The creation of an online questionnaire module for an open source virtual learning environment which performs statistical analysis on data collated.

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SUMMARY

The aim of this project was to produce a questionnaire module for an open source virtual learning environment which produced meaningful information from the data collated. The resulting software allows teachers to create questionnaires and offer them to the students. Students are given the ability to take questionnaires online or offline. The results from these questionnaires can be illustrated in multiple graphical formats.

The solution allows teachers at the Derek Fatchett centre the ability to create closed question questionnaires and offer them to the students. The results can be viewed in three graphical formats, allowing the teachers the ability to choose the graphical format which bests represents the information. The students are not restricted to taking the questionnaire online they also have the ability to easily transfer and print the questionnaire off using the PDF version of the questionnaire.

Whilst the system was not implemented into the school due to extending requirements, it did exceed all the requirements gathered at the requirements gathering stage of the project.

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Table of Content

1. Introduction

1.1 Problem Statement

Open source environments are becoming ever popular, allowing individuals, institutes and now the education sector the ability to have up to date systems for free. The Derek Fatchett learning centre, Leeds, uses the virtual learning environment Moodle to help in educating students enrolled on their courses.

The aim of this project is to extend the virtual learning environment by producing a questionnaire module that allows teachers to create questionnaire in order to gain feedback. Expressing the information in an easily digestible format will maximise the output and allow the courses to be better tailored for new students. The teachers at the Derek Fatchett centre identified the need for the questionnaires to be taken offline as well as online so a suitable format must be found to enable this. The questionnaires taken offline must be easily integrated into the result set of students who have taken the questionnaire online.

1.2 The aim of the project:

The aim of my project is to produce a questionnaire module for the open source virtual learning environment Moodle. The software will enable users to design, deliver and collate questionnaires online, and produce detailed reports using statistical analysis with graphical representation of trends.

1.3 Objectives:

The objectives of the project are as follows:

1. Research open source VLE
2. To outline benefits of using an open source virtual learning environment.
3. Establishing the system requirements.
4. Creating the questionnaire module.
5. Implementation and testing.
6. Evaluation of the implemented system.

1.4 Requirements:

The minimum requirements are:

1. Questionnaire generating module for Moodle.
2. A statistical analysis system with graphical data representation.
3. A system which can be seen to operate in the work place.

1.5 Possible extensions:

Possible extensions to the project are:

1. Supplying support for multiple output formats (HTML, PDF)
2. Analysis of different data mining techniques and algorithms.
3. Multiple graphical representations e.g. graphs, pie chart

1.6 Deliverables:

The deliverables of this project are:

1. The questionnaire Moodle module.
2. The final year report.
3. User manual.

1.7 Project schedule:

1.7.1 Initial schedule

Appendix B shows my initial schedule outline for the project. The schedule shows the two phase approach which has been adopted. The key milestones of the project are highlighted below:

- 16/10/2005 – 01/01/2006 Background reading – During phase one, I will be constantly referring back to researching in order to correctly implement stages and check for any alternative approaches.

- 01/11/2005 – 26/11/2006 Carrying out interviews and observation – Interviewing the Client to establish system criteria, and watching how the current system works and how the users interact with it.

- 16/10/2005 – 01/02/2006 Span of Phase one – By the start of January I hope to have a working system ready for the testing stage.

- 01/02/2006 – 10/04/2006 Phase two consists of a lengthy testing stage, where after completion of each of the revised tasks, it is tested again to make sure it meets user requirements and is user-friendly.

- 16/04/2006 – 01/05/2006 evaluation and implementation – This stage will involve evaluating the system and implementing the system into the school.

- 24/10/2005 – 01/05/2006 Writing up – The writing up of the report will be carried out from the start to finish of the project in order to keep the final workload down as well as the ability to works at a constant pace.

1.7.2 Actual schedule

Appendix B contains a revised version of the project gantt chart. The revised gantt chart shows that I still tried to keep a 2 phase iterative approach. The initial chart did not contain any time for revision for my January exams leaving me 2 weeks behind. Also taking on another module in the 1st semester slowed my progress but helped me to catch up in the 2nd semester.

- 16/10/2005 – 21/12/2005 Background reading – The majority of the background reading was completed one week in advance. Any further reading required such as security issues when developing a PHP system were not carried out until the implementation of phase one.

- 16/10/05 – 25/02/06 Completion of phase 1 – Due to taking an extra module in the 1st semester the completion of phase one ran over by 3 weeks.

- 05/03/06 – 30/04/06 Phase 2 – As I surpassed the time spent on phase 1, I had to reduce this phase to fit the project into the remaining time span.

1.8 Evaluation criteria

In order to measure the success of the project, a set of evaluation criteria has been derived. Evaluating the solution against the criteria set will determine how much of a success the project was.
The set of criteria are as followed:

1. Evaluate the chosen methodology
2. Evaluate against minimum requirements
3. Evaluate against user requirements
4. Evaluate against usability
5. Comparison of solution against existing solution

2 Background research

This section outlines the important issues surrounding open source virtual learning environments (VLE) and the production of a questionnaire module. It is vital, since the module could be made available to the public that the area of what an open source system is and the benefits it offers the users, are fully explained. The module must fit in with the overall aim of a VLE as well as the functionalities of a system, which is implemented in a school environment i.e. accessibility by all possible types of users.

2.1 Questionnaire generators

A questionnaire generator allows users to easily create questionnaires which can either be displayed online or printed off for distribution. The generator reduces the effort required from the users, in order to achieve their goal. The aim of a questionnaire is to gather people's opinion on set matters. To achieve this, the questionnaire must be well structured and simple for the user to fill out. If the layout is not flowing then the user will lose interest, and will not fill out the questionnaire with their accurate opinion.

There are many free and commercial questionnaire generators on the market.
EQUIP [19] provide two commercial questionnaire generators, one of which works online allowing the questionnaire to be placed on websites for users to take, where as the other is for offline use. Both of the software's allow the user to tailor the layout of the questionnaire, and enabling the use of graphics and background images for a professional finish. The questionnaire generators support multiple question formats, including radio, checkboxes (for multiple answers) and text fields. The advantage of supporting multiple questionnaire types, is that the user can get results with the use of open and closed questions.

2.2 Open source

An open source system is a system whose source code is freely available for people to download and alter. The online encyclopaedia Wikipedia [9] describes 'open source' as "software whose source code is published and made publicly available, enabling availability to copy, modify and redistribute the source code without payment of royalties or fees" . Since the source code can be modified the program can be customised for individual needs. Golden [28] expresses open source as a "relatively new phenomenon" which is not fully understood or utilised by potential users. Golden [28] then goes on to highlight some of the common misunderstandings when discussing open source software.

The Open Source Initiative (OSI) [10] which is a company set up in 1998, aims to manage and promote the open source definition by certificating system/programs as open source. For a system to be defined as 'open source' it must conform to the open source definition, consisting of 10 parts which can be found at the OSI website [10].

Meeting these 10 criteria will allow for the software to be certificated by the OSI as open source and under the licence the software is legally free to distribute and modify.

2.2.1 Benefits of Open source systems

There are many benefits associated with open source systems resulting in more secure and reliable systems. Some of these benefits are discussed below:

- The source code allows businesses to tailor the software to meet their own specific needs.
- Many eyes looking at the same code can pick up on security issues and as a result can be modified to reduce any security risks. Businesses can see the underlying code and look for themselves for any risks, therefore amending any flaws in the code.
- The coding of a system can rapidly improve as more changes are made. The program can become more efficient.

2.2.2 Drawbacks of Open source systems

There are drawbacks to open source. If they were perfect everybody would choose to use them. Some of the drawbacks of open source systems are highlighted below:

- As the code is viewable to all, malicious hackers will have the ability to find vulnerabilities and exploit them before an updated patch has been released and installed by the clients.
- There are no guarantees regarding the stability or quality of the system.
- The designers of the open source system cannot be held liable for any mistakes in the system.

Although open source systems do have their drawbacks, there are many advantages which outweigh these disadvantages. A well structured open source system has the ability to be stable and secure. The larger the number of users, the more stable and reliable they become as long as the users make sure the system is kept up to date, and new patches are installed as soon as they become available.

This section has dealt with who and how, open source systems are managed, as well as the benefits and drawbacks of using an open source system. The next section will deal with looking at what VLE are, and why open source VLE's are becoming popular.

2.3 Virtual Learning environment (VLE)

A virtual learning environment (VLE) is a system which aids in the learning domain by providing online resources, such as course material, assessments means and notices. The use of VLE allows for out of hours learning, distance learning, and as an onsite classroom learning aid.

2.3.1 Why open source VLEs are used

An open source VLE includes the source code allowing for the system to be altered, tailoring each system for the specific educational establishment. There is the ability to expand the system by creating plug-ins which can carry out different tasks. One of the most important factors is that they are free, and no licence is needed for them to be used by your business.

2.3.2 Moodle an open source VLE

Moodle [7] is an open source VLE which is described by the creator of Moodle, Martin Dougiamas, as a “Course management system”. According to the website, there are currently over 70’000 registered users in 138 countries. Moodle is freely available from moodle.org and is certified by OSI. Since Moodle is open source, the development of the system has been extremely fast. Users can develop their own plug-in modules allowing them to tailor and expand the current system. On the Moodle site there are currently 25 Moodle modules which have been developed by users and made freely available.

The Moodle environment has been written in PHP which is described by Ullman [12] as a server side HTML embedded scripting language. PHP gives the developer the ability to dynamically generate HTML web pages. To achieve this, the server side PHP script is passed to a PHP interpreter that will perform any database queries and pass back to the user a HTML web page.

2.3.3 The existing questionnaire Moodle module

There is an existing questionnaire module which can be implemented into Moodle. This module allows users to create a questionnaire consisting of different types of questions. There are 3 types of questionnaire that can be created. These are:

1. Private questionnaire which restricts the participants of the questionnaire to only the students enrolled on a set course. All teachers can view the results, but only the course teacher can edit the questionnaire.
2. Public questionnaire, which are available to all courses. All students can take this questionnaire. They are open to all users but only the course teachers where the questionnaire was made, can edit the questionnaire.

3. Template questionnaire, which themselves can not be directly used, but can be used in a new questionnaire.

Once a questionnaire has been developed and activated, it can be made viewable for students to complete. Once they have been filled in it is possible to view an individual's results or view the whole set of results. One of the main aims of the project is to produce graphical representation of the data, unfortunately this is not possible in the exiting questionnaire module; this means that for a large questionnaire with a large data set, it is hard to pull out information from the data. The questionnaire module can also restrict the number of responses to a set number of students.

The system is not implemented by Leeds' CLCs [8] because the questionnaire module does not provide any graphical representation of the results. Without the graphical representation it would be too time consuming, to manually collate the data, and express it in a meaningful format.

This section looked at the environment in which the questionnaire module will be installed as well as the existing Moodle module. The next stage will deal with designing a suitable user interface for this type of environment.

2.4 Interface design

Since the system will be implemented in a school, a user friendly interface is required which can be accessed by all types of user including disabled users. W3C [11] are the World Wide Web Consortium. Their main aim is creating web standard and guidelines. They have a guideline for how to create a web site which is accessible for all types of users. The accessibility guide consists of a number of checkpoints, which if obeyed will increase the usability of the site. In order to maximise the accessibility of the proposed Moodle module the W3C's guideline will be adopted as well as using A-Prompt [14], a free program which analyses a web page reporting on any accessibility faults. Using the W3C guideline will help in the construction of the module following these guidelines may still result in a system which is not fully accessible, this may be due to human error or conflicting statements. Testing the HTML output with A-Prompt will help alleviate these problems. Any problems found can simply be altered in the PHP code, resulting in a fully accessible system.

2.5 Human Computer Interaction

Human computer interaction (HCI) is described by Badre [6] as a combination of methodologies which include the behavioural science, computer technology and design. HCI involves the designing and implementation of computer software with the potential users' actions in mind. To achieve this, the target user must be understood, knowing the users prior computing knowledge will allow for a system solution which is tailored, resulting in a more efficient system.

Chen [26] discusses the importance of gathering the user requirements at the earliest possible stage by saying:

"The cost factor is time and the human resource to gather the type of information. However doing right the first time can create the software on budget and on time. Not considering an audience analysis and referring audience information base on existing data may create a larger project, which may involve several prototypes before the audience accepts the software."

The key points brought up by Chen are, not to lose track of who the intended users are to the system. Analysing these users will greatly increase the chances of getting the system correct in fewer iterations. Getting this wrong may result in incompletion of the system. To best understand the target audience, Chen has come up with a checklist to consider when performing an audience analysis. This consists of the age group of the user, the skill level they have with computers, the functions of the user, and the diversity of the users which includes language and culture. This approach will allow the questionnaire generator to be customised, depending upon the intended users.

In the Shneiderman and Plaisant [27] book entitled "Designing the user interface" they discuss five key fields when designing the display. The aim of these key fields is to help produce a user friendly interface which fits into the intended market area. The five fields consist of the following

1. 'Consistency of data display' which involves using the same colours for the text, and the same background colour throughout all the pages.
2. 'Efficient information assimilation by the user'. This includes formatting the data to a way they are familiar with. For example using measurement units that the user has dealt with in the past.
3. 'Minimal memory load to the user'. A user should not be expected to remember information between web pages. Also the layout of the page should be organised in a logical order for the user, resulting in minimal mouse movement.
4. 'Compatibility of data displayed with data entry.' The format of information entered by the users should be clearly linked to the format of displayed information.
5. 'Flexibility for user's control of data display', allowing the user to have the option of displaying information in a way which best suits them.

Using these five key areas will provide a starting point when producing a user friendly interface. These key areas will be used in the first iteration of the project, to produce the interface layout. This may change on the second iteration, depending upon problems encountered in the testing stages.

This section discussed the Human computer interaction aspects and the ways of correctly analysing the indented users of the system. The next stage is to research methods of statistical analysis which can be performed on any data to produce meaningful information.

2.6 Statistical analysis

Statistical is described by Chiang [2] as "a process for converting information into knowledge". The information in the questionnaire module will be the results from completed questionnaires stored in the database. The aim is to transform this stored information into something meaningful. As the main aim for the questionnaire module, is to gain feedback from classes students have already been taught, the statistical analysis should extract the student's feedback, and supply a concise summary of the information. As the answering scale of the questions will not always be numeric, there is a limit to the statistic analysis which can be performed on the dataset. The aim of the following statistical methods is to produce an average rating to each question.

1. Arithmetic Mean – This is the sum of all the results divided by the number of responses. This method can only work, either if the supplied values are numeric, or the values can be substituted for numeric values.

2. Median – The Median is a set of results ordered in sequential order and the middle value taken. This method can be used irrespective of type of value as long as they can be in some kind or order. To find the median value the following expression is used:

$$Median = (n+1)/2 \text{ th value}$$

   Where n is the number of values in the set.

3. Mode – The mode value is the value that appears most frequently in a dataset. The dataset in this case does not have to be ordered to produce a result.

From these statistical methods, the medium will be used to establish the average rating for a question. The dataset can easily be ordered by the position of the scale.

2.7 Graphical representation

Extracting data and turning this into useful graphical information from which trends can be seen can be achieved using a number of different methods. Expressing the data in an illustrative form makes it visually easier to extract information from the data. In order for the information to be seen the correct

graphical representation is required. There are many different graphical representation methods some of which are shown below:

1. Pie charts are a circular graph which as a whole represents 100% of the data set. The circle is split up into segments and colour coded to represent each section. The larger the segment the higher the percentage.
2. Bar charts show the frequency of a set in terms of a vertical bar which are stacked next to other set bars, allowing for an illustrational model where comparisons can be made.
3. Line graphs express the same data as in the pie chart but in a linear form. Using this graphical method, small changes can be seen, as well as highlighting an area which doesn't conform to the rest of the segments.
4. Histogram which were derived from bar charts, but the width of the columns are derived from the weighting of the set of answers. The height of the bar is from the frequency of the value appearing.

Each of these charts have there own advantages of expressing information in a different way which may represent the data better, this depends upon what the user expects to get from the graph.

2.8 The current system in place

Currently the Moodle system implemented by Leeds LEA, has only a basic system in place being a single html file that carries out the job of a questionnaire. This file is designed and used by Cisco and is not currently used by Leeds LEA. Once the questionnaire has been filled in by the student, it is emailed to the manager of the academy, who then forwards them on to Cisco. Once a student fills out the questionnaire they press the submit button which opens an email, and inputs the answers to the questions. This is done using XML in order to parse the question number and the answer the student supplied. There is no easy way of producing a new questionnaire without having to change the majority of the html and xml coding.

2.9 Database

The Moodle environment at the Derek Fatchett centre currently uses MySQL version 5, which is the newest version available. MYSQL is an open source relational database management system. The main advantages of Education Leeds using MYSQL, is that it is free and has the ability to be interfaced by multiple programming languages such as PHP, Java, C++ and python.

2.10 Security issues

The questionnaire module will be integrated into the existing Moodle environment. It is paramount that the module does not pose any security risks. The potential risks which may occur include SQL

injection, where malicious users purposely enter an SQL statement, which will have affected either the questionnaire module or the Moodle environment.
To help alleviate these SQL injection threats, it is advised to use prepared statements which help to prevent this problem by not allowing the user access to the SQL statement.

The users of the system will have the ability to manually enter text which will be displayed in the questionnaire; here a malicious user can enter JavaScript code which may for example open a large number of windows to another inappropriate site resulting in an unusable questionnaire.
Preventing malicious code from being entered into any text input field, PHP has some functions which strip out any tags inside the text. The method is named strip_tags(), all that is required is the string entered by the user.

3. Methodologies

There are many development methodologies available for outlining the framework to assist in creating a system. The methodologies considered are the following:

3.1 Waterfall model

The waterfall model [15] is one of the original system development methodologies from which many of the other methodologies have been derived. In the waterfall model there are 6 stages. These stages produce an output at each stage be it documentation or a prototype of the system. Fowler [3] has pointed out that the waterfall model has its draw back. Any mistakes picked up in the analysis stages are not found until the implementation stage of the project whereby it is costly to go back and rectify the problem. Although the waterfall model has been around since 1970 [15] and has been proven to work, this methodology will not suit this project because of the project span being relatively short in comparison to software development in the real world. The waterfall model would be a risk to undertake, knowing that if the system requirements are not fully captured in the analysis stage, it would be exceptionally hard to rectify.

3.2 Spiral model

The spiral model was invented by Barry Boehm in 1988[15]. This model consists of 4 stages each of which is gone through multiple times. The 4 areas are:

- 'Determining objectives, Alternatives and constraints'
- 'Evaluation Alternative, Identify, Resolve risks'
- 'Development'
- 'Plan'

Iterating through the cycle multiple times will make sure any missed system requirements are picked up on the next cycle. Using this method will eventually result in a complete system. It is unfortunately not known at the start, how many iterations are needed in order to gather all the system requirements. Since there is a set deadline which cannot be changed and it is not known how long the system is going to take to complete, running behind on this methodology will result in an incomplete system which may prove to be unusable. If the system requirements are gathered correctly at the early stages then this method can be efficiently incorporated into this project.

3.3 Rapid Application Development

The Rapid Application Development (RAD) approach aims to produce several iterations of the system. This approach repeats the four main stages of Analysis, Design, Development and Testing/Reviewing a number of times. The main advantage of this approach is that any mistakes in the analysis stage can be removed on the next iteration. Bocij, Chaffey, Greasley and Hickie[4] point out many of the areas where traditional methodologies fail. These are:

- Closing the gap of understanding of the system between the users and the developer
- The quality measured on past prototypes and against the users requirements

The RAD approach allows for comparisons on past prototypes and from these prototypes the user and the developer can understand what the problem domain is and how to correct the system to achieve the aim. At Gantthead[5] they have come up with a number of criteria to see if a project is suitable to use the RAD approach. They focus on the following: 'scope', 'data', 'decisions', 'team', 'technical architecture' and 'technical requirements'. From these six areas they aim to tell you if the project will suit the RAD approach or if to look for another methodology.

Using this methodology on this project will make sure that any missed user requirements are picked up on the next iteration. The cycle can be carried out N number of times until an acceptable system is created. Again if any process over runs it may over shoot the deadline resulting in an incomplete system. As there are only 4 stages to the spiral model it can easily fit into this projects aims and time scale.

3.4 Rational unified process

The unified modelling process is a repetitive waterfall model. Kruchten[1] describes the rational unified process, as software engineering process, and a process framework which can be adapted to suit the needs of most projects. The problem with this methodology is that it aims to fit a lot of work into a similar time span. The rational unified model is an ideal framework for overseeing a larger spanned project, with multiple team members, but since this project only involves me this approach will be unusable.

3.5 Choice of methodology

Studying the above methodologies, I concluded in order to optimise the project and to completely satisfy the customer's needs, an iterative development methodology would be the best approach. Non-iterative approaches have the problem of increasing the risk factor as you can not see if the project meets the system requirements until the testing stage at the end of the project span when it is too late. An iterative approach allows the users to give feedback on the prototype so alterations can be done. From the research I feel the Rapid Application Development would be a suitable approach as the use of prototyping will enable me to meet all the users' requirements and provide an adequate testing plan to make sure that the project achieves its aims. Gantthead [5] have a set of categories which help in deciding if the RAD approach is suitable for this project. Carrying out the Gantthead [5] suitability stages strengthens my belief that RAD is a feasible development approach for this project, the chosen categories pointed towards using the RAD methogology.

4 Gathering requirements

To correctly gather the user requirements of the system an investigation technique must be adopted. The adopted investigating technique can be tailored to fit into this project. As the Moodle environment already exists a full requirement of the current environment is not required. The techniques chosen to capture the users environment is the **S**ample documents, **Q**uestionnaires, **I**nterviews, **R**eading and **O**bservation investigation technique [13].

4.1 SQIRO investigation technique

This approach is used to identify as many of the system requirements as possible. This is not to say that all the requirements will be found. Each of the SQIRO requirements gathering techniques are discussed below:

4.1.1 Sample documentation

Sample documentation involves looking at current documentation in place. From this the developer can see how the current system tries to achieve the goal. It may be the case that the user requirements have altered so there is need for a change in the current architecture of the system. The documentation will show the current questions that are being asked to the students, the information gathered from the students (e.g. name, course) and also what happens to the questionnaire after it is submitted.

4.1.2 Questionnaires

Questionnaires are a useful aid for gathering user requirements on large sets. Using questionnaires allows the analyst to derive some of the less than major problems with the system. Getting the requirements wrong at the early stages can be rectified with little knock on effects but if this is found out at the end stages e.g. at the testing it will take time and money to correct the problem. Individuals do not always know all the problems with the current system, the use of a questionnaire will enable all the users to give their experiences of the system.

4.1.3 Types of questions

There are four types of questions that can be asked in a questionnaire these are as follows:

1. Boolean Yes/No questions- these type of questions are easy to analyse for each type of user.
2. Set scale – where there is a set range that the user can answer. These questions give peoples opinion on how well a set job is achieved.
3. Multiple choice – where the user can answer 0, 1 or many out of a set.
4. Open questions- which allow the user to put down any other problems or experiences of the system. These questions often pick up on other requirements for the system which are not easy to see. Analysing these results is hard because of the variety of the answers, any statistical analysis would have to be done manually. The aim of these types of questions is not to get a direct answer but instead get the users views of a certain situation.

Questionnaires are relatively easy to set up a basic knowledge of the system is needed in order to achieve this. The problem comes from analysing the results which takes time, if there are a limited number of users the results may not reflect the true problems of the system. Within this project the questionnaire approach will not be a suitable tool, as there are only a small number of users. The

results may not reflect on the true system requirements. There is not the time span to carry out a questionnaire on all the uses, and to produce analysis on them.

4.1.4 Interviews

Interviews are one of the widest used analyse techniques. They allow the analyst to find out the requirements from the full range of users. The questions asked in the interviews will be tailored for each type of users to gather their experiences of the system and what they aim to get out of the system. Bocij, Chaffey, Greasley and Hichie [4] express the importance of having a well planned interview whereby you have set aims from the interviews, which can be ticked off in the interview as each one is achieved. They also show that the use of opened and closed questions can be used in order to archive the optimum amount of information from each interview. The findings of the interviews must be properly recorded in order to pull out the qualitative data which is used to produce the system requirements. There are two interview types which are preferred in order to get the best from the interviewee. These are structured interviews and semi-structured which are discussed below:

4.1.4.1 Structured

A structured interview is when the interview outline is done prior to the interview. The interview questions can use any of the types discussed in the questionnaire section above, but the interview keeps to the layout. The advantage of this approach is that a wide area can be covered in a set time period. Unfortunately vital information can be lost if a requirement area is not brought up.

4.1.4.2 Semi-structured

A semi-structured interview is when there is a brief layout out of the interview but there is open discussion which may lead onto other topics not previously thought of. The interviewer has the ability to explore new areas here. It can be more difficult to record all of these details as many may arise in a short period of time. In a set time span, not all of the interview may be completed and the interviewer may walk away either not knowing all the requirements or having to arrange another interview to collate the result of the user requirements.

A semi-structured approach will allow the user to discuss the requirements of the system and the aims they want it to achieve. In the testing stage of the prototype another structured interview can be done to openly discuss the drawbacks of the prototype against the systems requirements gathered at the analysis stage.

4.1.5 Reading

This investigation technique involves reading and researching the resources available, such as documentation, user guides, course criteria and the web site in order to collect vital details about the current workings of the current system and data flow to help in understanding the problem. The

disadvantage in this approach is there is generally a large quantity of documentation to read which may prove to be irrelevant, or in too much depth for the system. The best process is to glance over the documentation to see if it is relevant or not. Once the information is collected you should stop and move on.

Since the new module is an extension of an existing system there is little or no documentation in regards to the questionnaire system. In this case any documentation found must be analysed.

4.1.2 Observation

Watching the users interact with the system can show faults and inefficiencies. Efford & Johnson [13] discuss the four levels of observation which are reviewed below:

1. First impression – the high level look on how the data is handled, captured and recorded.
2. Simple observation – watching a user interact with the system, and marking down any complications they come across.
3. shadowing – following each user around watching them with there day to day roles
4. Formal observation method- which involves timing individuals carrying out their jobs.

Using the Rapid Application Development allows the observation stage to be carried out with the new prototypes. Using the formal observation method allows observation of the users interacting with the prototypes, and using the time element as a means of measuring the success of the prototypes.

4.1.6 Summary

Of these investigation techniques the best approaches, based upon the project would be to use semi-structured interviews. These interviews will be carried out on each type of the user to make sure that all the user requirements are collected. Multiple interviews will have to be carried out to cross reference the requirements with the different users.
Since the current system does not allow for changes the formal observation will be used in the test phase within the RAD approach. This will show the efficiency of the prototype so that the final system will be as efficient as possible for all the users.

4.2 Outcomes of similar project

Driscoll [16] and Slade [17] both undertook dissertations in the academic year 2004/2005 working with Moodle. Driscoll went about removing the complexities associated with installing Moodle such as installing PHP, MYSQL and Apache. This was achieved by producing an installation package for Windows and Linux. Driscoll made use of the Heuristic evaluation by Jakob Nielsen [18] to highlight any usability problems which were occurred whist using the product.

Slade implemented Moodle into a school, and customised to meet the schools requirements. Slade used some pupils of the school to help in the testing of the system as well as running an introduction session with the teacher into how to use the new system.
From looking at these similar projects undertaken by University of Leeds students has giving me an insight into developing a user friendly system, and how to go about testing the system after the 1st iteration of the project.

To help in preventing me from repeating any mistakes which have been previously encountered by past 3rd year computer students, I have examined the personal reflection of both Slade and Driscoll. Looking at these reflections will enlighten my perspective of the project. Both of these project were external to the school of computing and as a result had to be focused on the external parties. Slade highlights a key point of always keeping in contact with the intended clients of the system. Driscoll makes the point that just because you are free means that the third party is free, Driscoll said "Don't under estimate how busy 3rd parties are". Depending upon the external company it can be hard to arrange times to meet and implement the system, Driscoll undertook his project in a high school and experienced delays of having to wait weeks to arrange a meeting with the 3rd party.

Looking at the personal reflection of past external projects has made me aware of the potential problem which may be encountered through the lifespan of this project. Keeping in contact with the 3rd party will help elevate some of the problems occurred.

5. Formulating user requirements

5.1 Interviews

In order to get the most from the interview a semi-structured interviewing techniques has been adopted. Using the approach discussed earlier by Bocij, Chaffey, Greasley and Hichie [4] in the interview chapter a clear objective interview style will be used. Objectives can be stated prior and ticked off once completed. It is important that all the information gathered from the interview is reported carefully and fully. Two interviews have been set up one with Mr Peter Fletcher of Education Leeds and the other with Mr Jason Thomas, the technical officer at the Derek Fatchett centre Leeds, who is responsible for keeping Moodle up and running.

5.2 The Cliental

The system is to be designed as a module for Moodle which is currently running at the Derek Fatchett centre [23] which is a Leeds City Council Learning Centre. The centre is part of Education Leeds [22] and is a non-profit organisation solely owned by Leeds City Council. The current Moodle system is in place to support in the Training of CISCO courses [24]. The extension to the system of a questionnaire module will allow them to receive not only valuable feedback, but also the ability to check understanding throughout the progress of the courses.

Using the approach suggested by Chen [26] the target audience have been researched. The students of the system are over the age of 16 and are qualified to the A-level standard or higher. To be enrolled on the course taught at the school they have to have a background in the computing field. The teachers who will be responsible for generating the questionnaires teach the CISCO modules and are therefore considered as experts in the computing area.

5.3 Interview One: Mr Peter Fletcher

This is the first interview regarding system requirements to ensure none of the fundamental requirements are missed the interview layout has been setup to start simple. The use of the semi-structured interview will allow for more into depth discussion as the interview progresses without wandering from the purpose of the interview.

5.3.1 Objectives

The objectives for the interview are as followed:

1. To establish the users of the system
2. To establish if there is a current Moodle environment
3. To discuss the current system in place (if there is one)
4. To discuss the look and feel of the new system
5. To establish the types of questions to be asked
6. To establish the response type
7. To discuss any preferences of the module.

5.3.2 Outcomes

The structure of the interview, along with the outcomes is shown in Appendix C. From carrying out the interview with Mr Fletcher a number of requirements have been gathered. The new questionnaire module must allow teacher to create questionnaire and offer them to students. The questionnaire module must be easy to use and require little or no prior training. If any training is required a help manual is present to assist the teachers. Mr Fletcher requested that the looks and feel of the new

module should be different to that of the current Moodle environment. The ability to store the results of the questionnaires in a relevant format so that a graphical output can easily and efficiently be performed. The ability to output the questionnaire in multiple formats allowing users to have the ability to simply print of the questionnaire, a PDF format was recommended to Mr Fletcher to achieve this goal. Since the questionnaire filled in by students in the PDF will not be stored in the in the database, it must be concluded that the teacher must have the ability to input the results manually, ensuring an accurate consensus for the graphical output.

5.4 Interview Two: Jason Thomson

The purpose of having an interview with Mr Thomson the administrator of the Moodle environment, is to find out about the working environment in which the project must fit in. The interview will enable to me to find the correct job allocations of the intend users of the system.

5.4.1 Objectives

The objectives for the interview are as followed:

1. To establish who will generate the questionnaires
2. To establish who is responsible for maintain the system
3. To find out how backing up is handled
4. To find out the current system versions
5. To establish the users knowledge base

5.4.2 Outcomes

The interview structure and outcome are show in Appendix D. Mr Thomson helped in the understanding of the system requirements by discussing the current versions of MYSQL and Moodle they are running. It was discussed if the system requires upgrading to facilitate the questionnaire module he would assist in the upgrade. Backing up of the system is done using a separate programming and is carried out once a day. To ensure that the questionnaires data is stored the tables can be incorporated inside the current database resulting in no change to the current backing up process. The teachers have the ability to change their course content so Mr Thomas is only responsible for initially setting up and maintenance of the system and not involved in the content that appears in the existing modules. The prior computing knowledge of the users was discussed to help determine the graphical user interface layout and the complexity of the user manual.

5.5 Observation

As there is no current questionnaire generator in place the only observation which can be carried out at this stage will be to examine users interacting with the current system to see how well the current questionnaire conforms to the HCI standards.

5.5.1 Aim

The aim of observing users interacting with the current questionnaire in place is to see the HCI design and how well it works in the environment. Since the current system is not a Moodle module a comment box has to be added to advertise to the student to take the questionnaire. Appendix E shows an example screen shot of how the system currently advertises the questionnaire.

5.5.2 Outcome

Appendix F shows a copy of the existing questionnaire. From watching users interact with the system it can be seen that the layout of the questionnaire is broken up by the use of section headings allowing the user to easily fill out the questionnaire. Each section seems to stick to the same answering scale making it straightforward for the user to answer the questions. The users of the system have two ways of filling out the questionnaire they can either fill it out online and press the submit button which will automatically email the results to Mr Fletcher or the user can print out the questionnaire and post it back. As the layout of the existing questionnaire is working, this can be used as a template for the outputs from the questionnaire module.

5.6 Current system use case diagram

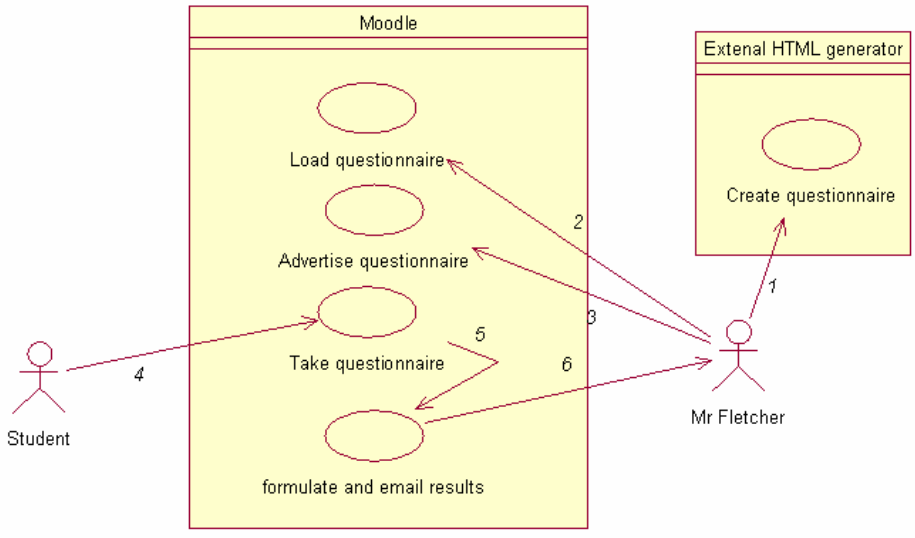


Figure 1- current system use case

Figure 1 illustrates the use of an external party when originally creating the current questionnaire. This can be seen by looking at the complex HTML code which made up the questionnaire. Stages 1 and 2 are only carried out once and the questionnaire is just re-advertised to the students for them to take. The use of forms in the HTML code allows the answers to be posted into an email and these are then posted to Mr Fletcher. Each student undertaking the questionnaire will email their results to Mr Fletcher making it time consuming for Mr Fletcher to collate theses before forwarding the results to CISCO.

6. System requirements

Throughout the requirements gathering stage a set of system requirements have been derived. These requirements will base the backbone to the first iteration of the project. The second iterations will be a revised version of the first iteration, based upon the results from the testing stage. This will enable any requirements missed in the requirements gathering stage to be incorporated into the system. The system requirements gathered are as followed:

A questionnaire generating module for the virtual learning environment, Moodle. This module will be incorporated into the current Moodle environment presently running on the server at the Derek Fatchett centre. The extension to the learning environment must enable teachers to generate the questionnaires. The questionnaires the teacher will create will only consist of closed questions on a scale selectable by the teacher. The teacher must be able to easily create the questionnaire with little or no training involved.

The resulting questionnaires must be stored in a suitable manner so they can be visited by the student and filled in. The outputting format of the questionnaire must be in a readable HTML format with an added option of an additional printable PDF format enabling the student to take the questionnaire offline. The teachers must have the ability to add the results of the questionnaire filled out offline to the stored results in the database, from students who selected to fill in the questionnaire online. From the results a graphical output is required to visually interpret the stored result set. As the system is to be incorporated into an academic institute usability is paramount to the success of the project. The system will have to be accessible by all potential types of users.

To system must also fit into the administrative roles at the Derek Fatchett centre to achieve this, the system must be able and easily backed up. Moodle may need to be upgraded to incorporate the new module a check will have to be carried out to see if this needs to be done.

Now that a set of requirements have been gathered the next stage is to begin the design process. This stage will uses the HCI techniques highlighted in the Human Computer Interaction section in the background reading to come up with a number of key steps to producing a user friendly interface.

7. Design stage

The design section deals with the first iteration of the module and the reasoning behind the choices. The results from this section will enable the prototype to be constructed. The designing of the system will reflect upon the HCI chapter in the background reading and the five key areas will be adopted to produce a functional user friendly design.

7.1 Current system environment

The first area which must be looked into is the current versions of software in place. Although it is possible to upgrade the versions currently implemented in the school, this is to be avoided due to the server running the Moodle environment is presently running 15 Moodle sites throughout the Leeds learning network. Upgrading will result in having to bring all these sites down.

7.1.1 Moodle

The school currently runs Moodle version 1.5. The newest stable version available is version 1.53 which fixes some of the problems found in other modules. For example version 1.5 does not support postgres 7 in the enrolment modules. Since the improvements are related to other module problems the Moodle environment will not need upgrading to accept a new questionnaire module.

7.1.2 MYSQL

Mysql version 5 is currently running in the Derek Fatchett centre which was recently updated prior to the start of this project. To prevent version problems version 5 will be used in the development of the questionnaire module.

7.2 Proposed system design

From the requirements gathered in the systems requirements stage it can be seen that there will be a new system implemented which will extend on the current system of a questionnaire. The new system will enable a user to generate the current questionnaire and any other questionnaires they require. To illustrate the changes figure 2 shows a new use case diagram of how the proposed system will allow teachers to create their own questionnaires and offer them to the students.

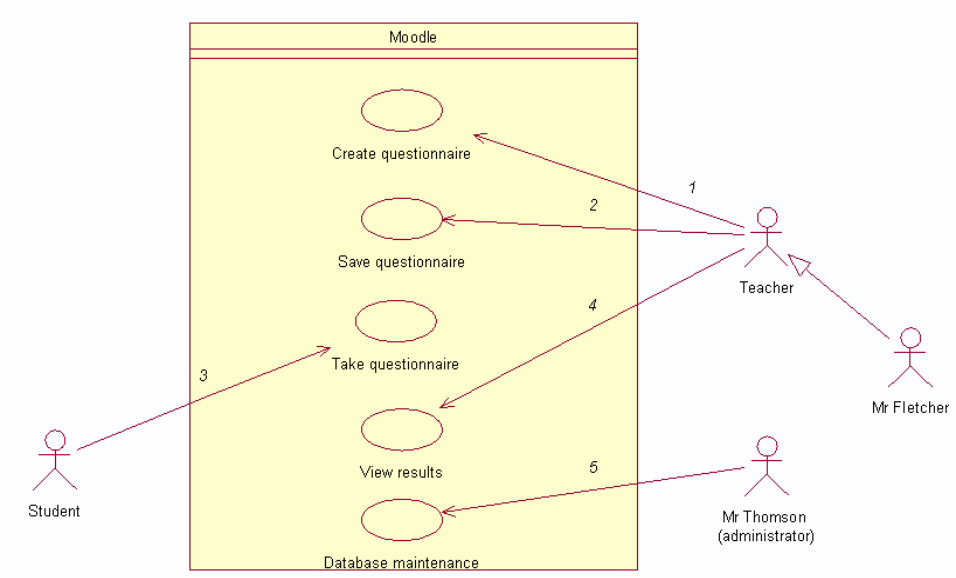


Figure 2- New use case diagram

7.3 Security

Security is a key area when designing software. As the new module is to be implemented inside the existing Moodle environment, authenticating users can be handled by Moodle all that is required to achieve this is to plug into the login section of Moodle. This will result in any user not currently logged in, being directed to the Moodle's login page before being allowed to proceed.

SQL statements must be carefully made to prevent SQL injections leading to malicious intent. Although it will be only teachers who have the ability to make questionnaire, preventing any type of potential misuse is crucial. SQL injections have the ability to not only cause problems to the

questionnaire module but the whole of the Moodle environment. This is because the PHP code used in making the Moodle environment is so highly dependable on the mysql database. To help prevent these SQL injections Moodle has some predefined methods situated in the library file named Datalib.php.

7.4 Database schema

Upon making a questionnaire a new table will be created to store the results, the easiest way to name the questionnaire will be to use the prefix for all tables inside the database as well as the questionnaires name. This will mean that the name of a questionnaire will uniquely identify it. Figure 3 below illustrates the database schema designed using the user requirements gathered in the section 4 of this report. The database schema identifies the primary and foreign keys which will link the tables together. The table new_questionnaire shown in the diagram will be replaced by the questionnaires name upon creation.

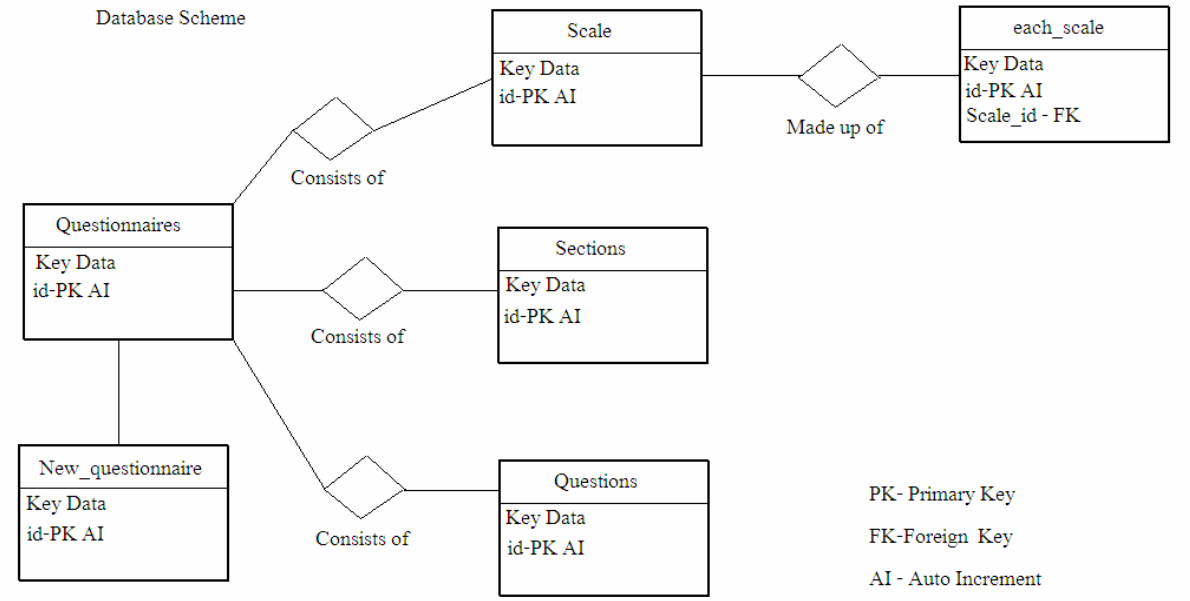


Figure 3 – Database architecture

7.5 Questionnaire generator layout

Figure 4 below is a template for the user interface of the page where teacher create questionnaires. The aim is allow users to create a questionnaire from within the one page which will reduce the work load of the user. The screen is split into two areas the left hand side holds all the information on questions (new and old) and the right hand side holds all the information regarding the questionnaire being currently created. Placing the buttons in the middle will help to break the page up allowing the user to easily distinguish between the tables.

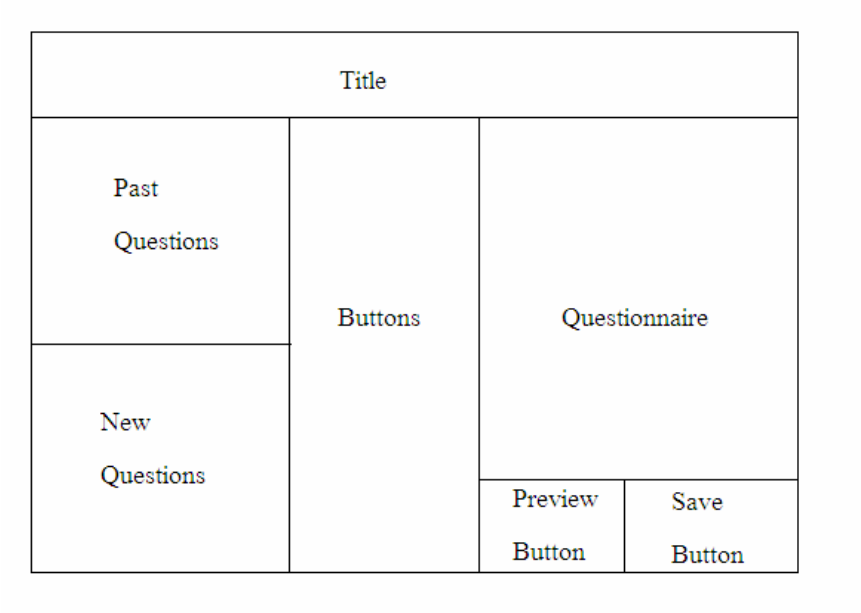


Figure 4-Questionnaire generator layout

7.6 Backing up

To enable easy backing up of the system the tables for the questionnaire module will be placed inside the existing Moodle database. Moodle attaches a prefix to the start of the table name the default is set to ‘mdl_’ and is what the Moodle environment in the school uses. Placing the tables inside Moodles database will allow for all the system to be backed up together.

7.7 Existing graphical tools

Producing the graphical outputs manually would take too much time and would be hard to produce in the time scale of the project. There exists multiple PHP based graphical tools which can be plugged in to the module. These tools enable a simple method to produce the graphical representation with minimal coding. The graphical tools provide a universal aid which can be integrated into multiple scenarios; the creator(s) of these tools have invested time into producing an easy integrated tool.

When researching for open source graphical tools, two graphical tools which have the ability to be integrated into the project stood out.

JPGraph

JPGraph is a stand alone graphical library written entirely in PHP. The library can be simply placed in an easily accessible location, e.g. inside the location where the questionnaire module will be. The

JPGraph library consist of a large example set which can be used to produce relevant graphical output from the results of a questionnaire. The only requirements to get JPGraph working is PHP and GL the open sources graphical library. The bar graph below illustrates an example bar chart taken from the examples provided. The X coordinates are passed as an array as well as an array of values for each of the columns. The Y coordinates are automatically determined by JPGraph to scale the bar chart correctly.

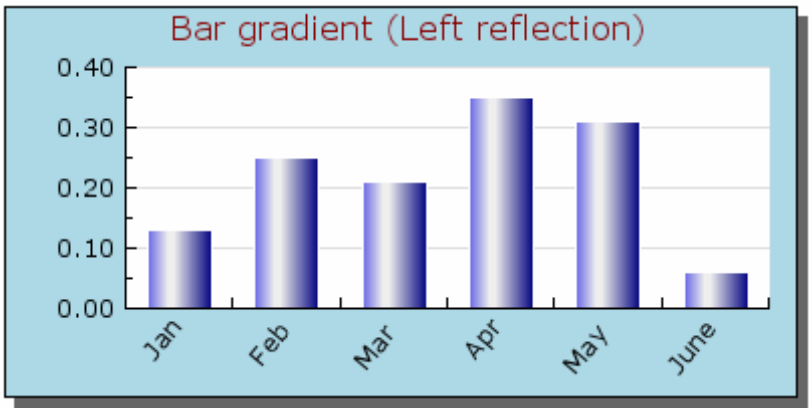


Figure 5 – bar chart example from JPGraph

JPGraph supports multiple graphs including bar charts, line charts, pie charts and stock charts. Using this library will allow multiple graphical outputs of the stored data allowing the users to choose a graphical representation which will best represent the information. The library is accompanied by a comprehensive installation guide and manual allowing for an easy installation of the library.

PHPGraph

PHPGraph is another PHP library allowing users to create simple graphs dynamically. To use the library the same requirements are needed as in JPGraph. PHPGraph is much simpler that JPGraph it supports only simple line charts. The library is out of date as it was written in an old version of PHP. Unfortunately the newest version of PHPGraph has not been released and the current version is no longer supported.

From looking into graphical libraries it is clear to see that the best graphical library to use in producing graphical outputs of the information will be to use JPGraph as it supports multiple graphical formats and is kept up to date.

7.8 Existing PDF generators

To producing dynamic PDF's is a difficult and long job to do. There are available free PDF generators which will dynamically produce PDF's. In order to create these PDF's all that is required is to interface with the classes and supply in the information required to be shown in the document. From researching into PDF generators the following were found:

HTML_TOPDF

HTML _TOPDF is a set of classes written in PHP which enable a user to create PDF's on the fly. The system works by being passed a HTML document and stripping out the text and adding it to the PDF. Unfortunately to get it working the system relies on other programs to be installed on the computer/server these include the ability to convert the html documents to post script (.ps) and also to convert post script to PDF. To achieve this a program called ghostscript is required. Ghostscript is a post script interpretation language which has the ability to convert to and from post script.
Additionally PEAR is also required for the error handling and operating system checking, fortunately this is installed as default with PHP 4 and greater.

Trials with the system have shown that only the text is extracted from the HTML page, as the HTML document will contain tables with radio buttons amongst text the HTML_TOPDF system will not correctly layout the questionnaire in a format suitable for the users, due to the fact that the layout will not be sufficient to generate a questionnaire and the system relies on other software this system can not be used.

FPDF

FPDF is another free PDF generator written in PHP. The current version of FPDF is supported by PHP version 4 and version 5. The FPDF system is an impressive program supporting multiple languages. The program allows the user to specify all the parameters including the page layout to supporting links inside the document. The program allows the user to insert tables which will allow questions and scales to be placed inside of these tables. The FPDF is a stand alone library requiring no other programs to function.
Unfortunately when trialling the system it is not possible to add more that one table to a page, attempting to do this resulted in the tables being joined together. As there will be multiple questions with multiple answer scales on the same page this program can not be used to produce the dynamic PDF's.

R&Os PDF

R&Os is the last free dynamic PDF creator found it is free to use in the public domain which includes educational use. This class is a simple PDF generator which supports multiple fonts and does allow multiple tables to be implemented on the same page. Unfortunately the class does not support radio buttons so substitution is required to replace the radio buttons with circles. The R&Os PDF generator provides a simple interface for setting the parameters of the page and adding text and tables with ease.

This PDF generator meets all the requirements for creating a dynamic PDF the only fault with this system, is that it is a non-module version so it is not loaded into memory until required, this does result in a slightly slower system but will work well in this questionnaire module.

After designing the structure of the system and determining through testing the third party software to use in order to meet the user requirements captured in the users gathering stage, the next stage is the implementation stage where by the first system prototype is created. The implementation stage will discuss and show the main parts of the system.

8. Implementation

The design stage outlines the designing processes and the tools which will be used to produce the questionnaire module. This section will takes these designs and turn them into a working system that meets the user requirements captured in the requirement gathering stage as well as detailing any problems encountered and the solutions found to overcome them. This section also details any decisions made and the reasons for choosing it.

8.1 Index page

The index page is the initial page any user of the system will see making it the central position of the questionnaire module. From here a user should be able to perform any task with just a few clicks. The system must allow students to easily take questionnaire so the easiest way of displaying the questionnaires to the students is to advertise them on the index page. Figure 6 below shows a screen shot of the index page once a student has logged in. From this page the user can choose to take the questionnaire online by clicking on the questionnaires name or open the questionnaire as a PDF which

can simple be printed off and filled in offline. Figure 7 shows a screen shot of the index page, logged in as a teacher, the pictures shows the additional features available to the teachers; these include the buttons to navigate to the questionnaire generating page and view the results of the questionnaires. The teachers have the ability to take questionnaires multiple times and can therefore simply enter any questionnaires given to them in a hard copy into the result set.

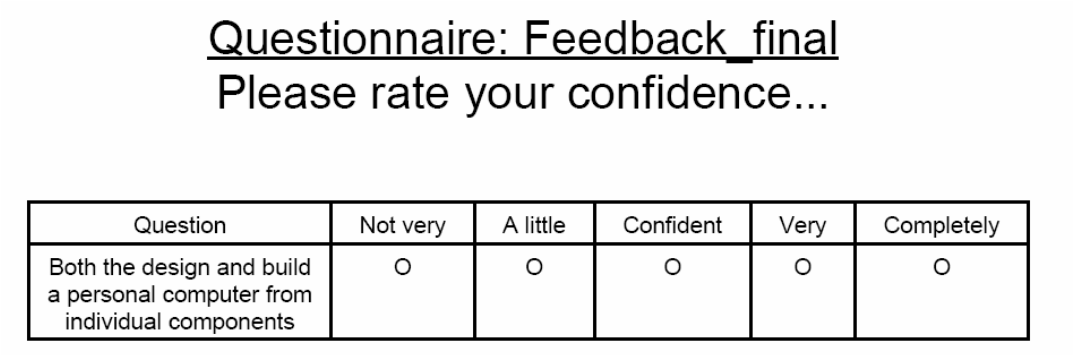
Figure 4: index.php Student

Figure 5: index.php Teacher

The name of all the questionnaires are stored inside the ‘questionnaire’ table. The database architecture shows that the questionnaires are made up from using the questionnaires id inside the ‘questionnaire’ table and the question, section ad scale ids stored inside the database ‘questionnaire_question’. Once a questionnaire is made and stored, a new table is created and given the prefix the_quest_questionnaire_ followed by the questionnaires name.

The PDF feature was created using the R&Os PDF library discussed in the design stage. The extensive documentation supplied with the library made it easy to find what function should be called to create each part of the questionnaire.

The ezTable method makes it easy to add a table by supplying an array of questions as well as an array of headings for each column. A distinct advantage of using R&O was the area where the question is situated, is of a set size. If the question is longer by default it moves to the next line resulting in a neater looking questionnaire. Figure 8 below shows an example of the PDF questionnaire it the first question from the CISCO questionnaire, as it shows the question spreads over multiple lines.


Questionnaire: Feedback_final
Please rate your confidence...

Question	Not very	A little	Confident	Very	Completely
Both the design and build a personal computer from individual components	O	O	O	O	O

Figure 8 – PDF example

8.2 Questionnaire generator page

Figure 9 below shows the questionnaire generating page, the design was created from the template which created in the design stage (figure 4). The questionnaire generator is the area where by a teacher has the ability to make a questionnaire. To reduce the workload of the user the majority of the requirements to make the questionnaire can be done in the one screen. The only operation which requires a new window being open is to add a new scale, this is due to the fact the user may not require to add a new scale constantly. If a user requires adding a new scale they simple click the new scale button which opens a new window where the user can add the name of the scale and the possible answers.

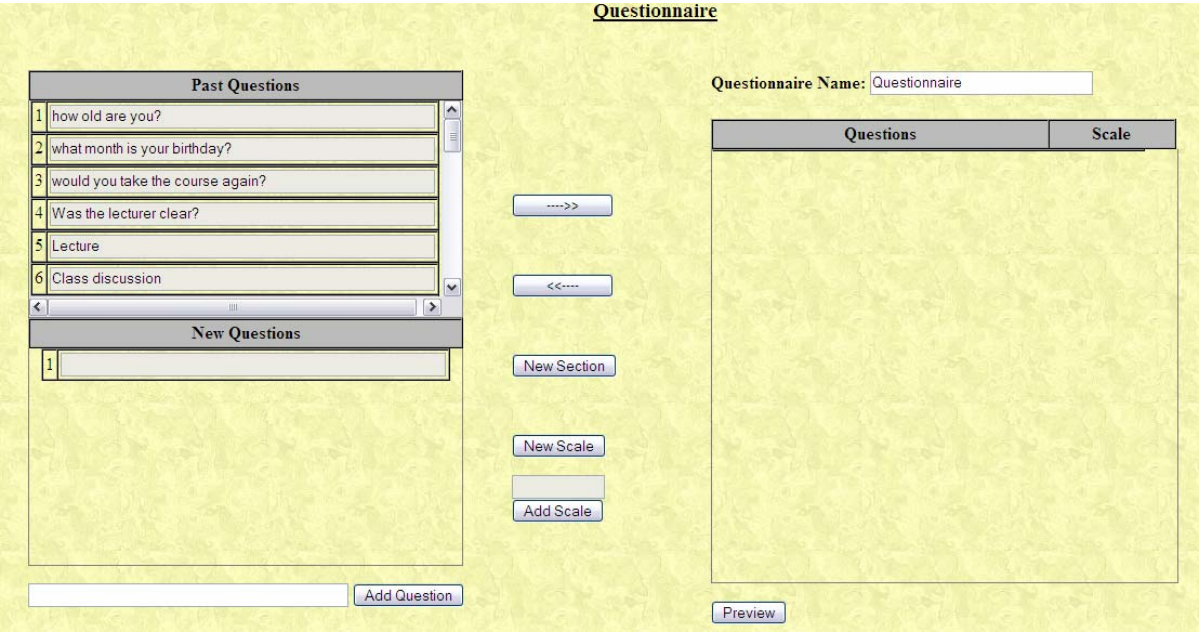


Figure 9 – questionnaire generating page

8.3 Preview page

The preview function allows teacher to see what the questionnaire will look like to the users. All the questions and scales are posted to the PHP file preview via the POST method which passes the information in a hidden format to the user. Using a series of FOR statement, the information passed is displayed in a manner familiar to the user.

8.4 Saving the questionnaire

After a teacher creates a questionnaire and previews it they then have the ability to save it. The questionnaires name is determined by the user and must be unique before being allowed to save. The save functions is passed the same information which is passed to the preview function again this information is split up. The resulting information is ready for insertion into the database. The frist insertion to be done is to add the questionnaire to the questionnaire table. After insertion we must then retrieve the entry we just made in order to get the id for the newly added questionnaire.
Before adding the details of the information stored in the questionnaire, any new questions, new scales and new sections must be added to the relevant tables and their ids retrieved. Once all the new information is scored the structure of the questionnaire can be stored in the questionnaire_question table. The questionnaire_question table brings all the information together by storing the id of the questions and the scales they have on them as well as the section headings.

8.5 View questionnaires

When a student opens a questionnaire page it works in a similar way to the preview page except for all the information required to make up the questionnaire is gathered from the databases. The only

information required to view the questionnaire is the questionnaires name this is because the questionnaires name is the unique identifier. To generate the questionnaire several calls are needed on the database. Initially the questionnaires name is taken and is queried on the questionnaire table to retrieve the id of the questionnaire. The existing Moodle libraries which contain the predefined SQL methods work on there being a unique identifier in the tables. Usually the identifier is called id, without this identifier the SQL statement would not function correctly. After retrieving the questionnaires id all the questions, sections and scales can be pulled out of the questionnaire_questions table which holds all the information required to make up the questionnaire. A simple SQL statement can be carried out to pull all the relevant information from questionnaire_questions, the SQL statement looks like the following where supplied is substituted for the id of the questionnaire:

*SELECT * FROM mdl_the_quest_questionnaire_question WHERE questionnaire_id = supplied;*

The resulting data set will already be in sequential order as it is ordered by id. As the information will be inputted in sequential order the id will increase down the questionnaire. For each of the results we check to see if it is a question or a section. If it is a question we add the question and pull out the scale and if it is a section we simple add the scale to the html document. The pseudo code below shows a simple representation of the FOR statement in place to produce a HTML document of the questionnaire.

```
For each results in the dataset
{
   If it is a question
   {
        Add the question along with the scale to a table
    }
   Else it is a section heading
   {
        Add the section heading
    }
}
```

Not all the required SQL statements could be achieved by using Moodles defined library, to overcome this problem a new library file was added inside the questionnaire module allowing any file inside the questionnaire directory access.

8.6 Human Computer Interface

The aim of the layout of the questionnaire module is to limit the work load of the users to achieve this; the user should have the ability to achieve the majority of the tasks required from within the same window. Any task which is not constantly needed should be at the most one click away. The questionnaire generator has been laid out to allow the teacher to pick from past questions or add new questions and simple add them to their questionnaire. The 3 column layout reduces the workload for the user to remember they can easily edit the questionnaire and preview it as many times as it takes to get it right. Everything associated with the new questionnaire is situated at the right hand side of the screen.

9. Testing

After generating a prototype of the system which consisted of all the major components of the questionnaire module, the testing stage began. The aim of this section is to locate any problems of the system which affect the functionality of the system. These include any human computer interaction problems which may have resulted from misinterpreting Shneiderman and Plaisant [27] rules discussed in the HCI section of the background reading.

The Testing Plan is as followed:

1. Check the outputting questionnaires HTML code with the W3C, by passing the code to the A-prompt software which analysis to maximise accessibility.
2. Observe the users interact with the system by supplying them with a list of task to accomplish.
3. Cross reference any HCI irregularities to find the best way to reduce the user's mouse movement and the work load on their brains.
4. Implementing the prototype into the Moodle environment at the Derek Fatchett centre.

9.1 Output

The first step of the testing phase is to pass the outputted HTML code which is generated from the questionnaire generator though A-prompt which will help alleviate any coding errors. Fixing the errors in the questionnaire code will increase the accessibility of the questionnaire.

Running a test questionnaire through the program highlighted some problems. The main problem found was the tables which hold the questions. The HTML code did not contain the summary, caption or headings of any of the tables. The only other area which is picked up on by A-prompt is the labelling of the radio buttons which is currently missing.
With the help of A-prompt, fixing these highlighted areas are relatively straight forward, to achieve this some of the PHP outputting had to be slightly changed.

9.2 Observation

In order to observe users interacting with the system a set of tasks were made for them to following. The task consisted of the following steps:

1. Creating a questionnaire
    a. With a unique name
    b. Add several question used in previous questionnaires.
    c. Add several new questions and add them to the questionnaire.
    d. Add several new scales to match the questions.
    e. Preview and save the questionnaire.

2. Take the questionnaire
    a. Fill out the questionnaire multiple times

3. View the results of the questionnaire
    a. View the answers

To test the success of the testing stage a questionnaire generated by the questionnaire generator was given to the students to gain there valuable feedback. Appendix G is the questionnaire given to the users after completing the given tasks.

Discussing the questionnaire with the user highlighted some problems which are easily fixed. The main problem encountered is when a user saves a questionnaire with the name of a questionnaire that already exists. Currently the checking of the name of the questionnaire is done by the save.php page. This means that a user is only made aware the questionnaire already exists when the information is passed from the questionnaire generating page to the save page. The user should be made aware the questionnaire already exists before they leave the questionnaire generating page allowing the user to easily rename the questionnaire.

Overcoming this problem will involve pulling out the list of current questionnaire and pass them from PHP to a JavaScript array. Once a user tries to save the questionnaire, the questionnaires name will be checked against the array and if it finds a match a dialogue box with an appropriate message should be shown. The current solution will still be implemented in the chance a new questionnaire has been added after the user began to create their own questionnaire. The JavaScript array will only contain the questionnaires that exist when the user opens the questionnaire generator.

9.3 Reviewing HCI Rules

Reviewing the HCI rules will evaluate the first iteration of the system to determine if the rules have been conformed to.

'Consistency of data display' – A cascading style sheet has been implemented to produce a uniform feel throughout the whole questionnaire module. The look and feel is deliberately different from the look and feel of Moodle, as this is one of the requirements of the system.

'Efficient information assimilation by the user' – The format of the outputting questionnaire matches the current CISCO questionnaire system resulting in a familiar environment.

'Minimal memory load to the user' – All the main tasks required in making a questionnaire can be accessed from within the same window or they are at most, one click away. A function which will be required in the questionnaire maker will be the save function.

'Compatibility of data displayed with data entry.' – The newly entered questions by the user are displayed at the bottom of the new questions table in exactly the same format as entered by the user. Tags will not be shown in the tables as the text is simply passed between the input dialog and the row in the table.

'Flexibility for user's control of data display'- When generating a questionnaire the preview facility allows the user to see what the questionnaire will look, the user then has the ability to alter the questionnaire before saving allowing for a flexible framework to the questionnaire generator. Currently the past questionnaire table is populated with all questions in the 'questions' table, as the number of questionnaires increase so does the number of questions in the table. Searching though this list may be more trouble than simply re-typing the questions. To help alleviate this problem a search function will allow the user to type in a search word, any questions matching these search term will be left in the past question table and the rest temporary removed until a new search is performed.

9.4 Installing a prototype

As the system has been developed outside the Derek Fatchett centre it must be installed to test for compatibility. There are numerous factors which could prevent the system from working efficiently, including any difference in operating system, web server or JavaScript version. After installation is was clear that the system was not functioning correctly. Initially it was thought that there was a problem with either the JavaScript code or with the JavaScript settings on the desktop machines at the Derek Fatchett centre. After checking the setting of the machines, the JavaScript was checked. To check the JavaScript the web browser Opera was used. Opera provides an intensive break down of JavaScript errors and back track to the suspected problem. The error encounter was:

ERROR Object expected, variable is Null or Not an Object

After extensively breaking down the code the problem was found. The error was in a piece of PHP code which was used to pull out all the information retrieved in an SQL statements. The get_variable method was used to pull out all the variables and place them in a single array where they could be easily accessed. To rectify this problem instead of trying to pullout all the information in one go each record retrieved by the SQL statement must be iterated over in turn. The get_variable method was replaced by a FOREACH statement.
This following statement shows an example of how the proposed solution will look. In the example all past questions are taken out of the questions table and each question is added to the past questions table in the questionnaire generator.

```
$eachQuestion=get_records("the_quest_questions");

foreach($eachQuestions as $each)
  {
     Addquestion($each->question);
  }
```

9.5 Results

The testing stage has created a set of improvements which will create a better interface for the user and provide the users with a fully functional system. The proposed improved system will have the following improvements:

Links to allow the user to return back to either the Moodle environment or the index page of the questionnaire system. The links will be located at the bottom of the page and clearly labelled.

The ability to save the questionnaire straight from the questionnaire generating page. The users will still have the ability to save from within the preview page.

The ability to allow the user to search for a past question in the past question table. Any matching questions are left inside the table and the rest will be temporary removed.

The last improvement to be integrated into the system is the validation of the questionnaires name in two places one inside the questionnaire generator page and again when the information is passed to be saved. This will alleviate the potential of another user creating a questionnaire with the same name as the user is still creating theirs.

The next section will discuss the implementation of the improvements which have been highlighted throughout the testing stage. This stage as well as highlighting the problems or enhancements of the current system also highlights potential solutions.

10. Second Iteration

The second iteration of the system aims to completely satisfy the customers need producing a fully functional system. The enhancing features aim to produce a better questionnaire generator.
Figure 10 shows a screen shot of the new questionnaire generator with all the enhancements implemented.

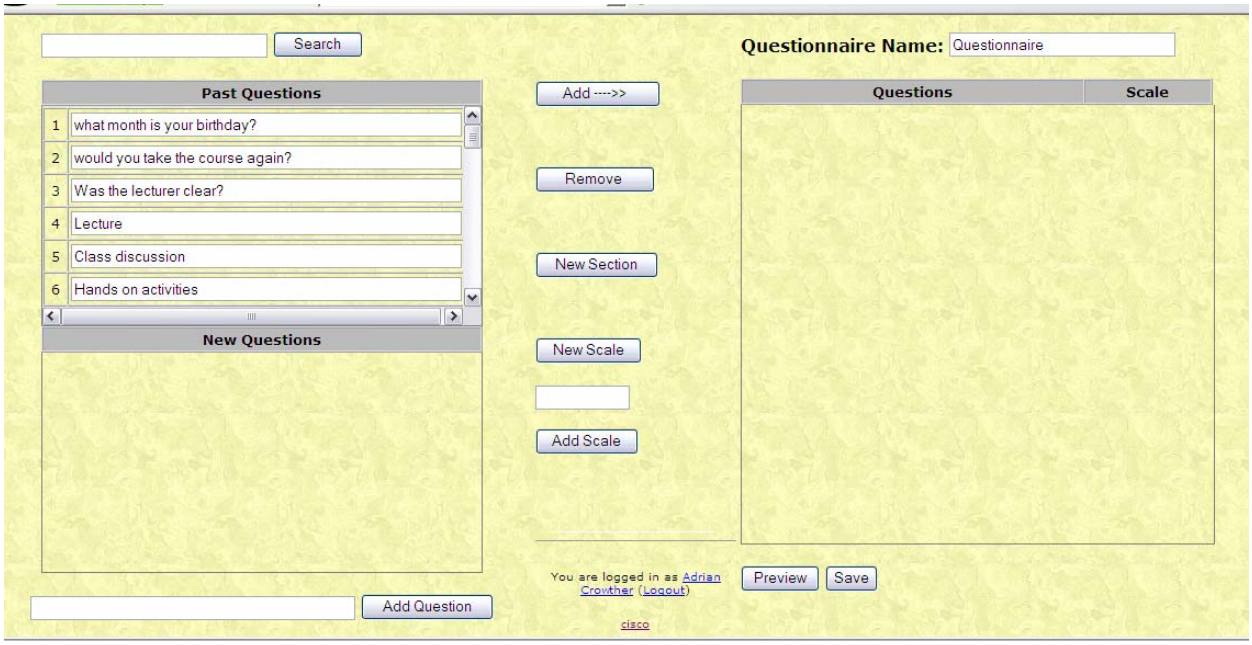


Figure 10- the improved questionnaire generator

The search facility located in the top left corner allows a user to easily locate past questions to achieve this, the user must type in a search word, any questions containing the supplied term will be left inside the questionnaire table and the rest removed. The search facility does not just match whole words; if there exists words which contain the phase entered by the user these will also be kept.

The JavaScript code below illustrates how the search function finds words by finding matches with the supplied word. Firstly the search term is extracted and placed into a variable named term. The next stage is to iterate over the array storing all the past questions and pulling out the position of questions which match the term.

```
function  matchquestions(){
  var term= document.getElementById('search').value;
  matches= new Array();
  var position=0;
  for(var i=0;i< pastquestionsarray.length;i++){
    var value =  pastquestionsarray[i];
    if(value.match(term))
    {
       matches[position]=pastquestionsarray[i];
       position++;
     }
 }
results(matches);
```

```
}
```

After establishing an array of the position of questions which match the search term, the array is passed to another method called results which removes all the rows in the table and repopulates it only with the questions which match.

Below is the results method which firstly calls the function removeTable which removes all the rows from the past questions table before pulling out all the positions of the rows to add from the matches array which is passed on calling. For a user to select a question they simple click on the question, to achieve this, an onclick function must be added to the question element. When a user clicks on the questionnaire the question is highlighted and a set of variables are initialised in the event of the user clicking the add button.

```
function results(mat){
  var tbl = document.getElementById('past');
  lastOne = tbl.rows.length;
  removeTable(‘past’);
  var position=1;
  for(var i=0;i<mat.length;i=i+2)
  {
    //add all matched questions
    var row = tbl.insertRow(lastOne);
    var cellRight = row.insertCell(1);
    var QElement = document.createElement('input');
    QElement.setAttribute('type', 'text');
    QElement.setAttribute('value', mat[i]);
    QElement.setAttribute('id', 'PastQuestions' +  lastOne);
    QElement.readOnly=true;
    QElement.style.cursor = "default";
    QElement.setAttribute('size', '55');
    var topass = mat[i].replace(" ","~");
    QElement.onclick=new Function("javascript:selectingRow("+"'"+topass+"'"+","+
mat[i+1]+","+lastOne+")");
    cellRight.appendChild(QElement);
    position++;
    }
}
```

Figure 11 illustrates the search function working correctly. All words containing the word ‘Both’ are pulled out. To repopulate the table with the full set the user must clear the search term and press the search button.

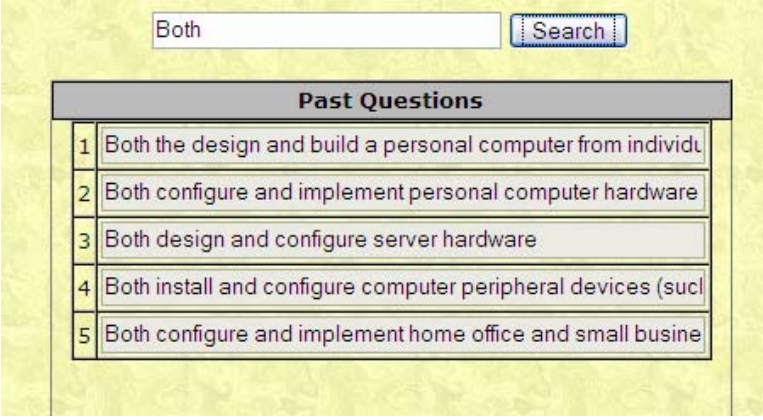


Figure 11 – Table after search

After tackling the search facility the next problem to overcome was the creation of an appropriate error message. The diagram below shows the error message displayed to the user if they attempt to create a questionnaires with the name of an existing questionnaire. The enhancement was implemented as discussed in the testing stage. An array containing the names of all current questionnaires is produced on opening of the questionnaire generator page. When the user attempts to save the questionnaire the array is checked over, if the current questionnaires name matches an element in the array the error is thrown. The previous method of checking the questionnaire is still implemented, this check was carried out by the save page which proved to be too late for the user. Keeping the initial solution will alleviate the potential of two users creating questionnaires with the same name at the same time.

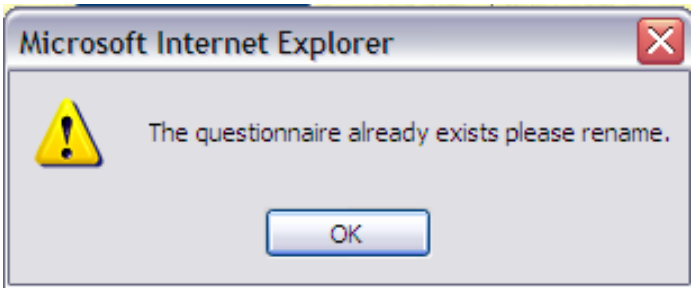


Figure 12-Error message if questionnaires name exists

The second iteration included the creation of a summary page which dynamically creates an HTML page containing the number of users who have currently taken the questionnaire, this will enable the teachers to see how many students still have to take the questionnaire. The summary page also holds administrative fields such as the name of the table and the questionnaires id. These fields illustrate the tables associated with the questionnaire allowing for easy location for any alteration required to be

carried out on the tables. The most important function the summary page has is the ability to calculate the average rating of each question based upon the answer set of all students who have undertaken the questionnaire. To accomplish this, the statistical analysis method medium was used. The statistical analysis section in the background reading discusses the options available to achieve this goal and the reasoning why the medium method was adopted. To hide any complexities from the user, two additional functions have been added. These functions are available from within the summary page and allow the teachers to flush the database, resulting in a fresh start and also the ability to remove the questionnaire along with any results. These functions prevent the teachers from having to manually remove the questionnaires by performing SQL statements.

Appendix I illustrates an example of the summary page; the page shown is the summary page of the testing questionnaire used to test the system. The summary page states that 5 users undertook the questionnaire this can be confirmed by looking at the bar graphs in Appendix H, counting the number of responses confirms that 5 users did take the questionnaire. Cross-referencing the average rating for each question in the test questionnaire with the actual results confirms the analysis is working correctly and affectively.

The last enhancement implemented was the extension of the graphical representation resulting in the ability to view the results of questionnaires in three formats. The formats chosen to best represent the information were bar charts which were the initial graphical representation implemented, pie charts and line charts.

The graphical representation aims to produce meaningful information from the data gathered. As the questionnaire will be a universal tool multiple graphical formats allow the users to choose a graphical representation which best portrays the results.

The bar chart expresses the information in bars portraying the number of responses for each possible answer allowing for easy comparison. The example below shows what the bar chart looks like, the correlation can be seen between the example bar chart in the design stage and this one. This is because the example bar chart was used as a template to achieve this. As stated before the Y-coordinate is automatically assigned by JPGraph to achieve an image of a constant size, irrespective of the number of responses to the questionnaire the size of the image will be the same.

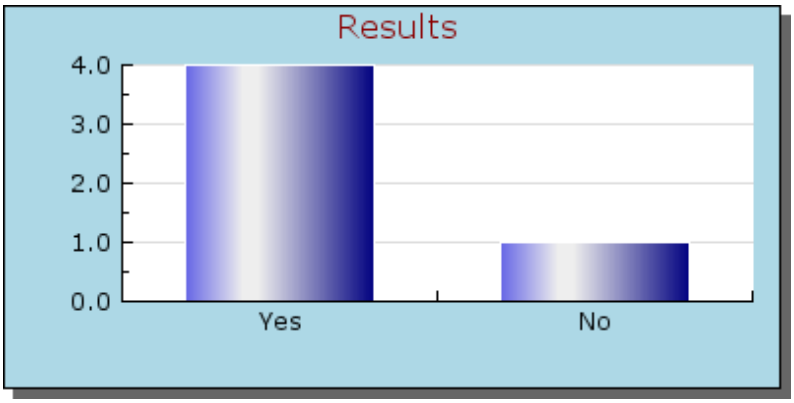


Figure 13-Bar chart example

The pie charts no longer supply the user with the number of students chosen a set answer but the percentage of students. This will prove useful for example when gathering feedback for a course/module, the number of responses is really irrelevant all that is required is the percentage of user who choose each answer allowing highlighted areas to be easily tackled.

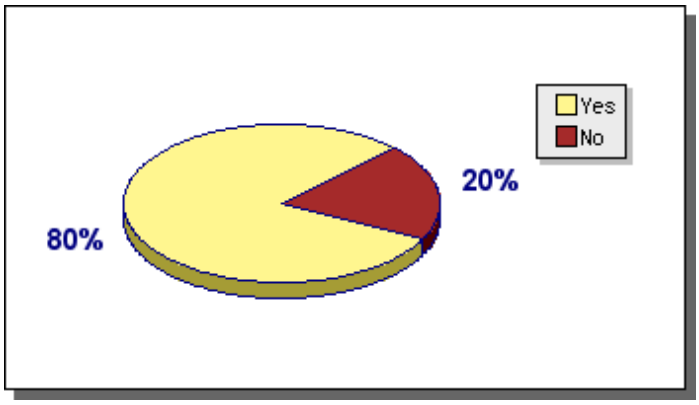


Figure 14-Pie chart example

Line graphs will be the least used graphical representation as the majority of the questions in the questionnaires are answered in a set scale but it is possible for each of the answer to have no correlation between each other. In this case the line graph will highlight irregularities as well as the minimum and maximum of the supplied answers. The example below shows a simple line graph created using JPGraph, again the Y-Coordinate is automatically scaled.

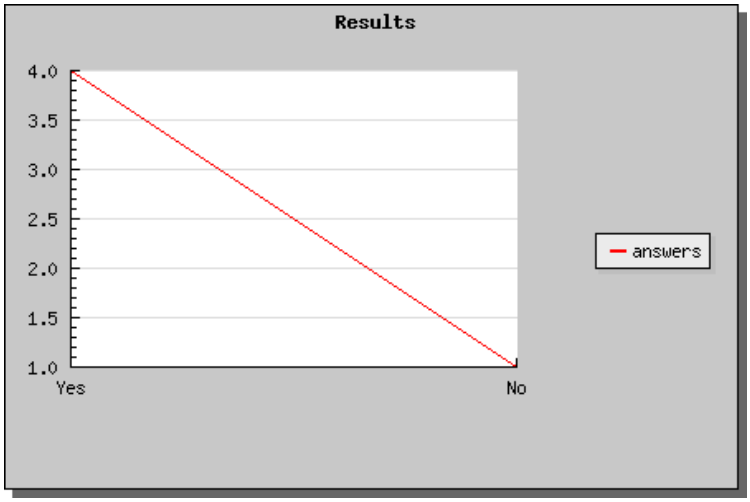


Figure 15-Simple Line graph example

10.1 Problems encountered

Throughout the creation of the questionnaire module many problems have been faced and over come. This section highlights the major problems encountered and the solutions found to overcome them.

The initial problem encountered was when creating the questionnaire generator; the system would pass the information entered by a user in the new question input field and add it to the new question table. The limitation of using JavaScript to achieve this soon became apparent. Unfortunately, if the user entered more than one word, the function would not work this was due to JavaScript being unable to deal with spaces. The fix to this was relatively straight forward, a simple check was performed on the inputted information and any spaces were replaced by any used character which was chosen to be ~. Once the information has been passed between JavaScript function the passed text was converted back by reversing the operation.

After resolving the space problem it did not take long to run into another problem. This problem was finding a universal JavaScript approach to adding new rows to a table which are read only resulting in a user being unable to edit once inserted. The initial solution were the intended input element was to be inserted into the table had an attribute named readOnly which was set to true only worked in internet explorer and Opera but not in Mozilla. After researching the problem a new solution was found, instead of calling a setAttribute method a variable inside the element called readOnly, was set to true. The resulting solution worked in all tested web browsers.

As a user simply click on the question to select it before pressing the add button to add the question to their questionnaire, highlighting the selected question was vital. Although highlighting a row in a table would have been thought, easy to be implemented it proved to be on the contrary. The main

problem is that the tables will be growing in size as new questions are added. The user has the ability to select questions from both the past question table and the new question table. To solve this problem upon creation of an element which is to be inserted into one of the tables, an onclick function was added. The onclick function called a JavaScript function and supplying the id of the question and the table it resides. This function was used for a dual purpose one to set the selected question variables which may be entered into the user's questionnaire and the other to highlight the selected question.

A major problem which was not encountered until the CISCO questionnaire was created and previewed was the use of illegal characters. The questionnaire consisted of a character which coursed a problem, using a single quote will close the string and as the information passed between pages are contained inside strings. Having a single quotation will result in the string being cut down to the data being inside the two quotations. The prevention of this problem was to remove any illegal characters these include single quotes and triangle brackets. Removing triangle brackets helped to prevent JavaScript insertion

The last major problem encountered was the number of pages being opened when the user performed a task. Every button the user pressed would result in a new page being opened, this proved confusing to the user. The solution to the problem would be to open a new page in the same window but unfortunately one of the web browsers (Mozilla) did not support this function. A compromise had to be made, since the students taking the questionnaires at the school would use Internet Explorer it seemed logical to choose opening a page inside the current window making it less confusing.

10.2 User manual

Appendix J shows the user manual attached to the system. Although the system has been implemented for the school the user manual still discusses the installation of the new module. As the school manages multiple Moodle environments the system at some point may be implemented into multiple environments, the aim is to keep the system as generic as possible. The user manual also discusses all the steps involved in creating a questionnaire through to removing a questionnaire.

This section dealt with the second iteration of the system, now that the system is fully functional the next stage is to licence the system. To achieve this, multiple licences will have to be studied to find a suitable open source licence which will accommodate the third party software used.

11. Licence

This section aims to discover an open source licence for the questionnaire module which will satisfy the user's needs with obstruction. The system will be freely available for use and change. The licence must accommodate the graphical representation tool and the PDF generating tools used.

Section 2.3.2 of the background reading stated that Moodle is certified by OSI who promote open source software. The OSI was an ideal starting point for locating an open source licence. OSI's website provides a list of over 50 approved open source licences. If any of these open source licences are adopted then my system will automatically be certified by the OSI. From looking at the list for general or relevant licences the following were found:

- PHP licence
- Open software licence (OPL)
- Q public licence (QPL)

The PHP open source licence was written by the creators of PHP and is specifically for systems written in PHP. The licence allows for the source code to be freely distributed and modified without permission. The licence does discuss the release of newer versions of the licence but the system is only covered under the licence which it has been covered under. Reading further into the PHP licence does show it to be for the sole use of the PHP development team and is not a generic open source licence. This means that this licence can not be used on my system.

The next licence considered was OPL which allows any user to freely user the software as a whole or partly and modify without authorisation. The licence also prevents the creator from being liable for any damage caused from using the software. Unfortunately the licence only covers original work and can not incorporate the third party software used.

The last licence to be looked at was QPL which is the licence used by JPGraph. The QPL licence is a relatively new in comparison to some of the other licences. The licence was created in 1999 and is still on version 1.0. The licence allows for free distribution and alteration of the software as well as no liability for the creator of the software. As JPGraph uses this licence is seems logical to incorporate the same licence into my software so that the licence governs the whole of the software. To be fully compliant to JPGraphs Licence the system can only be made available to the public domain which includes educational. As the questionnaire system is only intended to be incorporated inside Moodle the virtual learning environment then this licence will suit. To bind the software with the licence, the documentation must be supplied along with the software.

Now that the system is completed the next stage is to implement the system into the school.

12. Implementation

As mentioned in the previous section the aim of the implementation section is to put the completed system into the school. This had to be achieved without taking any of the Moodle environments currently running on the same server down. When implementing the first iteration of the system a number of steps had to be carried out. The steps are as followed:

1. Take the_quest module folder containing all the PHP files along with the database structure and place it inside module folder which is situated inside the CISCO Moodle environment residing on the server at the school.

2. Add a copy of the the_quest language file which contains a predefined list of variables which are called upon within the system and place it inside the eng folder inside the lang directory.

3. Insert an icon to represent the module once installed on the system. To achieve this, the theme running on the Moodle environment had to be determined. After looking at the settings the theme aqua was found to be running on the system. The chosen icon of a picture of the earth was placed in the theme/aqua/mod/the_quest location.

4. The penultimate task is to add the module to the Moodle environment. To do this, we must first login as an administrator then navigate into the course where by the new module wants to be available from. Once in the correct course an activity of the_quest must be added.

5. The last stage was to test the modules availability is correctly situated within the course.

The second iteration of the system was not implemented into the Derek Fatchett centre, had it been the same set of steps would have been followed as those above. The reason why the second iteration was not implemented was because the system did not fill Mr Fletcher needs. When walking through the second iteration with Mr Fletcher, a number of additional requirements came up. Unfortunately there was not enough time remaining in the project to implement these additional requirements. These additional requirements came about from Mr Fletcher wishing to implement the system to the whole of the students as apposed to implementing the system inside a course also the new changes came about from the way in which the system was designed. The additional requirements included the ability to distinguish the results between the schools which use the system as well as the ability to highlight students who have not currently taken a questionnaire. It was recommended to Mr Fletcher that the best way to accomplish this enhancement would be to incorporate the ability to automatically email the students with a standard email reminding them to take the questionnaire.

The implementation section walked through the stages needed when implementing the system into the Derek Fatchett. The first iteration was implemented without the need to bring all the Moodle environments down. The last section to discuss is the evaluation section where the system is evaluated against the user requirements gathered in section 4.

13. Evaluation

The aim of this section is to evaluate the RAD methodology to asses if this was the correct methodology to adopt for this project. This section also aims evaluate the system against the initial user requirements and highlight any mistakes which may have lead to a system which does not completely meet the users requirements. In order to determine if the project was successful the evaluation criteria set out in section 1.8 will be used.

13.1 Project Aim

The aim of this project was to create a questionnaire generator for an open source virtual learning environment. The system was to give teachers the ability to create questionnaires and offer them to students to take. The results for the questionnaires were to be displayed in an easy understandable format, allowing the teachers to gain valuable feedback. The initial aim of the system was to get feedback from the courses allowing teacher to tailor the courses slightly based upon the feedback. The questionnaire generator was to replace an existing CISCO questionnaire which was given to students before completion of a course. The current questionnaire was not used in anyway by the school, so the new system aimed to not only replace the existing solution but extend it allowing the school to utilise the results.

The completed system was not implemented into the school as some additional requirements were highlighted to late on. The solution aimed to be as generic as possible so the solution could be used in multiple environments. The system could be used in any Moodle environment and is not specific to only working at the Derek Fatchett centre, because of this I have chosen to place the system on the open source software development web site called sourceforge.net, this will enable any Moodle users

to incorporate the new questionnaire module into their Moodle environments. Currently the system is pending review and should be up available within a few weeks of completion of this project.

13.2 Chosen Methodology

As was discussed in section 3.5 an iterative development approach did allow the system to be developed in a efficient way. The creation and implementation of the first iteration allowed the coding of the questionnaire generator to be generic to both the machine where the system was developed and the server which the Moodle environment resides on. If a non-iterative approach was used, implementation of the system would have taken weeks as the coding faults would have to be found manually and a correct solution implemented. If given the opportunity to undertake this project again I would still have chosen an iterative approach but have attempted to fit in three iterations. The second iteration would have aimed to be the completed system minus any additional requirements the user required. The first iteration would be the longest task as it begins from scratch. The other two iterations would be shorter and extend the previous iteration.

13.3 Evaluate against minimum requirements

The first iteration system implemented at the school allowed teacher to generate questionnaires and offer them to the students. The students have the ability to take the questionnaire online in a HTML format or a PDF which enabled the questionnaire to be printed off. The results from the questionnaire could be viewed as a number of bar graphs. This version of the system was implemented and was tested in the work place.

The completed system was not implemented into the work place as it did not meet the extending requirements brought up in the last meeting with Mr Fletcher. The second iteration allows the results to be viewed in numerous graphical representation as well as statistical analysis to be performed on the data. The statistical analysis performed allowed to the teacher to view the average rating on each question in a questionnaire. The completed system extended the minimum requirements by supplying some of the possible extensions. The questionnaires are available in multiple formats.

13.4 Evaluate against user requirements

Section 6 contains the set of requirements gathered during the interview process, comparing these requirements against the complete system will determine if the project was successful. Breaking down the system requirements result in a set of requirements:

A questionnaire generator allowing teachers to create questionnaires with closed questions
The completed system allows teacher to create a questionnaire from a set of past and new questions. Only closed questions are supported in the questionnaire generator, although this meets the users needs it would be a good extension to allow the user to insert open questions. One of the major aims was to allow the user to complete the task of creating a questionnaire from within the same window. This was achieved using tables to transfer information into an easy format for the user.

The questionnaire must be displayed in a suitable manner making it easy for the user to fill in.
Appendix H displays the layout of an example questionnaire. The layout of the questionnaire was developed to be user friendly by having a set width for the question column, any longer questions will flow over to the next line. All sequential questions with the same scales are joined together making it easier and quicker for a user to fill in. Time was spent correcting the layout making it as easy as possible for the user to look at and take the questionnaire.

The student should have the ability to take the questionnaire online or offline.
The user has the ability to take all questionnaires online or offline. If a questionnaire is taken online the results are automatically stored in the database. A PDF generator was used to allow questionnaires to be printed out and filled in. The results will then be passed back to the teacher who can then take the questionnaire filling in the supplied answers. Third party software proved invaluable in achieving some of the major components of the questionnaire generator without these open source software this project would not have been possible at this level in the project time span.

Graphical representations to visual interoperate the stored results.
The system allows teacher to view the results of questionnaires in multiple formats. The teacher can choose the best graphical representation which best represents the data. The graphical representation chosen offer the user the best portrayal of the information. Discussion of the graphical representation with Mr Fletcher proved popular.

The system must fit in to the administrative roles at the centre.
The system is incorporated into the Moodle environment and database resulting in a system which can be backed up along side Moodle.

As can be seen the system meets all the user requirements which were gathered at the user requirements stage. Although all the initial requirements were met this is not to say the system was successful.

13.5 Evaluate Usability

As the system was to be implemented into an educational institute, usability was a major factor. The questionnaires had to be accessible by any type of user. Section 9.1 in the testing stage shows the process carried out to maximise the accessibility. The use of third party software greatly helped in highlighting the problems so they can easily be fixed. Once the HTML output was fixed the questionnaires were accessible by any user at the Derek Fatchett centre.

13.6 Comparing solutions

Comparing the existing Moodle questionnaire and the solution created throughout this project will strengthen the need for the solution. Section 2.3.3 summarised the existing Moodle questionnaire module which was determined to be inadequate for use at the Derek Fatchett centre. The existing questionnaire module aimed to be a generic system which allowed users to produce any number of questionnaires and view the results. The new system produces a system which fully met the users needs this included only dealing with closed questions and providing the results in a meaningful format.

13.7 Results of Evaluation

Although the evaluating the system against the minimum requirements and the user requirements show the project to be successful due to changes/additions of the users requirements resulted in a system which no longer met all the requirements. The changes to the requirements were discovered too late in the project resulting in insufficient time to implement the changes. The changes were derived from the way in which the system was implemented. This problem may have been diverted if the design stage was shown to Mr Fletcher as opposed to waiting for an iteration to be completed.

13.8 Possible extensions

The possible extensions to the project include the extensions brought up by Mr Fletcher in the last meeting. These include the following:

- A drop down box inside a questionnaire listing all the schools which use the Moodle environment.
- The ability to add and remove schools from the list.
- A list of all students who have not filled in the questionnaire and the ability to easily email them reminding them to take the questionnaire.
- Ability to not only search for a keyword in a question but also allow the user to type in a questionnaires name and pull out all questions in a questionnaire.
- The ability to view results from all and individual schools.

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Appendix A- Personal reflection

I believe the project as a whole was successful although not having the system implemented was disappointing. The new requirements came too late for them to be implemented in the time span remaining. As I had other coursework's and modules to consider whilst creating the system, I did not have time to constantly refer back to Mr Fletcher with every decision made. Although Mr Fletcher was extremely pleased with the system, he thought it would be best for these additional requirements to be implemented prior to being implemented into the school. I have to agree that the additional requirements will create a better system; it does greatly extend the goal of the project. The initial goal was to create a questionnaire generator to gain feedback. The new alteration will create a system that will have the capability to view individual results as well as producing a list of students who have not taken a questionnaire yet.

From reading past personal reflections I understood some of the difficulties involved in working with external parties. Many of the past reflections mentioned the key aspect of keeping in contact with the involved parties, although I tried my best to avoid finding myself in the same predicament I did become a victim. At the start of the design stage of the project I found myself becoming separated. From looking at the gannt charts it can be seen that I forgot to schedule in any time for revision for the January exams resulting in me falling behind schedule. The first iteration of the module was finished by late February lucky the administrator of the centre was available for me to implement the prototype. Unfortunately Mr Fletcher was away and subsequently I had to wait 3 weeks before being able to meet him.

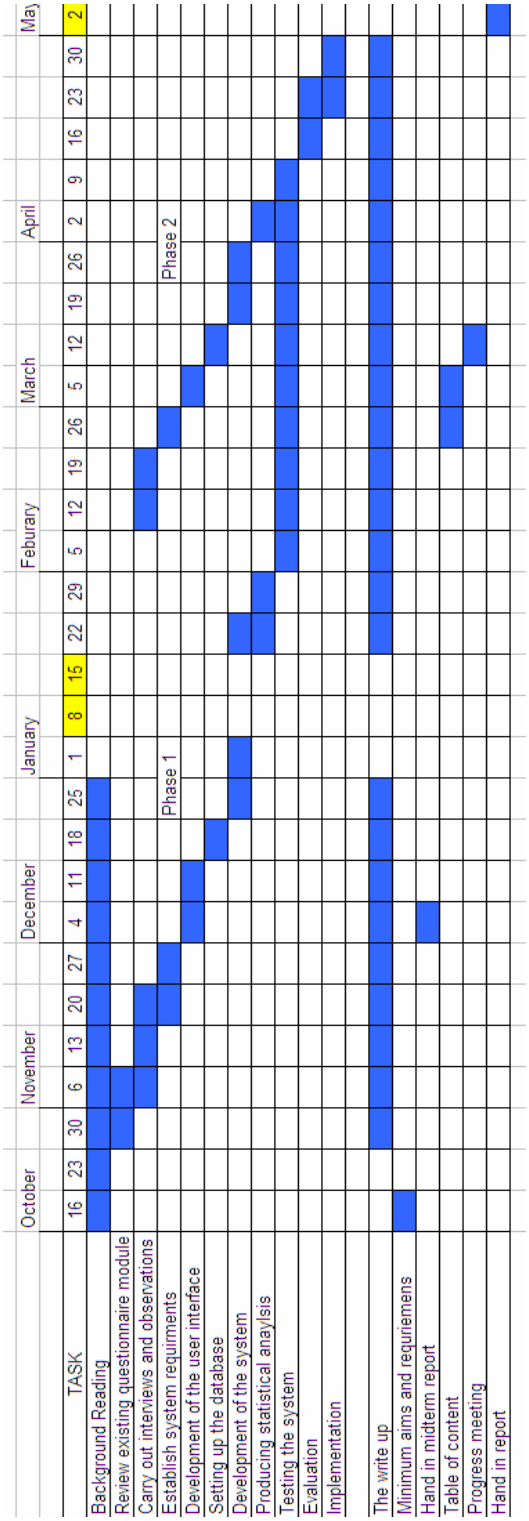
I found out the hard way that just because a program works on one computer means that it will work and function correctly on another. After installing the first prototype it quickly came to light that something was not right. Correcting the problem took me 2 days of code cutting trying to locate the problems. Luckily the prototype was not the full system to preventing the errors from appearing again was easy.

My advice to students about to undertake their final year project is to keep in constant contact with any third parties involved in the project and plan ahead. Make sure that you book some meeting times so that the system can be shown at each stage of the project. Also install a prototype at the earliest possible stage to help prevent or at least reduce the impact of any incompatibility.

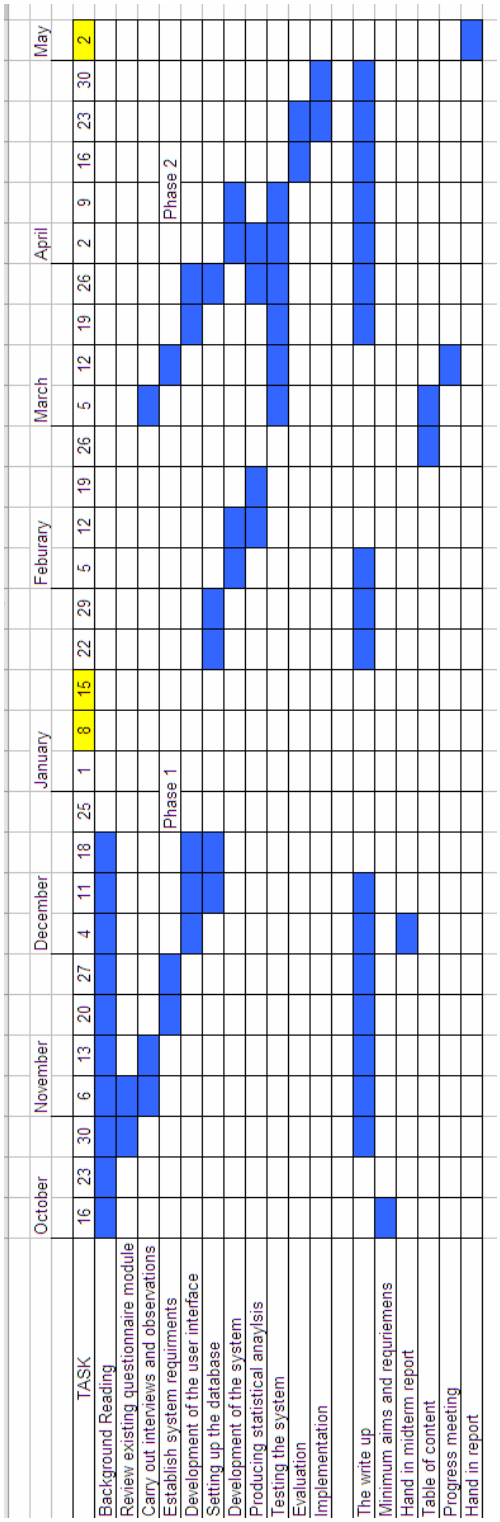
My last piece of advice to give is to keep your supervisor informed of your progress if you fall behind they will advise you on what to do, they are there to help you. They have gone though it multiple times.

Appendix B- The Gantt charts

Initial



Revised


October
November
December
January
Feburary
March
April
May
TASK
Background Reading
Review existing questionnaire module
Carry out interviews and observations
Establish system requirments
Development of the user interface
Setting up the database
Development of the system
Producing statistical anaylsis
Testing the system
Evaluation
Implementation
The write up
Minimum aims and requriemens
Hand in midterm report
Table of content
Progress meeting
Hand in report
Phase 1
Phase 2

Appendix C – Interview with MR Peter Fletcher

Interview with Peter Fletcher 6th November 2005
Derek fatchett centre

1. What systems are currently in place to currently achieve generating the questionnaires?

There is a basic system which is only used by Cisco themselves. Education Leeds currently don't use any of the data collected instead they are just sent to Cisco in paper format.

2. Is there an existing Moodle system that the new modules will fit into?

Yes it can be found at Cisco.leeds-clcs.org
In order for me to investigate the current system in place, Mr Fletcher has made me a user of the system.

3. Is there a certain look or layout wanted? E.g. to fit in with other relevant modules that are used?

Mr Fletcher is sick of constantly being reminded of being inside the Moodle environment so a alternative look and feel is require in the new system.

4. Will the name of the questionnaire uniquely identify it?

There is a basic questionnaire online to look at. This questionnaire is sent of to Cisco and Leeds education don't analyse it in anyway yet. In the new system the questionnaire name will be enough to uniquely identify it.

5. What fields will be needed on the html questionnaire?

See Cisco's questionnaire which every student must fill-in before graduating.
Types of fields include School name, academic year and teacher.

6. What type of question will be on the questionnaires?

Will they be closed questions which all can be answered on a set scale?
Will open questions be asked?

The questions will always be closed questions on the same scale. No open questions will be used on the system. The ability to add new scales is required. The current questionnaire shows how the same question may have different answers depending on the section they reside.

7. Are there any sample questionnaires available?

Yes online they can be found by logging into Moodle and clicking on…

Home page -> site news -> feedback form

Other areas discussed in the interview:

The new system must be easy to use for both the teachers involved in creating the questionnaire and the students who have to take the questionnaires. The new module will save the results of the questionnaires saving Mr Fletcher valuable time. Currently Mr Fletcher manually inputs the data before sending the results to CISCO.

Mr Fletcher also discussed the option of outputting the questionnaire not only as a webpage but also in a format which can simple printed off and the results easily inputted at a later time. A PDF format was recommended to achieve this goal.

Storing the results in a format by which statistical analysis can easily be performed on.

A graphical output is required which sums up the results of the questionnaire in an easily digestible format

There are four types of users which currently use the Virtual Learning Environment. These are as follows:

- The manager of the academy – who currently deals with the questionnaire that is currently in place.
- The administrator – who manages the Moodle system.
- The students – enrolled on the CISCO courses.
- The teachers – who use the current system to assist in teaching the courses.

Out of these user typed there will be three types of users to the system

- The teachers who create the questionnaire and look at the results
- The students who take the questionnaire
- The administrator who has the ability to remove and alter the data sets.

Arrange an interview with Jason Thomson the administrator at the Derek Fatchett centre regarding the working environment of Moodle.

Appendix D – Interview with Jason Thomson

Administrator for the Derek Fatchett Centre, 10am Wed 09th November 2005

1. Who will have the role of changing the questionnaire? Will it be you job or the teachers?

He will be involved with setting up the module and the teachers will deal with adding and editing the questionnaires.

2. Should the student be able to enter their details or do they want to be entered by the system?
    - Look at the Assessment module which he believes carries out this role already.
    - It would be best if the details where pre-entered.

3. What functions can the teacher perform on the system with the set permissions?

The have the ability to change the content of the module they teach. The can add the questionnaires so they are the users who will interact with the module on a regular basis.

4. What tasks will be done on a regular basis to the database?

- Backing up the system which is done automatically
- Cleaning up the databases (not frequently)

5. How are backup's handled?

Backup are done on disk once a day by using a separate program out side of mysql. Although Mysql has the ability they choose to use an external program to give them the ability to backup other programs.
The backing up is done using Disk to disk to tape.

6. Once a questionnaire is designed who is it put onto the website?

The teachers have permission to edit their course details and add/remove questionnaires.

7. What version of Moodle and Mysql are currently running?

Mysql 5 is currently running on the server.
The system has not been upgraded to Moodle 5.1.2+ yet although some of the other sites managed by Education Leeds already have. Jason mentioned if Moodle needs to be upgraded for my project then he will deal with the upgrade.

8. What is the computing technical knowledge of the users?

- The students
    - On the Cisco IT essentials they are A-level students
    - CCNA is above

- The teachers
    - The teachers know how to use the system
    - There is a new learning course coming up for teacher to show them how to use modern utilities not just Moodle.

Other areas which where risen

Jason uses Mysadministrator to manage the database. (Have a look at what facilities it has)

The assessment module does some the facilities that are wanted for the questionnaire module.

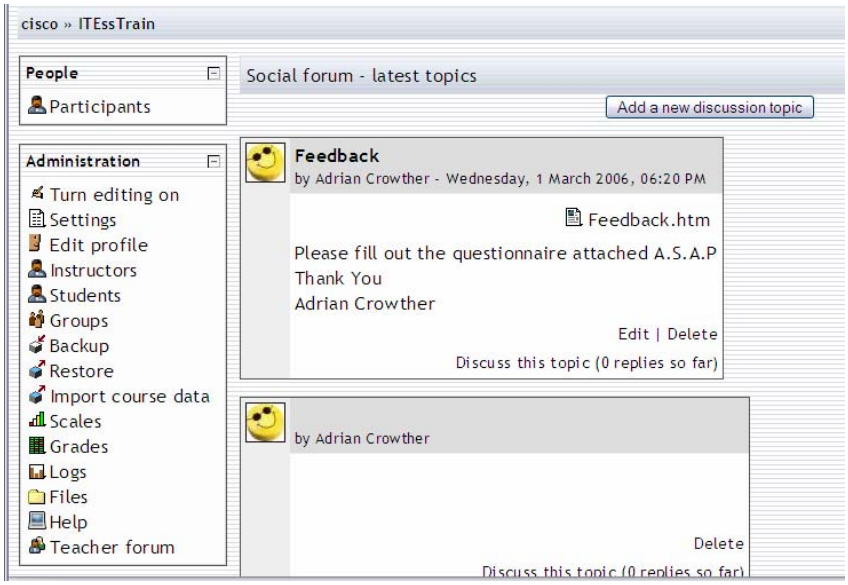
The site will be hosted on to begin with for test purposes. Eventually this is where the site will be hosted and no longer Cisco.leeds-clcs.org.

www.leedscshools.org/cisco

There is already an old prototype on this website which will be replaced.

Jason will make me a account for accessing the computers at the DFC so I have the ability to file transfer and update the site after each prototype. This will enable me to test the module on the server.

Appendix E – Current System implementation



Appendix F – Current questionnaire

Cisco IT Essentials I Programme Evaluation Form

Name School Year

Instructor

Curriculum Review

Please rate your confidence…

		Not very	A little	Confident	Very	Completely
Both design **and** build a personal computer from individual components:		☉	○	○	○	○
Both configure **and** implement personal computer hardware:		☉	○	○	○	○
Both design **and** configure server hardware:		☉	○	○	○	○
Install, configure, **and** implement Microsoft Windows operating systems:		☉	○	○	○	○
Both install **and** configure computer peripheral devices (such as monitors, printers, scanners, multimedia hardware, etc.):		☉	○	○	○	○
Both configure and implement home, home office, and small business personal computer networks		☉	○	○	○	○
Design, implement, **and** maintain a safe computer maintenance environment:		☉	○	○	○	○
Find answers to computer-related problems in order to successfully troubleshoot personal computers, peripherals, **and** computer operating systems:		☉	○	○	○	○
Understand binary, hexadecimal, **and** decimal conversions:		☉	○	○	○	○

Class Time

How often did your class include:

	Never	Rarely	Occasionally	Often	Always
Lecture:	☐	☐	☐	☐	☐
Class discussion:	☐	☐	☐	☐	☐
Hands-on activities (such as curriculum labs and course projects):	☐	☐	☐	☐	☐
Independently reading the online curriculum (e-reading):	☐	☐	☐	☐	☐

Please indicate how useful these activities were to you

	Not at all	Useful	Very useful	Essential
Lecture:	☐	☐	☐	☐
Class discussion:	☐	☐	☐	☐
Hands-on activities (such as curriculum labs and course projects):	☐	☐	☐	☐
Independently reading the online curriculum (e-reading):	☐	☐	☐	☐

Instructors

Please indicate your agreement with the following statements

	Not at all	Partially agree	Agree	Strongly agree
The instructor(s) was adequately prepared to teach the course.	☐	☐	☐	☐
The instructor's lessons were clear and easy to understand.	☐	☐	☐	☐
I felt comfortable approaching the instructor(s) with questions / ideas	☐	☐	☐	☐

What is the likelihood of you following another cisco Course?

Unlikely	Possibly	Likely	Certain
☐	☐	☐	☐

Thank you for your time. Please post or e-mail this document back to

Mr P. Fletcher fletchp02@leedslearning.net

Leeds NE CLC

Talbot Ave

LEEDS LS17 6SF

Submit Reset

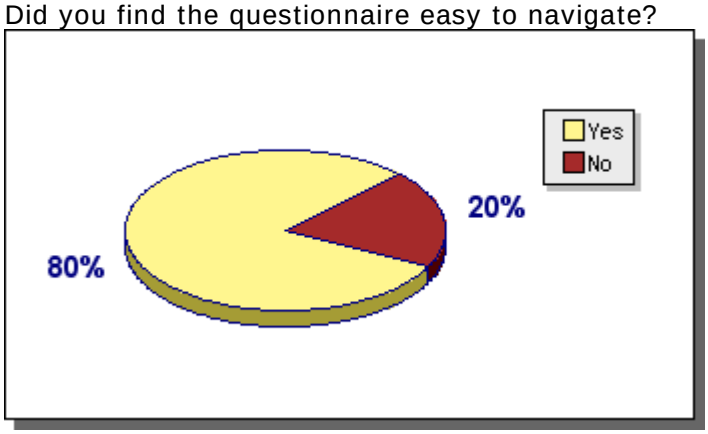
Appendix G – Testing questionnaire results

Pie chart

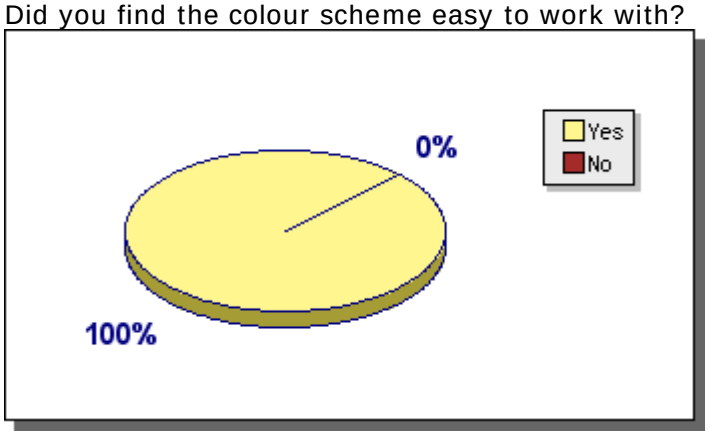
Making the questionnaire

Usability

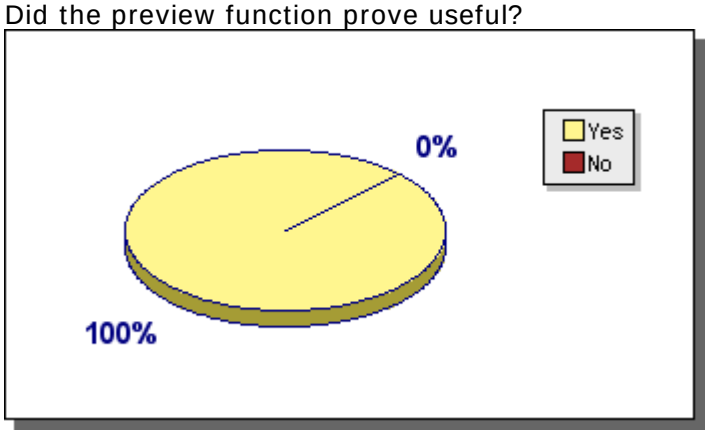
Did you find the questionnaire easy to navigate?



Did you find the colour scheme easy to work with?

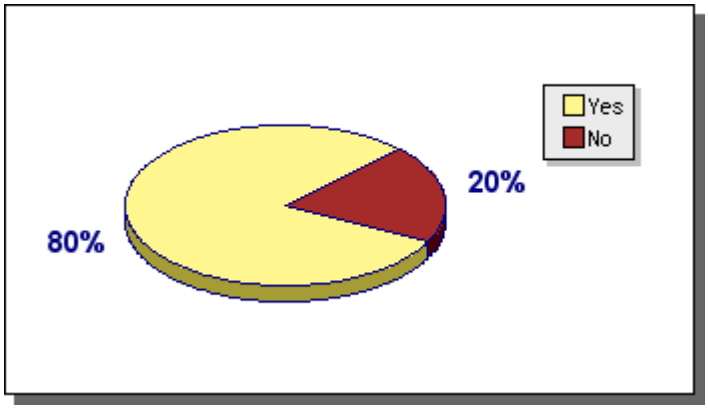


Did the preview function prove useful?

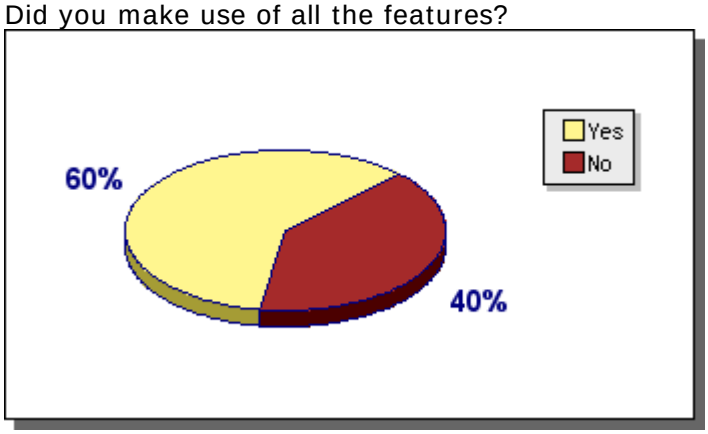


Suitability

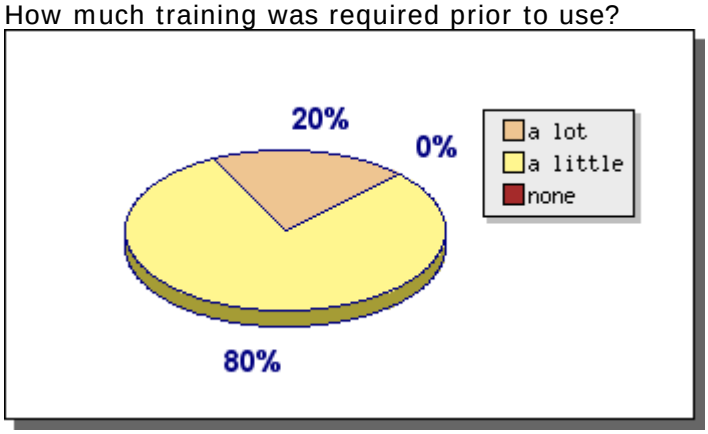
Did the module provide all the funcionality expected?



Did you make use of all the features?



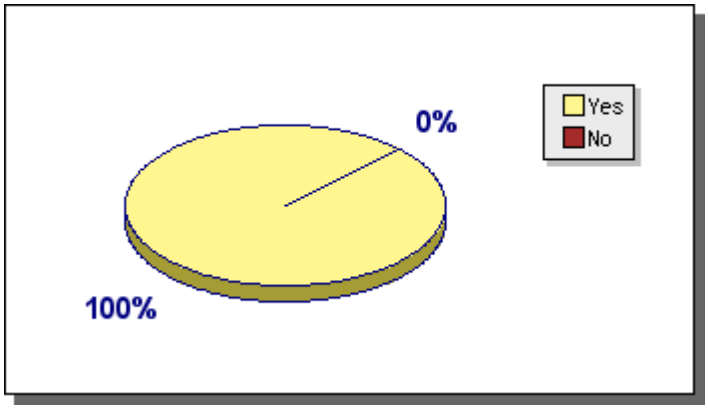
How much training was required prior to use?



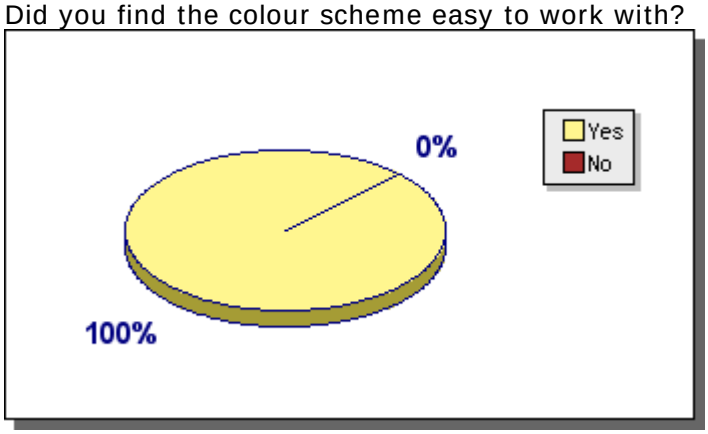
Taking the questionnaire

Usability

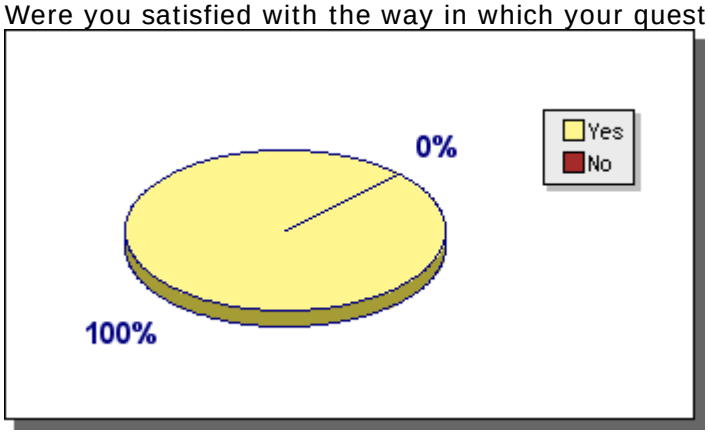
Did you find the questionnaire easy to navigate?



Did you find the colour scheme easy to work with?

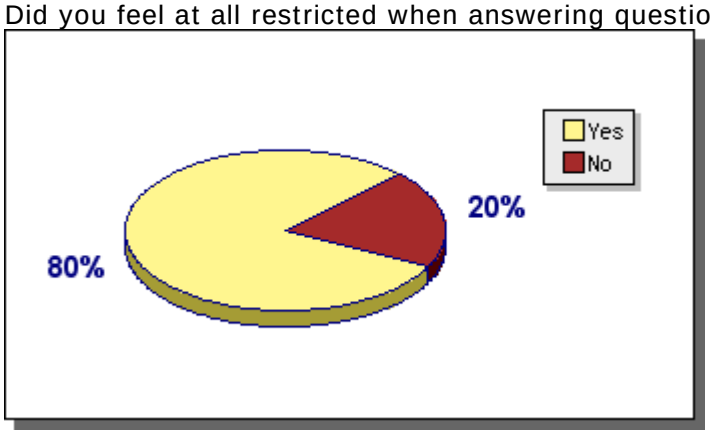


Were you satisfied with the way in which your questionnaire was stored?



Suitability

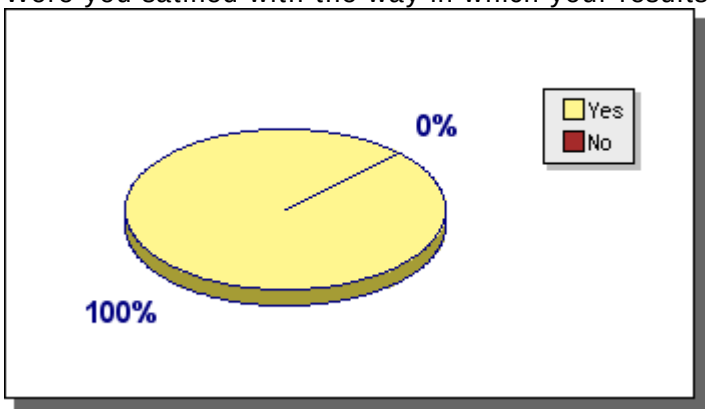
Did you feel at all restricted when answering questions?



Viewing results

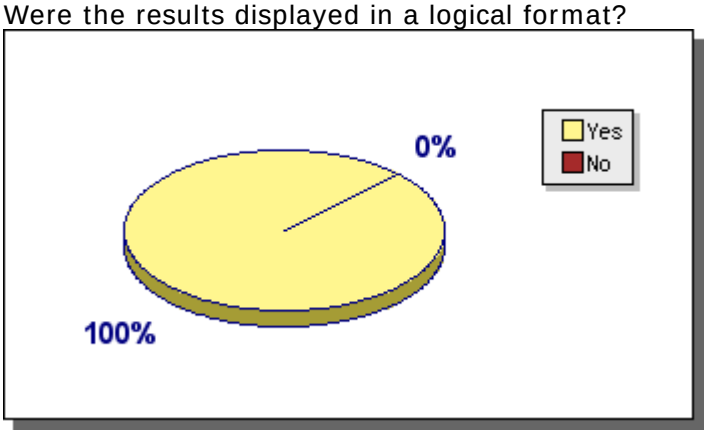
Usability

Were you satified with the way in which your results were stored?



Suitability

Were the results displayed in a logical format?



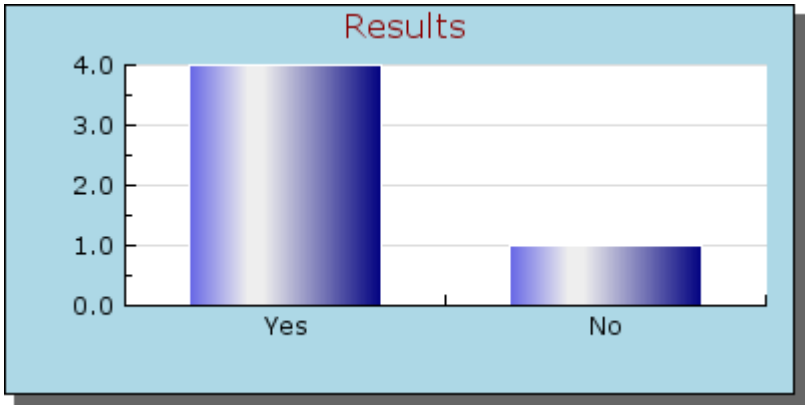
Bar graph

Questionnaire: System_testing_Questionnaire

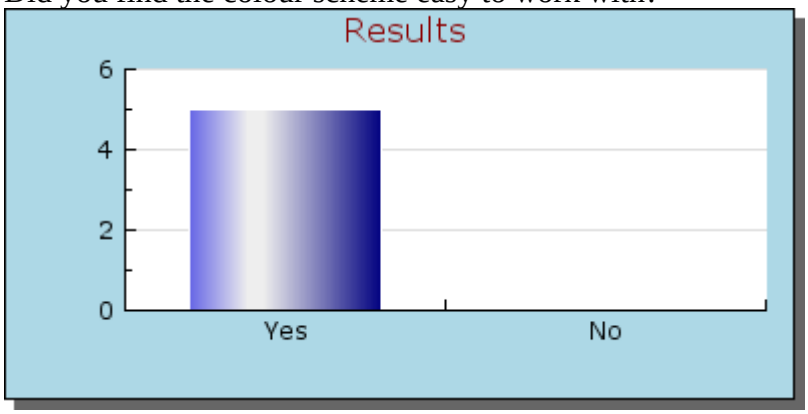
Making the questionnaire

Usability

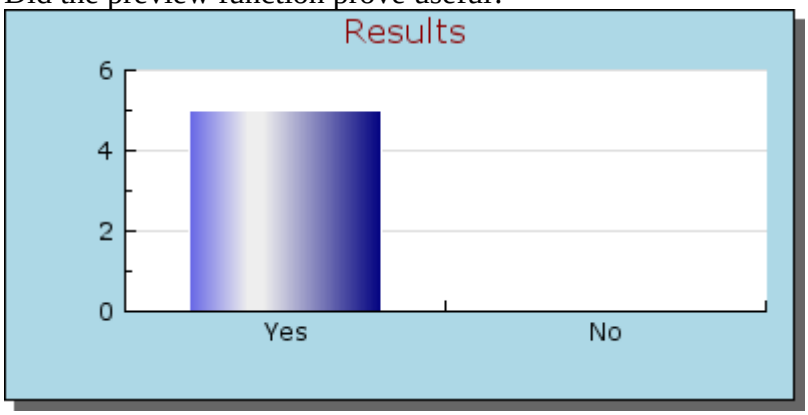
Did you find the questionnaire easy to navigate?



Did you find the colour scheme easy to work with?

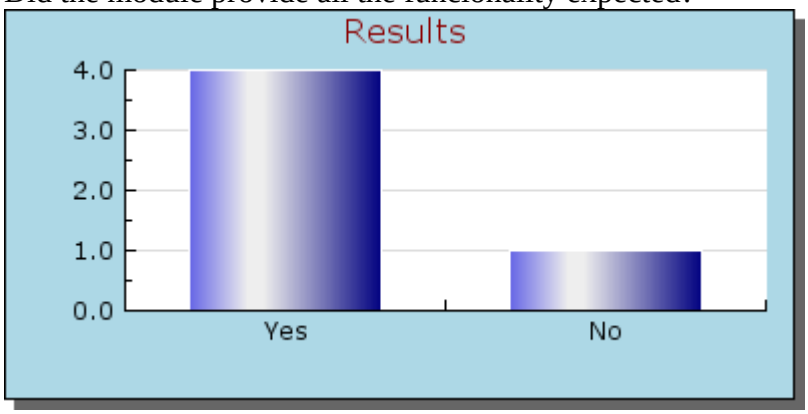


Did the preview function prove useful?

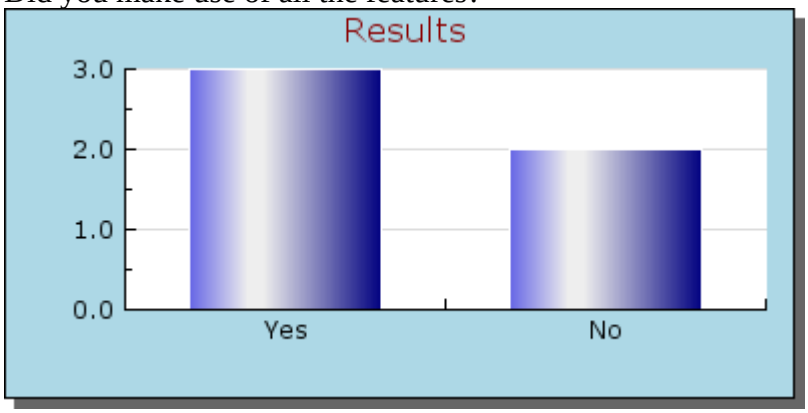


Suitability

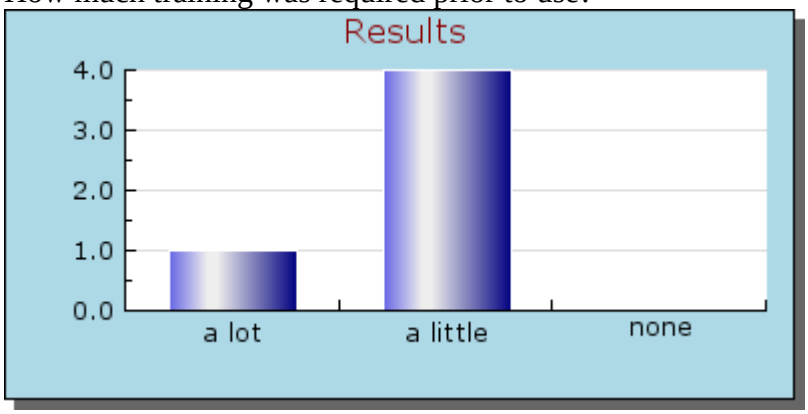
Did the module provide all the funcionality expected?



Did you make use of all the features?



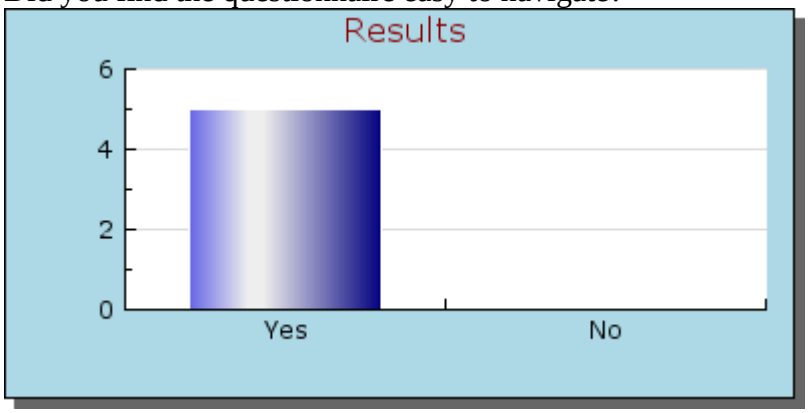
How much training was required prior to use?



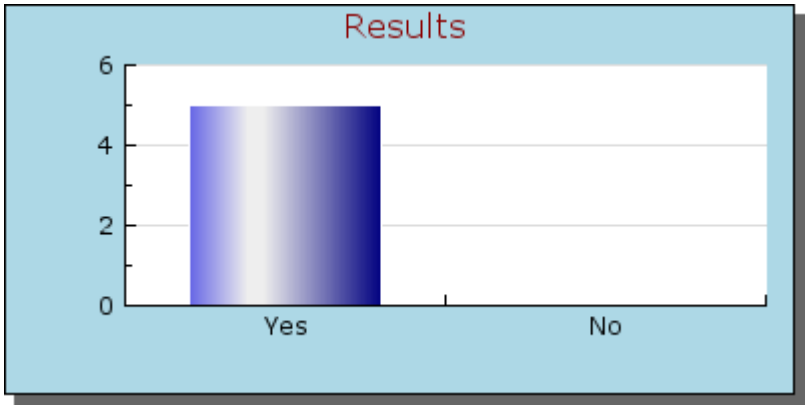
Taking the questionnaire

Usability

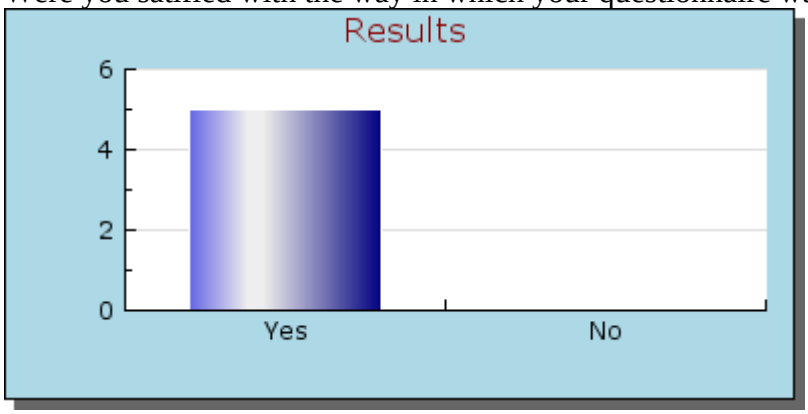
Did you find the questionnaire easy to navigate?



Did you find the colour scheme easy to work with?

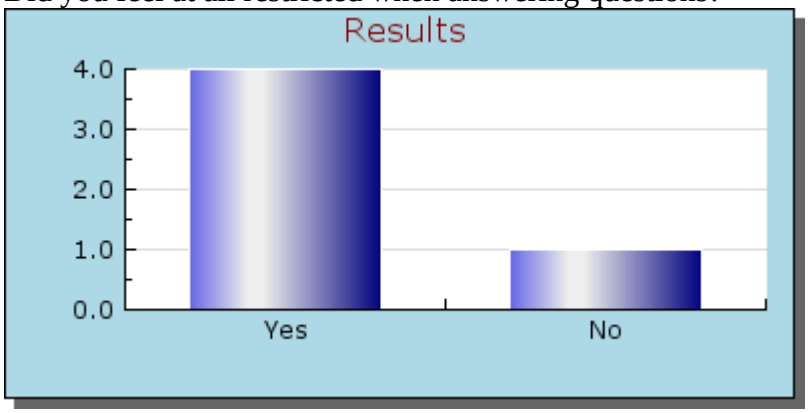


Were you satified with the way in which your questionnaire was stored?



Suitability

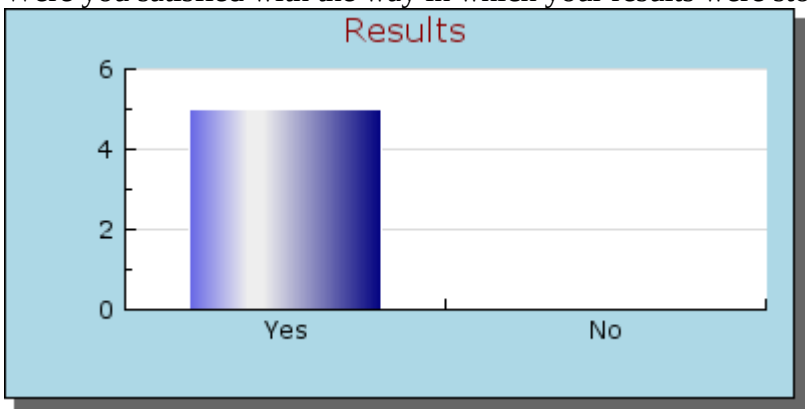
Did you feel at all restricted when answering questions?



Viewing results

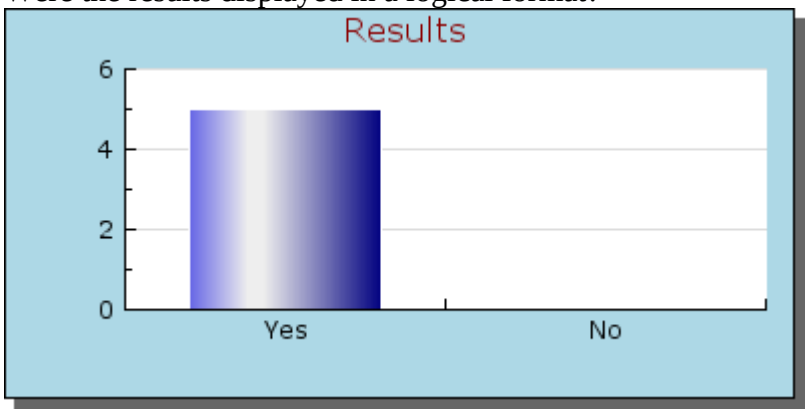
Usability

Were you satisfied with the way in which your results were stored?



Suitability

Were the results displayed in a logical format?



Appendix H – HTML output of current questionnaire using the system

Feedback_final

Name: Adrian Crowther

Year: 2006

Please rate your confidence...

Questions:	Not very	A little	Confident	Very	Completely
Both the design and build a personal computer from individual components	☐	☐	☐	☐	◉
Both configure and implement personal computer hardware	☐	☐	☐	☐	◉
Both design and configure server hardware	☐	☐	☐	☐	◉
Install, configure and implement windows systems	☐	☐	☐	☐	◉
Both install and configure computer peripheral devices (such as scanners, monitors, printers and multimedia hardware etc...)	☐	☐	☐	☐	◉
Both configure and implement home office and small business personal computer networks	☐	☐	☐	☐	◉
Design, implement and maintain a safe computer maintenance environment	☐	☐	☐	☐	◉
Find answer to computer related problems in order to successfully troubleshoot personal computers, peripherals and computer operating systems.	☐	☐	☐	☐	◉
Understand binary, hexadecimal and decimal conversions	☐	☐	☐	☐	◉

Class time...

How often did you class include...

Questions:	Never	Rarely	Confident	Often	Always
Lecture	☐	☐	☐	☐	◉

Class discussion	☐	☐	☐	☐	☑
Hands-on activities	☐	☐	☐	☐	☑
Independent reading the online curriculum	☐	☐	☐	☐	☑

Please indicate how useful these activates were to you...

Questions:	Not at all	Useful	Very useful	Essential
Lecture	☐	☐	☐	☑
Class discussion	☐	☐	☐	☑
Hands-on activities	☐	☐	☐	☑
Independent reading the online curriculum	☐	☐	☐	☑

Instructors...

Please indicate your agreement with the following statements...

Questions:	Not at all	Partially agree	Agree	Strongly agree
The instructor was adequately prepared to teach the course	☐	☐	☐	☑
The instructors lessons were clear and easy to understand	☐	☐	☐	☑
I felt comfortable approaching the instructor with questions / ideas	☐	☐	☐	☑

Questions:	Unlikely	Possibly	Likely	Certain
What is the likelihood of you following another CISCO course?	☐	☐	☐	☑

SAVE

Appendix I – Summary page example

Summary Page: System_testing_Questionnaire

Database Information:

Table name: the_quest_questionnaires_System_testing_Questionnaire

The questionnaires id is 85

Currently the total number of students who have answered the questionnaire is: 5

question 1: Did you find the questionnaire easy to navigate?
Average answer: Yes

question 2: Did you find the colour scheme easy to work with?
Average answer: Yes

question 3: Did the preview function prove useful?
Average answer: Yes

question 4: Did the module provide all the functionality expected?
Average answer: Yes

question 5: Did you make use of all the features?
Average answer: Yes

question 6: How much training was required prior to use?
Average answer: a little

question 7: Did you find the questionnaire easy to navigate?
Average answer: Yes

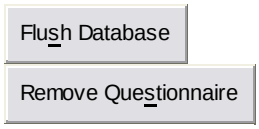
question 8: Did you find the colour scheme easy to work with?
Average answer: Yes

question 9: Were you satified with the way in which your questionnaire was stored?
Average answer: Yes

question 10: Did you feel at all restricted when answering questions?
Average answer: Yes

question 11: Were you satified with the way in which your results were stored?
Average answer: Yes

question 12: Were the results displayed in a logical format?
Average answer: Yes


Flush Database
Remove Questionnaire

Appendix J – User Manual

THE_QUEST User Manual

This document provides a user manual for using the questionnaire module for the open source virtual learning environment Moodle.

Installation

1. Install Moodle (www.moodle.org)
2. Insert the_quest package inside MOD folder within Moodle
3. Add the_quest lib script into lang/eng/
4. Login to Moodle as an administrator and add an activity

Creating a questionnaire

Only a teacher has the ability to create questionnaires and offer them to users.

To create a questionnaire:
1. Click on the_quest link from inside Moodle
2. Click on "make a questionnaire"
3. To select a past question simple click on the question and press add
4. To add a new question type the question in the input box in the bottom
   left cornor, then click "add question". This will add the question to
   the new question table. Now simple click on the new question just added,
   this will highlight the question then simple press the add button.
5. Adding a section heading, simple press section. This will add a section
   to your questionnaire. Now simple type in the section heading.
6. To add a new scale, click "new scale" this will pop up a new window in which
   the scales name and values need adding after completing this press add scale.
   Now in the questionnaire generator window the name of the scale will apprear in the
   box below the "new scale" button. To complete the adding of the scale click "Add scale".
7. You have the ability to remove the last question by simple pressing the "remove" button
8. To choose a scale for the questions simple pick from the drop down box or add a new scale (step 6).
9. Previewing the questionnaire by pressing "preview" at any point. This will show exactly
   how the questionnaire will look.
10. The questionnaires name entered in the top right hand cornor has to be unique to be allowed to
    save the questionnaire. Once saved the questionnaire will be added to the opening page of the_quest page.

Taking a questionnaire

To take a questionnaire either click on the questionnaires name and click the answer to the question
or click on the PDF and print it out. Once filled in it can be enetered into the database.

Viewing results

To view results from a questionnaire click on the "results" button and choose the questionnaire
from the drop down box, choose the graphical representation you wish to see the questionnaire in and press "results".

Maintenance

The maintenance button will remove any questions in the database not used by any questionnaire.

Summary

The summary page displays information about the questionnaire. The information shown is the
questionnaires id, table name and the average rating for each question.

Flush database

The Flush database button inside the summary page will remove all the data stored on a questionnaire

Removing Questionnaire

The remove questionnaire button inside the summary page will remove the questionnaire completely