. This obviously will greatly reduce on time wastage as is the case with the current system, and makes great improvement on work progress resulting in high productivity.

The manual timetabling systems poses a substantial threat to lesson progress and the normal running of the school program, as the teachers belonging to the time table committee would frequently be caught entangled in duo or triple tasks requiring their attention. As a result of this, many teachers will not find time to attend to their classes.

1.1 MOTIVATION AND SIGNIFICANCE

Being an educator, the researcher has come to notes how tedious and frustrating manual timetabling adjustments is in accordance to teacher availability. The Timetabling system provides an effortless scheduling of timetable elements apart from a series of benefits to

institutions of learning. Some of the benefits include:

i. Customization & Flexibility

This automatic Timetabling system can be fully customized to meet the unique class scheduling needs and suggestions of the school. Seamlessly it can integrate the school timetable to reduce conflicts among timetable elements like the allocation of classes, subjects and periods.

ii. Automatic Timetable Scheduling

Automatically it can create and maintain academic schedules of students within minutes. Automated Timetable Management System allows you to easily create a unique timetable for each class and subject, generate reports for different periods and automatically calculate teacher absence.

iii. Generate Multiple Timetables

The system creates multiple timetables at a time and manages different timetable databases for multiple departments with customizable notifications and alerts.

iv. Eliminate Paper-based Processes

As opposed to manual timetabling system which involves tedious paperwork and manual data entry that results in scheduling errors, automated time tabling system gives you the information you need at the right time. This improves the productivity of the learning institution and precious resources like time is well managed.

v. Intuitive & User-friendly

This timetabling Management system is simple and easy to use as technical knowledge is required to operate it. It's very easy to implement in institutions of any type or size.

vi. Optimized Resource Allocation

The system would help with the assigning of classrooms to responsible teachers for periods and optimize allocation of resources in the best manner possible.

vii. Highly Secure

This system is highly secure with role-based permissions, sessions and privileges to provide restricted access to users and ensure transparency. Therefore, the privacy and confidentiality of information is highly protected.

viii. Substitution Management

This Automatic timetabling system takes away the stress of creating the timetable from scratch when teachers are not available or absent.

ix. Localization Support

This automatic timetabling Management system offers support to multiple languages to ensure fast and smooth timetable creation in relation to the region in order to facilitate collaboration.

1.2 BACKGROUND

Bardadyn, (1996), hypothesize that many approaches and models have been proposed for dealing with the variety of timetable problems.

Problems range from the construction of semester or annual timetables in schools, colleges and universities to exam timetabling at the end of these periods.

Early timetable activities were carried out manually and a typical timetable once constructed remained static with only a few changes necessary, in order to fine tune it every semester or year (Sandhu K: *ibid*).

Barbadian's view above, we can therefore, deduce that the nature of substantial educational changes over the years and thus the requirements

of timetables have become much more complicated than they used to be.

Consequently, the need for automated timetable generation is increasing and thus the development of a timetable generation system that generates valid solutions is essential.

Sandhu K, (*ibid*) notes that as a result, during the last 30 years, many papers related to automate timetabling have been published in conferences, proceedings and journals.

In addition, several applications have been developed and implemented with various successes (Schaerf, *ibid*), some of which include:

i. QUICK Scheduler:

Which was used at Texas Tech University (TTU) back in 2005 is a web-based application that aimed to help students and academic advisors with the scheduling process. The user will input the courses he is about to take in a certain semester and the scheduler will select sections and courses that do not conflict with other classes or with other specified activities (such as their work outside school, basketball, practice, or family commitments, etc.). The final output is a one-page graphic schedule, showing activities the student has entered as well as his sleep time, study time, and class time. QUICK Scheduler also emphasizes the importance of allocating sufficient sleep and study time. A backtracking algorithm was used for producing the results (schedule). "If an acceptable schedule is not found on the first try, the student or advisor can change one or more courses or other criteria and submit again. This can be repeatedly done until the optimal schedule is found". Again, this shows an implementation of a mere human way of solving the timetabling problem, even if backtracking algorithm was used.

ii. UTTS Exam:

is the exam scheduling portion of University Timetable Scheduler (UTTS) software, an automated university timetabling program developed in the National University of Singapore (NUS), which when completed, the program was expected to automatically schedule both the course and examination timetables for all the faculties in the entire university that employ the modular academic course structure? While the exam scheduling portion of UTTS reached the deployment stage and was used to generate the 2001/2002 academic year in NUS the other portion the course scheduling is currently still under development. UTTS Exam also made use of artificial intelligence technology. It used the Combined Method for solving Constraint Satisfaction Optimization Problem (CSOP). It also made use of Genetic Algorithm with Tabu Search Post Optimization.

iii. Mobile Based Students Time Table Management System

This was created in Akanu Ibiam Federal Polytechnic Umwana, Afikpo Ebonyi state by Onuwa, Nnach Isaac in 2013. When completed it would to optimise the algorithm used in today's timetable system to generate the best of time tabling data with fewer or no clashes and also bring approved timetable closer to users especially to those who use android phones. Java, XML and PHP programming languages were used in developing the solution. MYSQL database was used as a back –end for the solution. The front-end solution will be implemented in an android mobile system for easier accessibility and proximity to users.

iv. Timetable Generation System

This was created by Andrew Biemba of the University of Zambia in 2004. Once completed it was to produce significantly better timetables

than those that were actually employed (produced by hand), it would also take a considerably shorter period of time to generate. The application was further to provide an easy, time-saving way to generate lecture timetables within given constraints. It was developed in Java, Microsoft access and an XML Knowledge Base. It was a replacement of the traditional manual way used to create lecture timetables.

2.0 MATERIALS/METHODS/DESIGN/ METHODOLOGY

This section will endeavour to look at the materials, methods, design and methodologies used in this project.

2.1 SYSTEM REQUIREMENTS

The prototype is not resource demanding and as such, any computer or laptop with a minimum of 1GB of RAM, 10GB Hard disk space as well as Mobile Phone devices with 500MB of RAM, 1GB System Disk Space would still support the application, the developer used a windows platform to develop the application, it should however, be noted that PHP is platform independent and can run on a number of available platforms

2.2 METHOD

Data was collected from the targeted learning institutions using a combination of methods, which included interviews and questionnaires. below is the questionnaire which was used:

INFORMATION, COMMUNICATION AND TECHNOLOGY UNIVERSITY
SCHOOL OF ENGINEERING
DEPARTMENT OF INFORMATION COMMUNICATION TECHNOLOGY
DISCLAIMER

Dear respondent, I am a student SIN at the Information Communication and Technology University carrying out an academic research on "web-based timetable coded RATECH Time Tabling System (RTTMS)". Be rest assured that this is a purely academic research and the information will only be used for academic purposes.

For more information, contact +260 973 899 693 or email: chinyamatepa@gmail.com

1. What is your education back ground?

- a. Certificate in education
- b. Diploma in education
- c. Bachelor with education

2. Is a time table a very important instrument in the running of a school curriculum?

- a. Yes
- b. No
- c. No idea

3. If your answer was yes in the above question briefly explain how.

.....

.....

.....

.....

4. Do you face any challenges with the current timetabling system?

- a. Yes
- b. No
- c. No idea

5. What are some of the challenges you are facing with the current timetable or time tabling?

.....

.....

.....

.....

.....

.....

6. Is there anything you think can be done to improve our current timetabling system?

- a. Yes
- b. No
- c. No idea

7. What do you suggest should be done to the current timetabling system?

.....

.....

.....

.....

.....

.....

8. Do u think assessments should be timetabled as well?

- a. Yes
- b. No
- c. No idea

9. If your answer for the above question is yes, briefly explain how.

.....

.....

.....

.....

.....

.....

10. Do you know what an automated timetabling system is?

- a. Yes
- b. No
- c. No idea

11. If your previous answer was “YES”, give an example.

.....
.....
.....
.....
.....
.....
.....

12. Would you like to use an automated timetable where the allocated time tallies with the content and later on determine when a topic must come to an end.

- a. Yes
- b. No
- c. No idea

13. If your answer is yes in the previous question briefly explain why you would like that.

.....
.....
.....

14. What would you recommend for use in school?

- a. An automated timetabling system
- b. A manual timetabling system
- c. No idea

15. Briefly explain your answer to question 13 to qualify your answer.

.....
.....
.....
.....
.....
.....
.....

2.3 METHODOLOGY

Rapid Application Development (RAD) methodology was used in the designing and development of this system. Software design is the process by which an agent creates a specification of a software artefact, intended to accomplish goals, using a set of primitive components and subject to constraints. It refers to either all activity involved in conceptualizing, framing, implementing, commissioning and ultimately modifying complex systems or the activity following requirements specification and before programming. In RAD model the components or functions are developed in parallel as if they were mini projects. The developments are time boxed, delivered and then assembled into a working prototype.

Advantages of the RAD method:

1. Integration from very beginning solves a lot of integration issues
2. Reduced development time.
3. Quick initial reviews occur
4. Increases reusability of components
5. Encourages customer feedback

Disadvantages of RAD method:

1. Only system that can be modularized can be built using RAD
2. Depends on strong team and individual performances for identifying business requirements.
3. Requires highly skilled developers/designers.
4. Inapplicable to cheaper projects as cost of modelling and automated code generation is very high.
5. High dependency on modelling skills

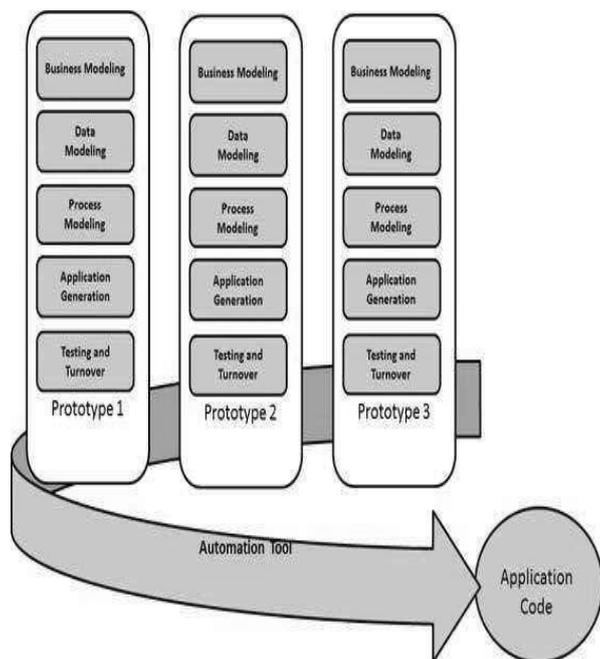


Figure 1: Rad development cycle

Source: <https://www.tutorialspoint.com>sdlc>

2.4 DESIGN

The design was implemented by using the technologies and languages listed below:

i. PHP

This is a general-purpose scripting language that is suitable for server-side web Development. PHP generally runs on a web server. The PHP code is embedded into the HTML source document. Any PHP code in a requested file is executed by the PHP runtime, usually to create dynamic web page content. It can also be used for command-line scripting and client-side GUI applications. PHP can be deployed on many web servers and operating systems, and can be used with many relational database management systems (RDBMS) and it is available for free - (Mwape, 2017).

ii. HTML5

HTML stands for hypertext mark-up language, and the hypertext refers to the fact that HTML makes it so that you can click on links in web

pages. That's the hypertext. The words mark-up language just means that it is something that you use to mark-up normal English to indicate things. Each page contains a series of connections to other pages called hyperlinks. Every web page you see on the Internet is written using one version of HTML code or another. HTML code ensures the proper formatting of text and images so that your Internet browser may display them as they are intended to look. Without HTML, a browser would not know how to display text as elements or load images or other elements. Hypertext Mark-up Language was first developed by Tim Berners-Lee in 1990.

iii. MySQL

MySQL is a freely available open source Relational Database Management System (RDBMS) that uses Structured Query Language (SQL).

SQL is the most popular language for adding, accessing and managing content in a database. It is most noted for its quick processing, proven reliability, ease and flexibility of use. MySQL is an essential part of almost every open source PHP application. Good examples for PHP & MySQL-based scripts are WordPress, Joomla, Magento and Drupal.

One of the most important things about using MySQL is to have a MySQL specialized host.

iv. JAVA SCRIPT

JavaScript is considered to be one of the most famous scripting languages of all time. JavaScript by definition is a Scripting Language for the World Wide Web. The main usage of JavaScript is to add various Web functionalities, Web form validations, browser detections, creation of cookies and so on. JavaScript is one of the most popular scripting languages and that is why it is supported by almost all web browsers available today like Firefox, Brave or Google Chrome.

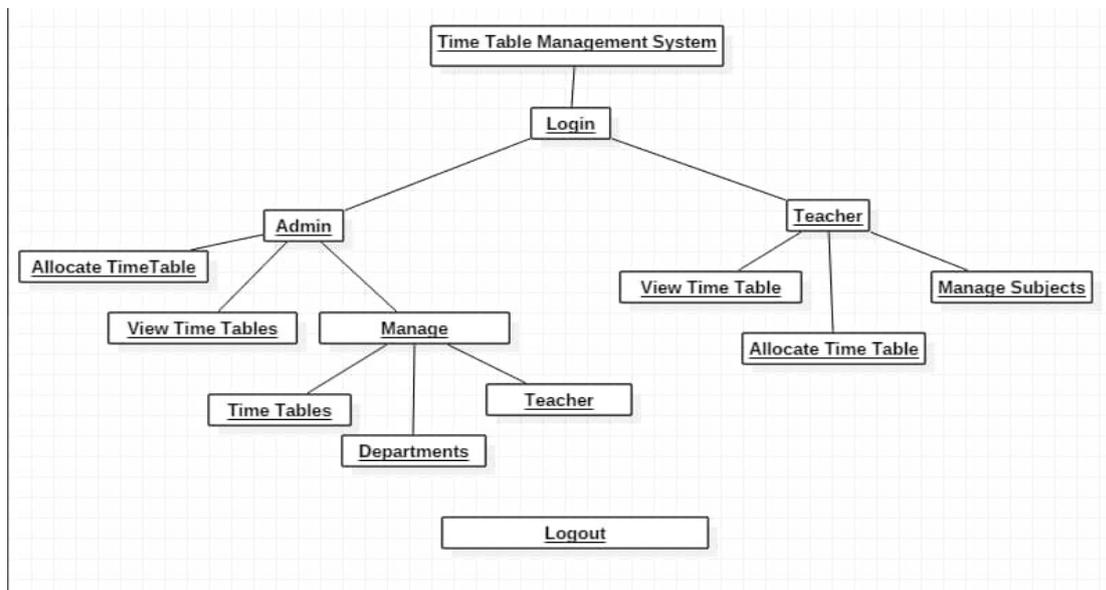
v. XAMPP

XAMPP stands for Cross-Platform (X), Apache (A), MySQL (M), PHP (P) and Perl (P). This is a simple, lightweight Apache distribution that makes it extremely easy for developers to create a local web server for testing purposes. Everything you need to set up a web server application (Apache), database (MySQL), and scripting language (PHP) is included in a simple extractable file. XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows. Since most actual web server deployments use the same components as XAMPP, it makes moving from a local test server to a live server extremely easy as well. - (Mwape, 2017).

2.6 MODULAR DESIGN OF THE SYSTEM FUNCTION

The sub-systems that make up this Time Tabling System is as shown in the figure below. These are presentation, login, manage users, allocate timetable, manage timetable, view timetable, manage classes, manage departments and manage subjects.

Figure 2: Modular Design of the system function



Source: Chinyama Raphael Tepa

a. Login

This is a module that allows the user or administrators to have access to the systems data base. It requires a login pass code without which one cannot login.

b. Admin

This is the super user of the system.

c. Allocate Timetable

This module allows the admin to adjust the timetable in terms of when the sessions or periods begin and end, how long should a session take, how many sessions should be conducted in a day, how many learning days in a week, Muting sessions in case of meetings and many other administration functions.

d. Manage Departments

This allows the admin to add departments and off course give them codes.

e. Manage Teachers

This one allows for the addition of teachers, give them user names and pass words, attach them to the right departments.

f. Manage classes

This module enables for the addition of classrooms and their capacity which makes it simple to know which class can be accommodated where.

g. Manage subjects

Here either the administrator or user adds the subject t topics identifications.

h. Allocate Timetable

This module permit's the admin or user to allocate subject topics by dragging them from the right panel to the desired or required slot.

i. View timetable

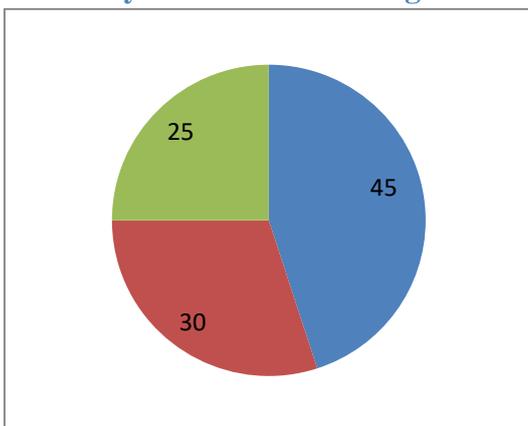
This module allows to view the actual timetable after it has been worked on. It also allows The Time Table to be downloaded.

3.0 RESULTS

This section will look at the survey results and system implementation results where tools and proگرامing languages used to develop the system will be discussed.

3.1 SURVEY RESULTS

1.What is your education background?



Figure

3: Research Question 1 Source: Chinyama Raphael Tapa

The education back ground of the respondents was such that 25% were holders of certificate in education,45% were diploma holders and last but not the were bachelor degree holders who accounted for 30%.

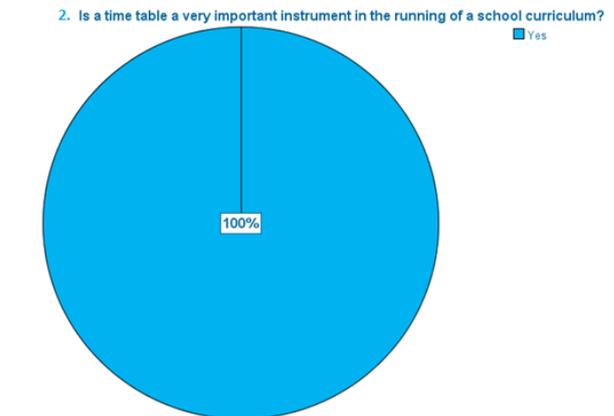


Figure 4: Research Question 2

Source: Chinyama Raphael Tapa

As can be seen from the figure, the respondents enormously agreed that the time table is a very important instrument in the running of the school curriculum.

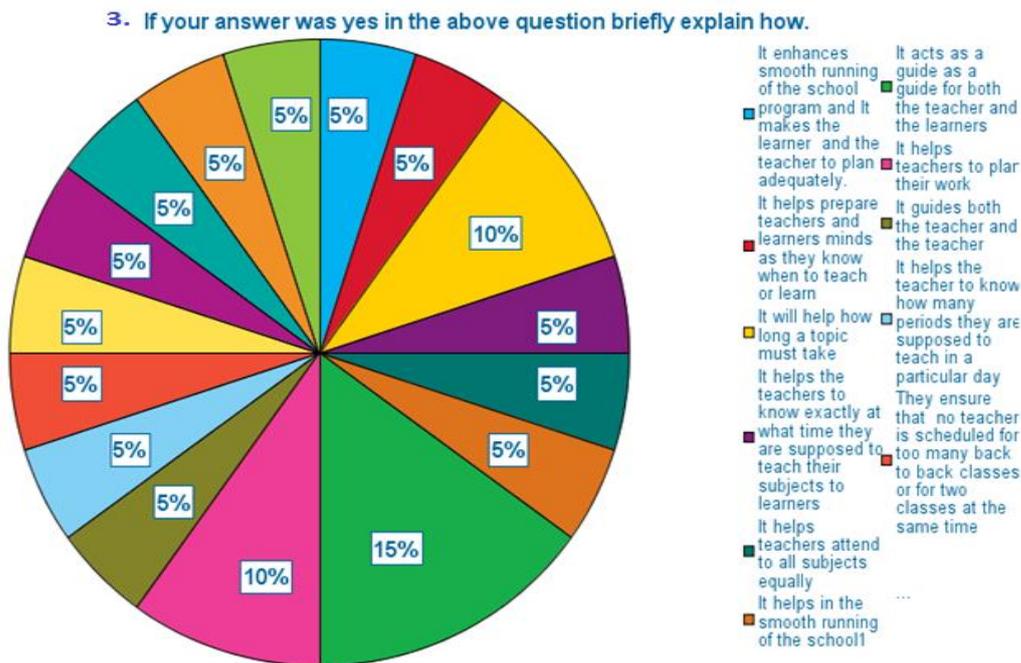


Figure 5: Research Question 3., Source: Chinyama Raphael Tepa

In qualifying their response of a 'yes' from the preceding question the respondents had divergent reasons. To start with, 5% said it enhances the smooth running of the school program and it makes the learner and the teacher plan adequately, secondly, 5% said it helps prepare teachers and learners minds as they know when to teach or learn, thirdly, 5% said it helps teachers to know exactly what time they should teach their learners, fourth, 5% said it helps teachers attend to their subjects equally, still, another 5% said it helps in the smooth running of the school, not only this, but another 5% also said it guides both the teacher and the learner, another 5% said it helps the teacher know how many periods they are supposed to teach in a day, further, 5% said it helps avoid collisions, to add on, 10% said it helps teachers not to have back to back periods, on top of this, another 10% said it helps guide how long a topic can take.

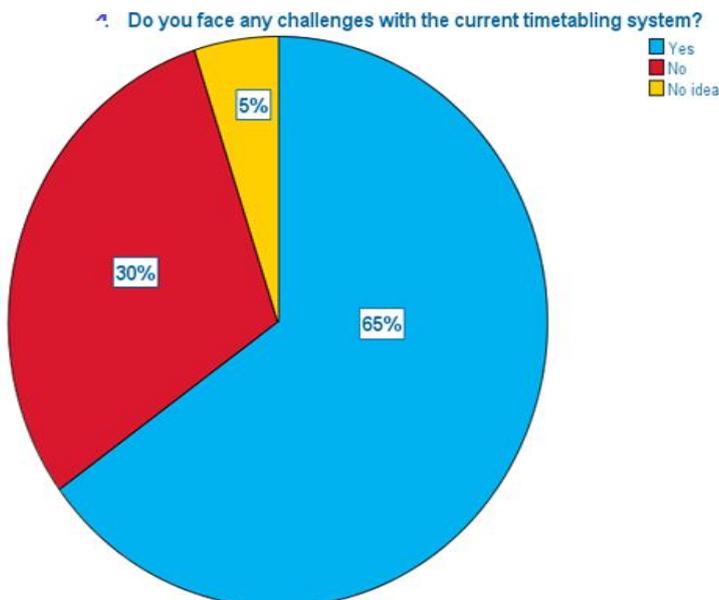


Figure 6: Research Question 4. Source: Chinyama Raphael Tepa

As regards to challenges faced by respondents with the manual timetabling system 5% had no idea, 30% had no challenges while a whole majority of 65% said they had challenges.

5. What are some of the challenges you are facing with the current timetable or time tabling?

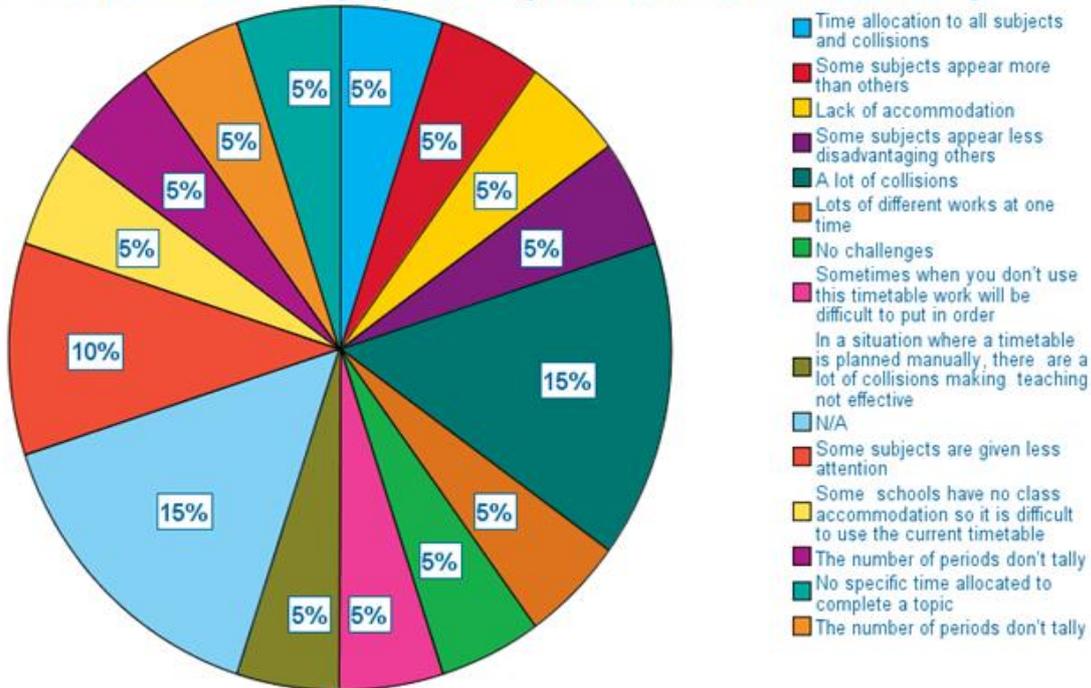


Figure 7: Research Question 5. Source: Chinyama Raphael Tapa

Once more the respondents had a divergent of views when it came to challenges, they face with the current (manual) time table or time tabling. Firstly, 5% said collisions, secondly, 5% said some subjects appear more than others, thirdly, 5% said lack of accommodation, fourthly, 5% said some subjects appear less disadvantaging others, fifth, 5% said lots of different works at one time, further, 5% said no challenges, on top of this ,5% said sometimes when you don't use this timetable work will be difficult to put in order, to go on, 5% said lots of collisions , making teaching not effective, not only this but another ,5% also said some schools have no class accommodation so it is difficult to use the current time table, moreover ,5% said the number of periods don't tally, in addition, 5% said no specific time allocated to complete a topic, still 5% said the number of periods don't tally, to go on ,10% said some subjects are given less attention, to top up ,15% said a lot of collisions, and finally 15% said nothing.

6. Is there anything you think can be done to improve our current timetabling system?

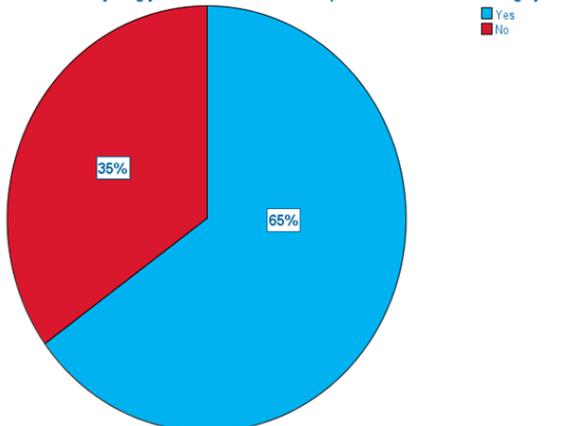


Figure 8: Research Question 6. Source: Chinyama Raphael Tapa On anything they thought to improve the current timetabling system 35% had no idea while a whopping 65% had

7. What do you suggest should be done to the current timetabling system?

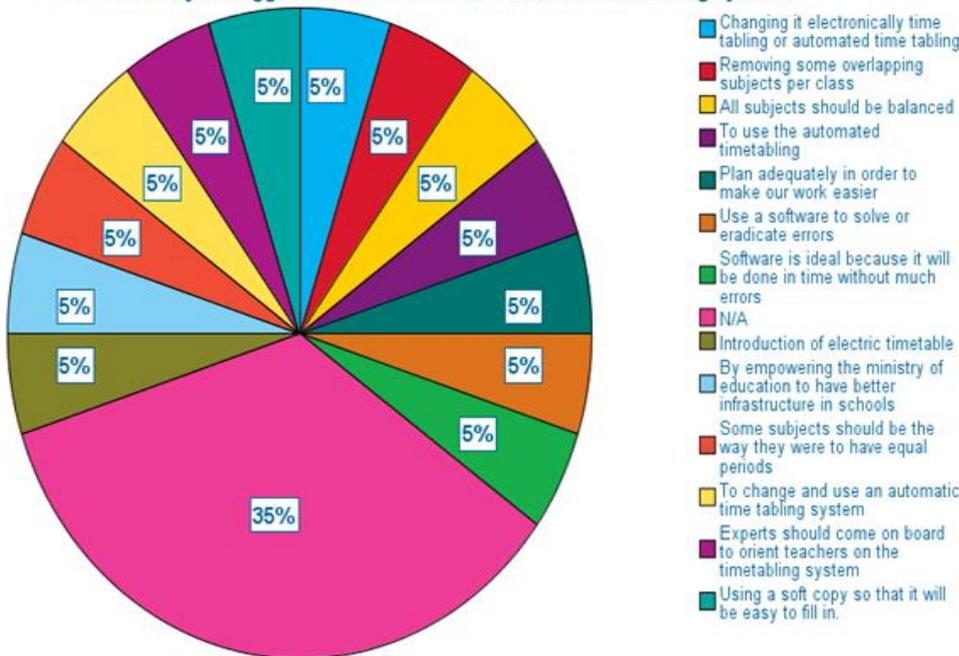


Figure 9:
Research Question 7.
Source:
Chinyama Raphael Tapa

Asked what should be done to the current (manual) timetabling system, 5% suggested it should be changed to an automated one, 5% suggested

removing overlapping subjects per class, thirdly, 5% suggested that all subjects should be balanced, fourth, 5% suggested the use of an automated time table, further, 5% suggested to plan adequately to make our work easier, another 5% suggested the use of a software to eradicate errors, still 5% suggested that software is ideal as it will be done with less errors, in addition, 5% suggested the introduction of electronic timetable, on top of that, 5% suggested having better infrastructure, not only this, but 5% also suggested a graduation to automated timetable, a further 5% suggested the use of soft copies for easier feeling in, to go on, 5% suggested an orientation on timetabling by specialists. Finally, 35% had no suggestions.

8. Do you think assessments should be timetabled as well?

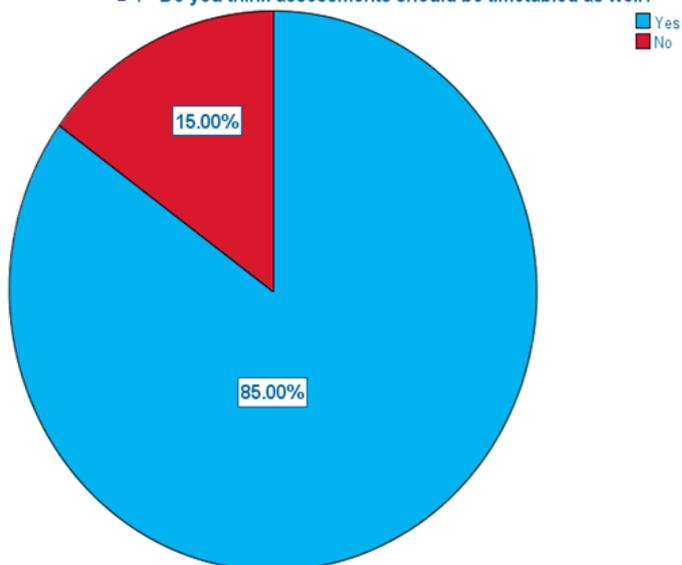


Figure 10: Research Question 8
Source: Chinyama Raphael Tapa

15% did not agree to timetabling assessments while 85% agreed.

9 . If your answer for the above question is yes, briefly explain how.

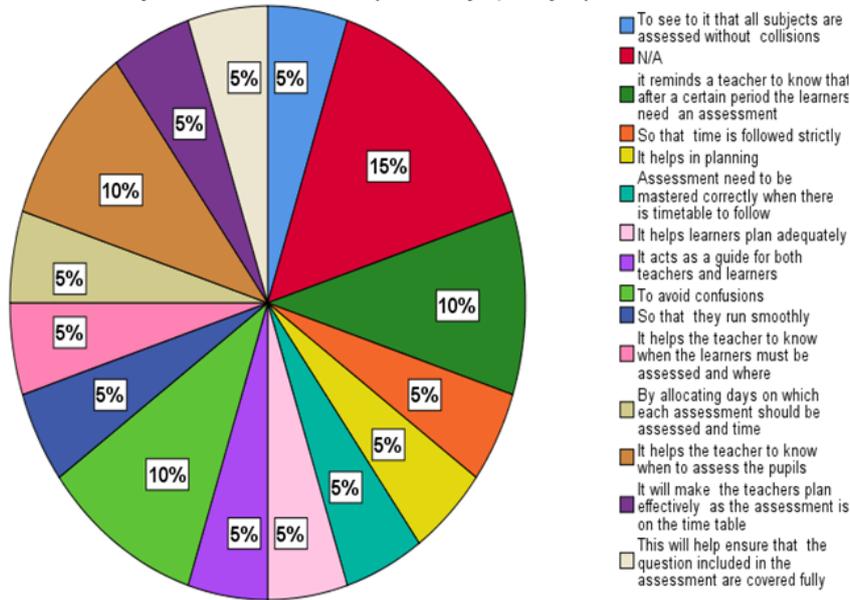


Figure 11: Research Question 9.

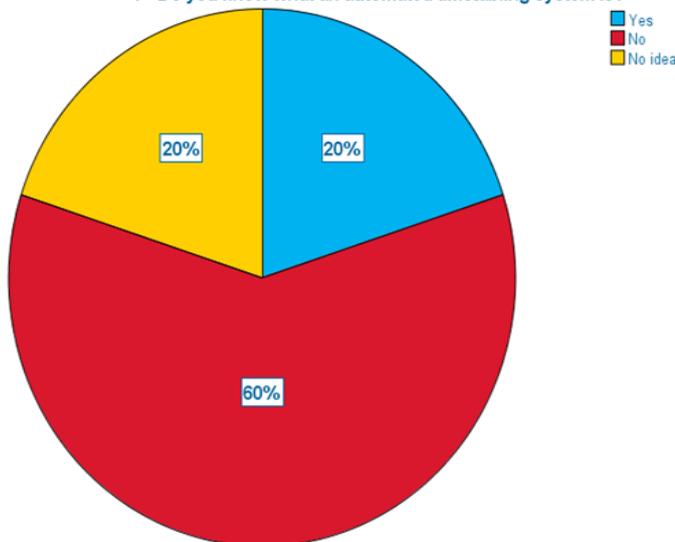
Source: Chinyama Raphael Tapa

To justify why assessments must be timetabled, the respondents had this to say: 5% said to see to it that all subjects are assessed without collisions, secondly, 5% said it will make the teachers plan effectively, as the assessment is on the timetable, thirdly, 5% said this will ensure that the questions included in the assessment are fully covered, fourth, 5% said so that it is strictly followed, fifth, 5% said it helps in planning, sixth,

5% said assessment are mastered correctly when there is a timetable to follow, further, 5% said it helps learners plan adequately, in addition, another 5% said it acts as a guide for both teachers and learners, on top of this, 5% said so that they run smoothly, not only this, but another 5% also said it helps the teacher to know when the learners must be assessed, to go on, 5% said by allocating days on which each assessment should be assessed, moreover, 10% said it reminds the teacher to know that after a certain period the learner need an assessment, still 10% said to avoid confusions, a further 10% said it helps the teachers know when to assess the learners, and finally 15% could not give any response.

Figure 12: Research Question 10. Source: Chinyama Raphael Tapa

10 Do you know what an automated timetabling system is?



60% did not know what an automated timetable was while 20% new what it was as another 20% had no idea

11. If your previous answer was "YES", give an example.

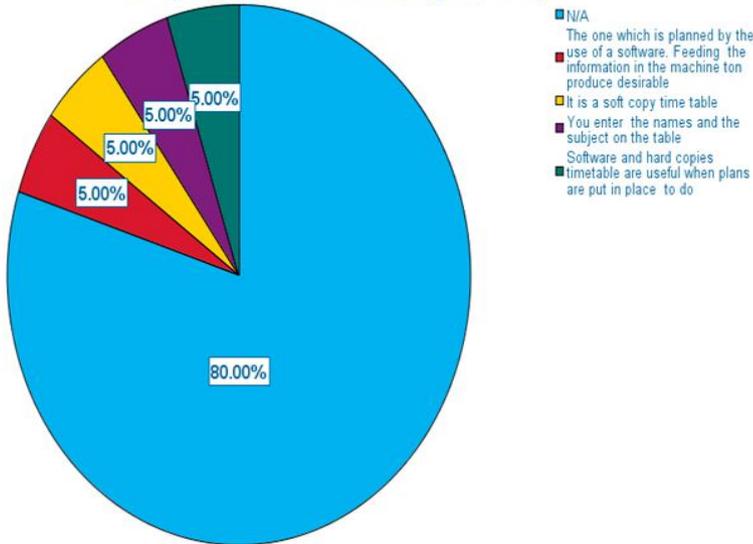


Figure 13: Research Question 11.
Source: Chinyama Raphael Tapa

On giving an example of a timetabling system 80% did not answer, 5% wrote that it is a soft copy time table, another 5% wrote that it is soft and had copy, further, 5% wrote that time tables are when plans are put in place, while the finale 5% wrote that it is the one planed by use of software.

12. Would you like to use an automated timetable where the allocated time tallies with the content and later on determine when a topic must come to an end.

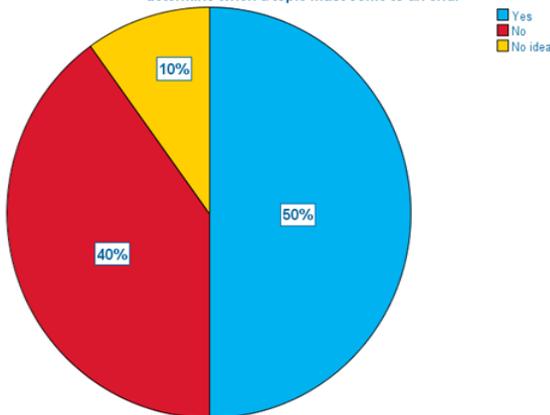


Figure 14: Research Question 12.
Source: Chinyama Raphael Tapa

50% agreed to the use of an automated timetable yet 40% did not and 10% had no idea.

13. If your answer is yes in the previous question briefly explain why you would like that.

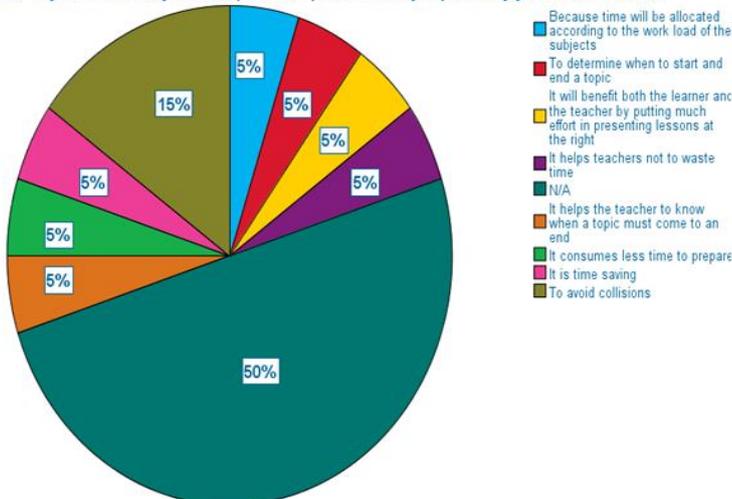


Figure 15: Research Question 13.
Source: Chinyama Raphael Tapa

Asked to give reasons why they had agreed to the use of an automated time table 15% of the respondents gave the reason of avoiding collisions, 5% wrote that it was time saving, thirdly, 5% wrote that it consumed less time, further, 5% wrote that it would help the teacher to know when a topic must come to an end, 50% had no reasons, another 5% wrote that it would help the teacher not

waste time, still 5% wrote that it would benefit both the teacher and the learners by putting much effort in presenting lessons at the right time, in addition ,5% wrote that it would determine when to start and end the topic, last and not the least, 5% wrote that time will be allocated according to the work load.

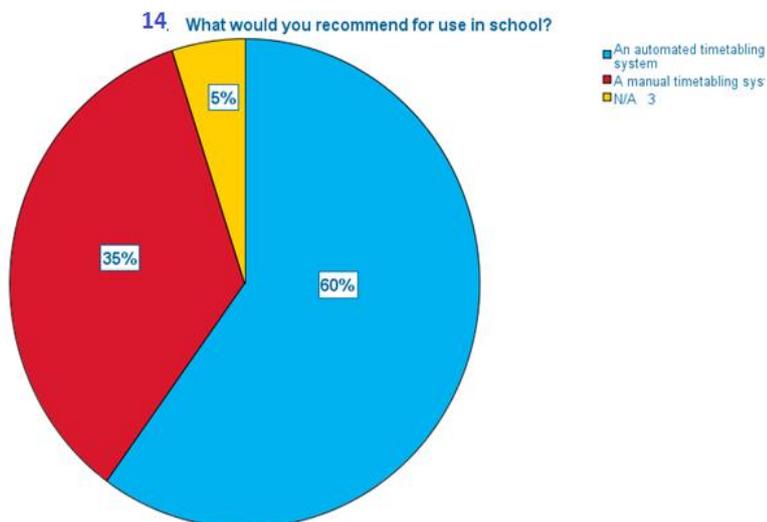


Figure 16: Research Question 14.
Source: Chinyama Raphael Tepa

On giving recommendations on what should be used in schools 60% anonymously suggested an automated timetable,35% suggested a continuation of manual timetables while 5% did not give any suggestions.

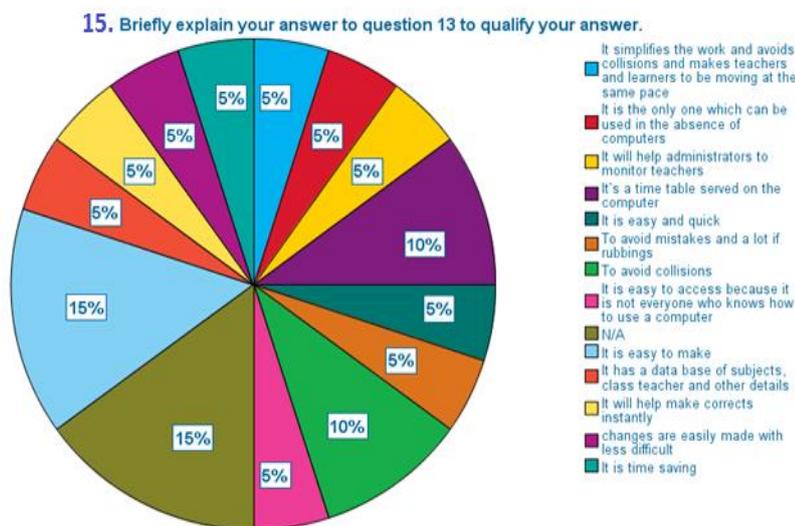


Figure 17: Research Question 15.

Source: Chinyama Raphael Tepa
access because it is not everyone who knows how to use a computer, eighth, 5% said it is easy and quick, further,10% said to avoid collisions, in addition ,10% said changes can easily be made with less difficult, to top up ,10% said it is a timetable served on a computer, to go on,15% said to avoid mistakes and a lot of rubbings, to top up 15% said it is easy to make, finally 16% said

nothing.

In explaining their answer to question 5% of the respondents said it simplifies the work and avoids collisions, another 5% said it is the only one which can be used in the absence of computers, thirdly, 5% said it would help administrators monitor teachers, fourth, 5% said it has a data base of class teachers and learners, fifth, 5% said it helps make corrections instantly, sixth, 5% said it is time serving, seventh,5% said it is not easy to

Timetabling of school subjects or courses has been a long-standing problem that has characterized the education sector for years now. This fact was confirmed at local level during a survey around schools sampled. The question to find out whether Teachers had challenges in coming up with a good time table using the current manual system was asked and the response was evident.

3.2 TESTING PROCEDURE

The testing procedures was done in two stages

- Module testing
- System testing

3.3 TESTING ACTIVITIES

The testing activities that were carried out are as follows:

- Security testing
- Testing for valid and invalid data
- Integration testing

3. 4 SECURITY TESTING FOR WEB SYSTEM

To gain access to the system the, a user is always asked to enter a correct user name and a correct password. Entering a wrong combination of user name and password displays an error message: Enter Correct User name and password.

Table 1: Security testing for web system

Test	Expected Results	Actual Results
Correct User name and Correct Password	Login dialog box disappears and user has access granted	Access to system granted
Wrong User name or Wrong Password	Error message: Invalid User name and Password	Access to system denied
Correct User name, Wrong Password	Error message: Invalid Password	Access to system denied
Wrong Username, Correct Password	Error message: Invalid User name	Access to system denied

3.5 DATA ENTRY

The following was observed during data entry.

□□ When a valid record was entered a user is alerted that the record has been added to the database and the fields are refreshed in readiness for entering a new record.

3.6 Valid Data and Invalid Data

3.7 Creating a Record

Table 2: Creating a Record

Test Data	Expected Results	Actual Results
Valid data	Textboxes are refreshed when data is stored	Data is stored and the changes seen in the database
Invalid data	Data not stored in database	Requested changes not seen in the database

Testing using valid and invalid data

3.8 Entering Incomplete Data

Table 3: Entering Incomplete Data

Test Data	Expected Results	Actual Results
Leaving some fields empty	Cursor sets focus on the blank field	Cursor set focus message prompt
Complete data	Data accepted	No message prompts

Incomplete Data

3.9 INTEGRATION TESTING

The purpose of integrating testing is to test how various modules are working together in the system. It also involved tests to find discrepancies between the system and its original objective and current specification. When the system was run using correct and incorrect data, the system collaborated well with other modules and it displayed the appropriate error messages when an error occurred. For valid transactions the system did not display any error message but simply execute the transaction. Network connectivity tests were carried out. The timetabling web system was hosted on the computer running the server and it was accessible on the internet using the browser. The tests produced required results in areas tested, modifications were made where necessary. All the tests that were conducted revealed errors. The testing was successful as many errors were found and corrected.

4.0 DISCUSSION

This section begins with the discussion then concludes with recommendation based on the results of the research. It then looks at the possible future works pertaining to this research.

4.1 DEVELOPMENT OF THE SYSTEM

The survey revealed that there was a greater appreciation in the use of timetables in schools. A time table is a tool which keeps, maintains and sustains order in mainly places of learning. It can also be used to manage conflict in schools as it dictates where and what should be done at every point in time. The discussion above motivated the design and development of an automated timetable which is able to time table content to help go a long way in effective lesson delivering.

4.2 COMPARISON WITH OTHER SIMILAR WORKS

Significant work has been made in the area of innovative use of ICTs that cover various fields of such as health, education, commerce and banking. This research acknowledges similar works that have been done before it.

4.3 POSSIBLE APPLICATION

The work in this study is an attempt to reduce time spent on timetabling by timetabling within a click of a button. It also endeavours to not only schedule time but also timetable content. This in turn will promote effective teaching and learning as it helps among other things improve syllabus coverage.

5.0 CONCLUSION

ICTs can be used to address the plight of the learning institutions such as schools, colleges and universities. A time tabling system such as this one can be used by learning institutions to save on their resources that include time and money. Application of ICTs in this manner will stimulate good governance in learning institutions and beyond. Government policies and regulations will become more enforceable and this will help rise quality of education in the said institutions. This time tabling system was developed to work either on computers or smart phones.

6.0 ACKNOWLEDGEMENTS

My biggest thanks go to the Almighty God for making everything possible for me. I also wish to acknowledge my mother Doreen Chinyama for remaining the number one believer in my aspiration. Your input and encouragement continue to invigorate and sharpen my focus to aim higher. Special thanks go to Yoram Mwape, Martin Mapoma, Audrey Susa, Kamoso, Andrew Lwila for the extensive and painstaking research work we did together which rendered this work to its current state.

7.0 REFERENCES

- [1] Bardadym, V. A. (1996), Computer-aided school and university timetabling: the new wave Practice and Theory of Automated Timetabling, First International Conference. Selected Papers. Springer-Verlag, Berlin, Germany.
- [2] Beligiannis GN, Moschopoulos CN, Kaperonis GP, Likothanassis SD (2008) Applying Evolutionary Computation to the School Timetabling Problem: The Greek Case. Computers and Operations Research, Vol. 35, 1265-1280, Elsevier.
- [3] Bello GS, Rangel MC, Boeres MCS (2008) An Approach for the Class /Teacher Timetabling Problem. In the proceedings of the 7th International Conference on the Practice and Theory of Automated Timetabling (PATAT2008).
- [4] Biemba A (2014), time table generation system, school of natural science: department of computer studies, The University of Zambia, Lusaka.
- [5] E. H. L. Aarts and J. Korst (1989), Simulated Annealing and Boltzmann Machines. John Wiley & Sons, New York, USA.
- [6] Edmund K Burke, Barry McCollum, Amnon Meisels, Sanja Petrovic, Rong Qu, "A Graph-Based Hyper-Heuristic for Educational Timetabling Problems." European Journal Operational Research, 176: 177-192, 2007.
- [7] <https://www.siteground.com/tutorials/php-mysql/mysql/>. Viewed 20th October, 2018
- [8] Institute Teknologi Harapan Bangsa. (2010). Panduan Akademik Mahasiswa 2010/2011. ITHB.
- [9] Kuswandi, dan Mutiara, Ema (2004). Delapan Langkah dan Tujuh Alat Statistik untuk Peningkatan Mutu Berbasis Komputer.
- [10] Michael W. Carter, Gilbert Laporte. Recent developments in practical course timetabling. Practice and Theory of Automated Timetabling II, pages 3-19. Springer-Verlag LNCS 1408,1998.
- [11] Sandhu, Kuldeep Singh (2003), Automating Class Schedule Generation in the Context of a University Timetabling Information System, Griffith University, Griffith Research online.
- [12] Schaerf A., (1999), Local Search Techniques for Large High School Timetabling Problems, IEEE Transactions on Systems, Man and Cybernetics.
- [13] Wright-M, (1996), School timetabling using heuristic search, Journal-of-the- Operational-Research-Society.