Question Banks: A tool for improving Higher Education Assessment across National Resource Networks: The Polytechnic of Malawi case study

Chifundo CHILIVUMBO
The Polytechnic, University of Malawi. P Bag 1, Blantyre. Malawi
Tel: +265 99 1303868, Email: Chifundo.chilivumbo@gmail.com

Abstract

Question Banks are used to increase the access to quality material for assessing the students in institutions of higher learning. A good question bank which is in line with the learning orientated assessment framework, should facilitate the, learning orientated assessment tasks, developing evaluate expertise and aid in student engagement with some feedback. This paper seeks to create a solution that will allow for these properties to be streamlined by an information solution for higher institutions to be delivered over National resource networks, with one of the University of Malawi’s constituent colleges, the Polytechnic as a case study. This paper documents the work done with the Department of Mathematics and Statistics and Language and Communication in the Faculties of Applied Sciences and Education and Media Studies respectively. Information about the assessment creation and assessment artifact storage was gathered from these two departments through the study of existent literature, observation of processes and a self-administered questionnaire given to participants from the two departments. The first version of the software was created with work being done to improve the system to ensure it’s efficiently aids the assessment process. Although the current process is paper based the system tracks the process using an electronic solution with the aim to allow for an aid to creation and research of questions and possibly in the future for electronic delivery of assessments. The system also takes into account the issue of interoperability of the new system with the Universities existing systems that support Virtual Learning and Student Information Management.

Keywords: Question-bank, Assessment-Moderation, Higher Education, Assessment Artifacts, Moderation, E-assessment.
1.0 Introduction

The University of Malawi’s constituent college, The Polytechnic, has put in place several Information Communication Technology (ICT) Systems to enhance and support its activities. It has a student management system to aid in the tracking of student data including fees, assessment results, registration statuses and student bio-data information to name a few. It also employs the use of Information Technology in the extension of services such as those offered by the Library and the teaching staff. Online library sources are offered to students both on and off campus. Virtual Learning Environment platforms are used to extend the teaching staffs’ class content to students online.

These systems as seen above have been employed in many areas of the University core activities. However, one area that is lacking in this intervention is that of assessment creation and assessment artifact storage. This paper seeks to address this deficit by attempting to introduce an Information System solution to manage and automate the assessment creation process.

Similar studies such as that of the Universities of Southampton, creating large-scale test banks found that these can be used successfully in National Resource Networks such as the National Electrical and Electronic Engineering Assessment Network. (White and Davies, 2000) This work allowed for the sharing of questions across Universities in the South Coast consortium of Bournemouth, Portsmouth and Southampton Universities. This resulted in an improvement in assessment creation at these institutions by giving more direct resources to assessment creators and thereby increasing the assessment creation efficiency.

This paper details the work at the Polytechnic to create a Question Bank for Assessment creation that can be further used in resource networks to share moderated questions across Universities, Colleges and even Community Colleges currently being rolled out in Malawi.

1.1 Overview

Assessment is an important aspect of higher education in the education of undergraduate students. It has a range of powerful impacts on what students and lectures alike do. A defined system of assessment and improving assessment has a huge impact on the quality of student learning (Boud and associates, 2009).

It is in this vein that Institutions of higher learning such as the University of Malawi have put a high priority on assessments. Assessment tells students what is valued and what they need to achieve to be successful in their studies. It captures their attention and study time, and acts as an instigator for harder work. Its results inform students of their progress, which in turn impacts on how they view themselves as individuals. (Ridgway et al., 2004).

1.2 Problem Statement

Information Communication Technology has been put in place in many of the University of Malawi’s constituent colleges, like the Polytechnic, in their core activities but very little has been implemented to assist in Assessment. The University uses ICT to support the assessment process but these systems do not help in the adherence of assessment concepts and principles that help to ensure that the assessment given to learners meets the University standards.
Assessment systems drive education, but are themselves driven by a number of factors, which sometimes are in conflict. To understand likely developments in assessment, we need to examine some of these drivers of change. One such driver is the need for increased access to education to insure inclusivity in education which is in like with developing nations Millennium Development Goals (MDG’s). (National ICT Policy, 2013)

Technological solutions such as E-learning systems are thought to by some to be the main method of achieving this. As the University moves toward these goals it would be necessary for it address the problem of having Assessment artifacts in manual scripts, which cannot be delivered over Electronic means. Therefore this paper seeks look at efforts to create a question bank as a future solution to sources of questions for e-assessment and that will address the problem while still capturing good practices in assessment development.

1.3 Aims and Objectives
The work looked at in this paper aims to develop a question bank that will capture assessment questions at their source, in this case the Assessment creator. The aim is to capture the current process of assessment creation using all its checks and balances to create higher learning standard summative assessment materials. It then seeks to ensure the long term storage of these assessment materials to be used for further assessment activities of any distinction.

The information seeks to create a system for inputting questions derived from:
1. Lecturer’s own perspective of teaching material
2. Prescribed or recommend reading text book Questions
3. Previous Assessment Questions including the modification of such questions.

The system will also accept supporting assessment information like Question weighting or grading and model answers

The aim is the creation of a system that can work with other Higher Education systems and will deal with issues of interoperability in this case the ability to integrate its questions in to other Questions banks and the ability to be shared on Resource network. These could be stand alone options like Question Mark or those in Virtual learning environments like Moodle. It will also be a system that can be accessed over several different devices seeing that Universities employ several device usage policies such as Bring Your Own Device (BYOD) and others.

Another main objective to create a system that will be easy to maintain and improve by using a model view controller development model that guides development in a well documented framework. The CodeIgniter framework was selected for this purpose. The system should also be a user-friendly application following proper heuristic guidelines and be well documented for programmer and users alike.

2.0 Assessment
Assessment is central to educational practice. High-stakes assessments exemplify curriculum ambitions, define what is worth knowing, and drive classroom practices. It is essential to develop systems for assessment which reflect our core educational goals, and which reward students for developing skills and attributes which will be of long-term benefit to them and to society.(Ridgway et al., 2004)
There has been a remarkable growth of interest in the assessment of student learning and its relation to the process of learning in higher education over the past twenty years. This interest has been expressed in various ways – through large scale research projects, international conferences, the development of principles of assessment that supports learning, a growing awareness of the role of feedback as an integral part of the learning process, and the publication of exemplary assessment practices. (Joughin, 2008)

Despite the recent growth in interest noted above, assessment in higher education remains under-conceptualized. This paper takes into account the significant contribution to conceptualizing key aspects of assessment, learning and judgment carried out by the University of Malawi’s constituent college, The Polytechnic.

2.1 E-assessment
Assessment has always been a vital part of learning and with the coming of computers, computer aided or computer-based assessment has evolved greatly. The traditional forms of testing or assessment are objective, summative, diagnostic, formal and informal and others. These need to be carried over into the electronic and online world with the tools that come with computers used to the betterment of assessment (Sclater and Conole, 2006). These tools include automated marking, storage of assessment artifacts and adaptation of questions to match student ability to name a few.

Therefore e-assessment is basically the traditional assessment brought over to the devices with computing power and adapted to use the different capabilities of this new environment. The literature available on e-assessment points to an enriched form of traditional assessment delivered by electronic devices with computing power.

As predicted by Ridgeway et al. (2004), computer-aided assessment (CAA) now forms a significant part of many students’ experience of higher education, especially for subjects with a significant mathematical/analytical content and especially at the lower levels (years 1 and 2) where assessments typically test more mechanistic skills and techniques.

Several mature technologies now exist that can reach beyond their intended audience and discipline, meaning that e-assessment looks likely to be increasingly pervasive, for example in schools or for in-service training of numeracy skills for the general work-force. Such assessment should not only simply grade students, but also should promote learning, which means that effective questions will need to be based on sound pedagogic principles. (Greenhow, 2015)

2.2 Evaluation of Assessment Artifacts
A good question bank should be able to be used in assessing factual, conceptual, procedural and metacognitive knowledge (King, 2005). This paper will look at the use of software to streamline the addition and creation of questions into a single repository of questions. This seeks not to change the process of assessment creation but to use a simple framework to evaluate the principles of the current assessment creation method at the University against this framework.

Studies have been made to formulate a framework to depicted by King, with three key drivers in learning-oriented assessment. This simple framework argues that it is these three elements, learning-oriented assessment tasks, student engagement with feedback and developing
evaluative expertise as depicted in Figure 1.1 that impact significantly on the kind of learning which students derive from the assessment process.

Figure 1.1: Learning-oriented assessment framework

The apex of the framework is represented by the assessment tasks, which students are carrying out as parts of the courses for their degree programs. Assessment tasks strongly influence how students direct their efforts. Therefore, the access to assessment artifact material is of use in both as a tool by students to measure knowledge and for lectures in assessment creation.

There is need to make distinctions between the various types of assessments. They are summative, formative, and diagnostic assessment types. Summative assessment is used for grading purposes such as final semester exams. Formative assessment is used by educators to gain feedback to assist in the learning process. While diagnostic assessment is used to determine the learners' prior knowledge (Bull and Mckenna, 2004).

Students have always learned strategically based on what they perceive as the assessment requirements of their course, however increasing demands on their time means that obtaining a qualification is the fundamental driver for growing numbers of learners.

It has been made apparent through the assessment creation process indicated in documentation available, that the University like other Institutions of higher learning sees, the realization of a qualification, as the main use of assessment. And this paper looks at the work to create a system which will ensure that lectures have access to assessment materials that have been assessed to be learning orientated assessment artifacts, and allow for the development of evaluative expertise and can be used for the student to engage with the assessment questions and provide adequate feedback throughout their learning experience.

These will be thought to be achieved by forcing the assessment process to adhere to peer review processes and allow for student access to ensure that students are able to also evaluate the questions towards their learning material.
2.3 ICT in Assessment
ICT provides a link between learning, teaching and assessment. In school, ICT is used to support learning. Currently, we have bizarre assessment practices where students use ICT tools such as word processors and graphics calculators as an integral part of learning, and are then restricted to paper and pencil when their ‘knowledge’ is assessed. (Ridgway et al., 2004)

This further raises the argument that ICT should be used to a greater extent in the assessment process. Either like in this case to simply provide a system to feed high quality questions in a central repository or to aid in assessment delivery (online or e-assessments) or as aid to marking assessments ICT can play a big part in improvement of assessment.

Questionmark Perception is an example of a complete assessment management system that enables assessors to create questions and organize them into exams, quizzes, tests or surveys. The system also allows for the scheduling of assessments and delivery of these systems in a variety of electronic means, together with the viewing of results in twelve different report types. (Questionmark Perception, Getting started Guide, 2011)

The proposed assessment solution will seek to take the concept of the creation of questions from systems like Questionmark Perception but seek to use the other University systems like Student Management Information Systems for viewing of results and delivery of assessment in the future to Moodle and currently to paper based assessment delivery. These tools will be evaluated further under interoperability of University ICT systems.

3.0 Methods and Methodology
This section methods, tools and methodology used in creating the proposed question bank. The process of collecting system requirements was done through a process of collecting University provided literature on the moderation and assessment processes and through a self-administered questionnaire. This section will also discuss the various tools used in the system development. An agile development methodology was used to develop this system using good programming practices such as version control systems, using development frameworks and the of good programming standards and proper documentation.

3.1 Evaluation of Current Systems
Being a member of the ICT team at the University allows for a greater knowledge of the ICT systems. The University currently runs several ICT systems that support the core activities of the University. These systems include student information management systems, a virtual learning environment, several types of accounting systems and even online library Management systems. All these systems can be accessed over networks and have central processing and storage architectures. This is due to its work-forces requirements.

Network systems allow for collaborative work to be done on the system by teams in different offices, campuses and even geographic locations. University staff needs access to systems all the time and across networks to work on data that needs to be manipulated by several different players. This makes systems server based systems accessed over networks to be best suited. Some lecturers still lecture while studying postgraduate courses abroad using Virtual Learning Environment’s like the University’s Moodle E-learning systems. They also need access to the student access management system for inputting student progress and student records.
The University has infrastructure to support server-based systems that it currently runs. The University also always access to these systems over the internet via an ISP that offers it Internet Services. This is then in line with the University’s policy on ICT equipment. Lectures, support staff and students are allowed access to the Universities personal computers for academic and work purposes. They are also allowed to access University systems using their own devices over BYOD policy. This makes web based systems the best fit for a University. A server-based system would also be best suited to be accessed across national resource networks.

3.2 Evaluation of the Assessment Process
An evaluation of the Assessment process was undertaken through the collection of assessment moderation literature made available at the University, general observation, and information solicited from lecturers involved in the process from the Mathematics and Languages Department though a questionnaire.

The Moderation process is Uniform throughout the University departments and the Mathematics department assessment has assessment material that uses both language like statements and the use of symbols as well. Each University Department has a moderation coordinator that is the department deputy head. The coordinator facilitates the process of moderation. The Head of Department facilitates a meeting to plan the department’s activities. At this meeting a schedule for all activities is made together with the assessment creation schedule to be ready for the final summative assessment at the end of semester.

The study used an open ended self-administered question questionnaire pertaining to the Assessment moderation. The assessment creator, who can be any member of the department, starts the process by creating an assessment artifact. The respondents included a staff associate, an assistant lecturer and a full lecturer plus the deputy head of the department. Respondents are from the faculty of applied sciences and the department of mathematics and statistics. All respondents have at one point served as either an assessment creator, or moderator. Only one is currently serving as a Moderator coordinator.

The role of the assessment coordinator involves creating assessment tools that are effective in assessing students’ retention of the content covered over the course of the semester and discriminating among the students in terms of those that are excellent, very good, good, average, and poor. The assessment creator’s responded that they create questions by:

- By selecting questions from different books but pertaining to the content I lectured in.
- Creating Short answer questions and Essay-type questions
- Using materials used for teaching, course outline objectives, and other end of book exercises

Other methods used to create questions include:

- Text Book Question Banks (Hard Copies),
- Past Assessments (Reuse of past Questions),
- Past Assessments (Modifying past questions),
- General Internet Searches
The role of moderator involves critically looking at the assessment tools created by other lecturers and ensuring that they are up to standard in terms of the language used to create the assessment tools and the level at which they are assessing students.

Moderator’s responses to the tasks they carry out included:

- Evaluating examination papers from a colleague in the same field.
- Checking if the test items
  - are in line with the objectives of the course syllabus
  - meet the required standards of the level of the learners
  - well-structured and legible
  - are compliable in the time allotted
- Checking whether there are any technical (e.g. mathematical) errors
- are looking at questions created by other assess to give an opinion as to whether they are of good standard

These tasks are put in place to ensure that the assessment criteria meets the standards of higher learning and can be used to educate learners to be able to adhere to Blooms taxonomy of learning objectives. A good question bank should contain questions used in assessing factual, conceptual and procedural and metacognitive knowledge (King, 2009). On completion, a check list in the form of completion form is filled out and handed over to the coordinator.

The questionnaire also discovered that respondents felt that any system for the assessment creation would benefit them by:

- Making sourcing of assessment materials easier
- Offering a variety of test items hence increasing chances of validity of the exam
- Saving time and resources.
- Helping to reduce the time spent on formulation /creating the assessment questions
- Being a ready source of questions that can be tweaked and reused.

The respondents thought that students would benefit from this by:

- Enabling them to prepare adequately for assessments
- Students would be able to revise course work through a question bank hence help them prepare well for assessment.
- They could be in a better position to understand how the Lecturer asks questions, what they look for in a question and be well prepared i.e. they could analyze the questioning technique and will prepare well
- It would be a repository of questions with topics that may come up in an exam.

The respondents also felt that the necessary items that need to be stored for a Question bank to be stored where:
Figure 2: Moderation Process Diagram

The process can therefore be noted as in the diagram above. It starts with assessor who submits the assessment within the department timelines. The coordinator receives them and then selects moderators or in some cases shares to the whole department. The moderators then moderate the questions. They then fill out the moderation form that has a detailed check list of things to moderate on. This is submitted to the coordinator who then returns the comments to the assessor who works on the questions and then returns the reworked questions to the coordinator. The process either ends here and a final paper is accepted for the assessment or the processes are repeated from the selection of moderators (different moderators may be selected).

3.3 System Development Considerations and Methodology
After the process was evaluated it was necessary to document the evaluation and analysis in such a way that the relevant inputs, outputs and processes would not be missed. The evaluation of current University systems discovered that currently most of the systems that directly support student learning are browser-based applications. This was done to accommodate the access of these systems from several devices from users running different
operating systems and varying geographical locations. Therefore a similar type of application is suggested here for the same reasons as the other systems, accessibility over networks using varying operating system devices.

3.3.1 Interoperability
Interoperability describes the extent to which systems and devices can exchange data, and interpret that shared data. For two systems to be interoperable, they must be able to exchange data and subsequently present that data such that it can be understood by a user. (HIMSS, 2015)

Any system that is to be created and used in an environment must have the ability to work with other systems and share data for common organizational goals.

The browser- based systems available at the University that directly support student learning are the Student Management Information System (SMIS), and Moodle a Virtual Learning Environment(VLE). SMIS is a PHP and MYSQL based application created in house at the University for the tracking of student data. It allows for the inputting of grading, financial and demographic data for students.

Moodle is open source or free software (GPL). It is written in PHP. It will run on most common web servers, on common platforms. It requires a database, and will work with MySQL, PostgreSQL, Microsoft SQL Server or Oracle.

Moodle focuses on providing an online space for teaching and learning, rather than any of the other systems that an educational organization might need. Moodle provides a basic implementation of the other functionalities, so that it can function either as a stand-alone system or integrated with other systems. The role Moodle plays is normally called a virtual learning environment (VLE), or learning or course management system (LMS, CMS or even LCMS). Brown, A. & Wilson, G. (2015)

These two systems support assessment at the University by either keeping record of student progress or as an assessment delivery method. All student grades are stored in SMIS and some lectures use Moodle for formative and diagnostic assessment. However all summative assessment is done through written papers.

Therefore any Question Bank system had to be created with the thought of inoperability in mind. Since PHP is the common programming/scripting language together with MYSQL for database connectivity for systems at the University, this was the scripting/programming language chosen. To keep up to date with good programming principles a Model View Controller(MVC) framework, Codeigniter, was decided upon.

3.3.2 Defined System steps
From the evaluation and analysis of the process of assessment, the steps of the process where ascertained as follows:

The assessor produces a hardcopy of the assessment during the said timeline for the department. He/she then submits this to the moderation coordinator who then selects specialists for that area or subject to moderate the test paper. This coordinator can also decide to share the assessment with the entire department to solicit comments from all members.

This is then moderated with the moderators filling out a moderation form that serves as a checklist to ensure a thorough and in depth process of assessment quality assurance. Then the submissions are submitted to the coordinator who is the deputy head of department and again in hardcopy on the moderation form.
The moderation coordinator then receives the changes and then resubmits to the assessor who then edits his/her questions if necessary according to the responses. They then resubmit to the coordinator who can either ok the paper for submission in portable document format or restart the moderation process.

Hence the Steps in the Process are:
1. Submission to Coordinator of draft assessment
2. Coordinator identifies Moderators
3. Submission of Questions to moderators
4. Moderations process takes place
5. Moderators submit moderation form
6. Coordinator redirects comments to assessor
7. Assessor makes edits
8. Assessor resubmits to Coordinator
9. Coordinator accepts paper as final or repeats step 3

3.4.3 Methodology
After a complete evaluation of the process of moderation and taking into account all the considerations, an agile methodology of development was decided upon. This will involve an incremental systems development in an event-driven development cycle using the model view controller framework.

The development will centre around the activities of the key players seen in the process. The identified players are:
- Assessor
- Moderation Coordinator
- Moderator
- Students

Use cases were developed for the processes described in figure 2 and an incremental development model was used to incrementally development or modules and functionalities for each user.

Each use case contained these attributes:
Background Information:

<table>
<thead>
<tr>
<th>Table 1: Use Case Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use Case Title</td>
</tr>
<tr>
<td>Version</td>
</tr>
<tr>
<td>Package</td>
</tr>
<tr>
<td>Summary</td>
</tr>
<tr>
<td>Primary Actor</td>
</tr>
<tr>
<td>Secondary Actors</td>
</tr>
<tr>
<td>Inherits</td>
</tr>
<tr>
<td>Includes</td>
</tr>
<tr>
<td>Extension Points</td>
</tr>
</tbody>
</table>
**Business Rules**

**Pre-condition(s)**

A typical sequence of events

**Table 2: Sequences**

<table>
<thead>
<tr>
<th>Actor Stimulus</th>
<th>System Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 [User steps]</td>
<td>2. [Question Bank System Response]</td>
</tr>
<tr>
<td>3.</td>
<td>4.</td>
</tr>
</tbody>
</table>

Relevant Information:

**Table 3: Relevant Information**

<table>
<thead>
<tr>
<th>Post-condition(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
</tr>
<tr>
<td>Outstanding Issues</td>
</tr>
<tr>
<td>Author</td>
</tr>
<tr>
<td>Notes</td>
</tr>
<tr>
<td>Version History</td>
</tr>
</tbody>
</table>

Alternative sequences of Events from the typical sequence of events:

**Table 4: Alternative Information**

<table>
<thead>
<tr>
<th>Actor Stimulus</th>
<th>System Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Continues from typical sequence]</td>
<td></td>
</tr>
</tbody>
</table>

**4.0 The Application**

**4.1 Welcome screen**

All the user cases will go through the welcome screen. So instead of including it into all the user cases it was case studied on its own. The system has a welcome screen that is the first thing that user sees when entering the system. Ideally the link to the system would be found on the University website. When this link is clicked it will divert the user to the welcome screen. A brief explanation of the system can be found on the welcome page together with options for moderation process or simple question bank search. The system welcome was created as below.
The search option will give the user access to a simple search or filter questions by Coursecode, question content or year when question was used. This can be seen in the screen shot below.

**Figure 3: Welcome Screen**

**Figure 4: Search Screen**
4.2 Assessor and login Use Case:

Input View

The assessor question input case. This involves the assessor or moderator or coordinator being already registered in the system by the coordinator. They then enter their credentials in the login screen as below.

![Login Screen](image)

**Figure 5: Login Screen**

The login credentials are provided the administrator of the system. Existing members of the system can add new users. This can be done in the login area that will be seen in the register section.

Once the assessor has successfully entered the system they will be presented with a user area as seen below:
The screenshot above shows the Question bank main area. This screen has all the main menu elements for the system including the current dashboard screen. The Other sections are moderation, reports, register, search and logout.

The main dashboard area has the main area of the system, which is Assessment artifact creation. This area allows for the inputs of:

- Course Code
- Question Title
- Question
- Model Answer
- Weight
- Semester
- Year

The assessment also allows for the entered questions to be edited or completely deleted. The pencil symbol will give the assessor access to the window for editing question inputs. This allows for edits to be made to the appropriate section of the question. Like shown in the image below:

**Figure 6: Assessors Screen**

The screenshot above shows the Question bank main area. This screen has all the main menu elements for the system including the current dashboard screen. The Other sections are moderation, reports, register, search and logout.

The main dashboard area has the main area of the system, which is Assessment artifact creation. This area allows for the inputs of:

- Course Code
- Question Title
- Question
- Model Answer
- Weight
- Semester
- Year

The assessment also allows for the entered questions to be edited or completely deleted. The pencil symbol will give the assessor access to the window for editing question inputs. This allows for edits to be made to the appropriate section of the question. Like shown in the image below:
The left sidebar in the dashboard is dedicated to the comment area. This can be used to add comments to this assessor area obtained from the moderation report. The assessor can then tick off every comment he adds to his questions by using the tick. He can also delete the comments by using the x symbol. This feature is common throughout the system.

When the assessors feels they have completed all their tasks in this area they can now select the notify coordinator link. This link will allow the user to send a notification of completion mail to the coordinator. Please note this system is currently only for the mathematics and statistics department as per the evaluation. So the email will be sent to the coordinator for the Mathematics and Statistics department who is the deputy head of department. The email address is hardcoded so that it can only be changed from the backend. The snapshot below shows the notification screen.

This area will allow the assessor to enter their Name and Email and any other relevant message for the use of proper coordination or moderation of the proposed assessment material. Currently this area could be used to state the assessment materials timeframe. There was a conflict between trying to force the assessor to enter a time frame for each question or to allow for a timeframe for the entire assessment. This problem arises due to the fact that all the researched past papers only contain a full paper timeframe but the system seeks to allow individual question artifacts to be stored. This would need to be furthered researched to find an acceptable method of indicating time per question if acceptable by assessors or to just have the total amount of time for the full paper tagged to each question.
4.3 Processes

This section includes the processes of edit, delete and option select. The questions inputted into the system have a functionality to allow the assessor to edit the contents. This could be as a result of comments made during moderation. The system also allows for deletion of questions and comments. The x symbol allows for these actions for both. The correct tick ✔ in the comment section allows for the user to highlight or highlight comments that have been worked on and can be used as a checklist for accommodating changes.

4.4 Error Messages

The assessor’s area has several error messages that appear. Each area has validation methods to ensure that the user follows the right critical when working in the system. The validation scripts are created using codeigniter tools as well as java-script pop ups and flash areas that appear in the system screens. The login area has been set to validate and confirm the username and password fields. The username and password are verified against the username and passwords found in the user table of the systems database. Currently the admin password is hardcoded into the system. The application will finally be altered to include a user administration page for all users.

Any miss in inputting the username and password into the system will result in the system responding to the user with an invalid login message. The system is case sensitive and will only accept inputs that match the system database record exactly. The type of input error response can be seen below.

![Figure 9: Invalid Login](image)

The user will be prompted to enter the correct credentials to access the protected session areas. Both the username and password are considered required fields and any omission of these will prompt the error shown above. This allows for some system security to ensure that there is never any unauthorized access to the system. If the User enters the correct credentials they are brought to the questions input page with the full dashboard.

The assessor area also has some validation checks in place. The system will output errors for any errors made in inputting empty fields for required areas which are all the areas except for the model answers which have been identified through the questionnaires as a non- required area and is optional. Any omission in these areas will result in validation errors appearing here. A snapshot has been shown below.
Figure 10: Validation Error

The screen shot depicts the required fields omitted in the system input. This is prompted upon clicking the create button without having completed the required inputs properly.

The system also has x symbols in the question side bar and the comments side bar. These symbols represent the delete action. The action can be called by clicking the symbol. A validation method appears to ensure that you are certain that you want to actually carry out this action. This is to prevent accidently deleting a desired item permanently. The validation confirmation screen can be seen below.

Figure 11: Delete Confirmation Message
4.5 Coordinator and login case:

The coordinator uses the same login case as explained in the assessors case. Although the assessor is the main user of the system the coordinator has the admin login and is responsible for registering assessors and moderators alike. The coordinator logs in with administrative rights and then registers the users.

Coordinator Input Views
The coordinator fills out the form for the moderators and assessors and sends an email to the selected member of staff to login and perform their tasks. The process of information sharing is purely by email. The system notifies by email. And the coordinator sends emails to inform the users that they need to perform their tasks.

![Figure 12: Register View](image)

4.6 Moderator Use Case:

Input View

The moderator area has a search area that allows for the moderator to select the material to moderate on. The moderator enters the course code for the subject he wants to moderate on. The system will display only that course. The system is designed only to store active questions for moderation. When questions have been used for assessment they can then be removed from the current database to the search database for where all questions can be viewed. These questions will also be transferred into the Moodle database for formative and diagnostic assessment by lectures and self evaluation by students.

This area also has the comment area. The comment area allows for comments to be made on questions seen in this area. The comments made are not saved in this area but are added to the assessor comments section. Once the moderator clicks the link for the moderation form the comments get moved to the assessor seen below.
When the assessor finishes looking at questions here they fill out the moderation comments form. Here they check that the assessment meets the criteria. All the questions are required and the moderator must answer all the questions. This is the acceptable format for comments and will all be fed into the reports section of the application.

Figure 13: Moderation Report Form View
When the moderator completes the form they can then submit it. They then send the completion email to notify the coordinator that the task has been completed. The form is the same as the notification form for the assessors completion of tasks.

Outputs

The moderator outputs consist of the questions for the particular searched paper code. The moderator will have filtered all the course to moderate on and view only relevant content. Then all the inputted comments can be searched again according to course code to filter out the irrelevant sections. The headings have pop up titles that appear on a mouse arrow hovers over them for the complete questions for Q1 up to Q12.
Processes:

The search process allows for the moderator to filter out all the non-essential questions and focus on the correct questions. This is also true for the report view where the user accessing this page can also filter out unnecessary comments and focus on the necessary questions.

4.7 Search Case (Question Bank area)
This area allows for the assessor, coordinator to search through the complete database of questions. This can be used to assist in creation of new assessment material.

![Figure 16: Question Bank Search Area](image-url)

5.0 Discussions and Conclusions
The Question Bank solution looks at creating a method of collecting moderated questions using an already existing tested methodology of creating higher learning assessment questions for summative testing. There for the system allowed for the assessor to input the questions that they create from their various sources via an online system. The lecturer still however has control over the process of question creation and ensures that they are used in assessing Factual, Conceptual, procedural and Metacognitive Knowledge.

The system also caters for a level of quality assurance. To ensure that the lecturer adheres to the concepts of Blooms taxonomy of learning framework for approaching the problem of assessing for higher learning outcomes, checks and balances where added. The system incorporated a moderation approach to ensure that the assessor adheres to this standard. The moderator has to ensure that the paper meets particular criteria pointed out in the moderation form. This form is main deliverable of the moderation process and must be completed and submitted to the system. The system also allows for a notification to be sent to the Coordinator via email to ensure that this process has been done successfully.
A simple framework argues that these three elements, learning-oriented assessment tasks, student engagement with feedback and developing evaluative expertise that make up a good assessment system. (Bull & Mckenna, 2004) Hence the need to evaluate whether the system created allows for these elements to be included in assessment and to what extent.

The lecturer or assessor is main actor in the assessment creation process and is there responsible for these elements to be addressed in assessment. This system only aims to create a tool to aid them. The system ensures that the assessment tasks and questions are of a higher learning standard that are learning orientated and develop evaluative expertise by forcing the lecture to adhere to these standards through moderation. For instance in question 8 of the moderation form it says “Do the exam items test the various levels of: knowledge comprehension, analysis, synthesis, application evaluation etc.”. This question amongst others seeks to ensure that the two elements are adhered too.

The other element of student engagement with feedback seeks to be addressed in the provision of access to past assessment materials through the search system. This will allow students to properly prepare for assessment by engaging with the material in easy to access system and then engage the lecturer throughout the course on items where they need clarification. Therefore I feel that the system does act as an aid to creating assessments for higher learning to a very high degree.

Other system objectives included some security features that I feel have been addressed by using a framework that includes database security features including data injections. The use of sessions to secure page content and the use of email field hiding to protect the notification page from being attacked from spam bots.

5.1 System Testing
Inputting sample tests collected from lecturers was met with general success when testing the system. The system allows for the input of symbols as well but would need the expertise of a seasoned computer user. This will need the use of shortcut keys to input special symbols used in Mathematics and Statistics.

5.2 Future work
The current system will still need a lot of work for it to be properly implemented. Some tasks that were planned for like user evaluation were not carried out due unavailability of staff due to a student strike at the University causing some lecturers not to be physically available on campus. This evaluation would have streamlined some need for interface changes and features that could improve the system.

However an expert analysis produced a list of proposed future work:

- Creation of a user administration area
- Creation of a suitable time per question system
- Creation of a print function to allow for the printing of question papers from system
- A software keyboard for symbols, to allow for specialized symbols to be inputted into the system.
- Creation of a function to move questions used in assessment from the moderation database to the general assessment database for students to utilize
5.3 Conclusion

The University of Malawi’s constituent college The Polytechnic has a very good process of assessment creation. They have put in place the necessary measures to ensure an educated student that can be able to enter meaningful employment in various sectors of society. This project sought to mirror this process without losing out on any of the current good but manual practice features of the current system. It has to a very good level succeeded in that, but it has, however, not been tested in a real assessment situation for there to be a true verdict on its ability to aid in the assessment process.

Similar projects such as the National Electrical and Electronic Engineering Assessment Network were successful in creating a task force to create a system that could be used across Universities.(White & Davies, 2000). The issues include a generalized naming structure, keywords for searches and system of grading questions into levels that can be used across Universities and Colleges. The emergence of technical community colleges and private Universities can benefit from experienced knowledge from established institutions of higher learning like the Polytechnic. But the questions and artifacts need to be structured and delivered in a method that would best benefit different institutions.

With the establishment of the National Council for Higher Education (NCHE) and the development of MAREN (Malawi Research and Education Network) the structures for organization and delivery of such question banks are possible. This paper seeks to bring to light the benefits and the work done towards this goal of a unified question bank system for national use.

6.0 References


Malawi Government,(2013) National ICT Policy. The Republic of Malawi, Malawi


**Biography**

Chifundo Chilivumbo is an IT professional currently working in the field of E-Learning and E-Health Systems. He has over 10 years’ experience working in the IT Sector. He is currently working as a the E-Learning Specialist for the University of Malawi’s constituent college The Polytechnic and also serves as a Senior Consultant for Vital Wave evaluating Health Systems in Malawi. He holds a BSc in Computer Science and an MSc in Software Engineering. He has a passion for using ICT for development in Malawi and developing countries.