Management Science and Information Systems Studies

Final Year Project Report

E-Stats
for
Statistics Discipline,
Trinity College Dublin

Niamh Collier

March 2014
DECLARATION

I declare that the work described in this dissertation has been carried out in full compliance with the ethical research requirements of the School of Computer Science and Statistics.

Signed: ___________________

Niamh Collier
24/03/2014
The aim of this project was to create an online self-assessment tool which could be used by students studying statistics. This tool would promote self-regulated and continuous learning among its users. This was done by investigating the various resources available to build such a tool, researching the best practices in statistics teaching and self-assessment, creating the quiz and finally evaluating the quiz.

The best implementation method of the quiz was found to be one where one quiz is created after a lecture to test the students’ knowledge of the material covered in that lecture. Students would be allowed take the quiz with any material they wish, including peer discussion, and accumulative results would be examined by the lecturer and used to clear up any common misconceptions or misunderstandings among students. The quiz system was developed through a content management system and fully meets the needs and requirements of the clients.
PREFACE

This project was undertaken by the Statistics Discipline in Trinity College Dublin. The client contact for the Statistics Discipline was Dr Rozenn Dahyot.

The online quizzes successfully meet the clients' requirements and specifications and the terms of reference. The quiz system remains flexible to accommodate any changes that may be required in the future. Future uses of the tool are addressed in Section 5.7.

This project saw the entire creation of an online self-assessment tool from researching languages and applications that could build the quiz to designing the statistical questions and feedback and finally to system implementation and testing. The main difficulties encountered involved the installation of the quiz systems and the quiz modules; however this difficulty was outweighed by plethora of benefits which arose from using this framework such as browser compatibility, an administrator panel and an easily navigable user interface.

I would like to thank Dr Rozenn Dahyot for her help, enthusiasm and clear vision throughout the project and her students of ST5007, Time Series Analysis, who were willing to help test and evaluate the quiz.

Finally, I would like to thank my project supervisor, Aideen Keaney, for her consistent guidance, support and invaluable feedback which greatly attributed to the completion of this project.
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1. INTRODUCTION & SUMMARY

This chapter briefly describes the client and the background to the project. This chapter also states the terms of reference for the project and provides a summary of the remaining chapters in this report.

1.1. Client Background

Founded in 1966, the Statistics Discipline provides courses in Statistics in Trinity College at both undergraduate and postgraduate levels. The teaching is mainly conducted in class using lectures, tutorials and computer labs. The client contact for this project is Dr Rozenn Dahyot, in the Statistics Discipline. Dr Dahyot currently teaches applied forecasting, applied linear statistical methods and time series analysis.

1.2. Project Background

Smart devices such as laptops, mobiles and tablets are becoming more pervasive amongst the student population in Trinity. Learning outside the classroom can now be accommodated more easily; for example online games and quizzes could be designed to help memorize and understand course content.

According to the latest review of statistics for smartphones connected to the TCD Student Wi-Fi Network (IS Services, Feb 2014), 3538 users had connected with an Android OS while 6454 users had connected with an iOS device. With this high usage of smart devices it makes sense to give students the opportunity to learn outside the classroom and in an interactive and student friendly way.

Learning outside the classroom has also been enabled through online platforms such as the answer engine ‘Wolfram Alpha’ that helps users with mathematical problems and the online learning platform ‘Wiley PLUS’ that assists students revise subject material at times and places suitable to them. These are also accessible on most smart devices. The virtual learning environment, created by tools such as these, enables students to learn anytime and from any place that has a computing device and an internet connection. This environment allows students to engage with educational content and can encourage active and continuous learning by being so accessible.

The client wants to create an online interactive quiz that can be used alongside her lectures to help students prepare for exams by reviewing lecture material in the days following a class. Such a quiz could encourage students to review class notes each day as it could have a set completion time and allow students to self-assess their learning progress through immediate feedback. This continuous revision could better prepare students for exams; reduce the need to ‘cram’ before final exams and generate a more diverse learning environment.
1.3. Terms of Reference

The terms of reference are to:

- Identify best practices for using online assessment in an undergraduate statistics course;
- Identify the best platform on which to create an online quiz based on best practices;
- Design and build the quiz using the most appropriate platform. Question creation is not within scope of this project; and
- Research methods of evaluating the quiz and evaluate the quiz using the most appropriate method found.

The terms of reference of this project were expanded to include question creation, design and development under the scope of this project. Initially these had been defined as outside the scope of the project.

1.4. Summary

- Chapter 2 includes conclusions and recommendations drawn from this project.
- Chapter 3 provides a high level overview of the project as a whole.
- Chapter 4 outlines an overview of the www.estats.ie system designed to hold the quizzes.
- Chapter 5 gives a description of work done in researching and building the quiz and the e-Stats website.
- Chapter 6 provides a description of work done in evaluating the e-Stats quiz.
- Chapter 7 describes the analysis of the online self-assessment quiz.
2. CONCLUSIONS AND RECOMMENDATIONS

This chapter details the project conclusions and recommendations.

2.1. Conclusions

The online quiz is fully functional and meets the requirements of the client as set out in the terms of reference. The tool was evaluated through the creation of a quiz after each lecture which tested a students’ knowledge on the material covered in that lecture. Students were allowed use any material they wished to help them answer the questions and could complete the quiz as many times as they liked. The quiz was made available for them to take anytime and on any device with an internet connection.

This research has shown that an online self-assessment quiz can be easily integrated into a course in statistics as it contains mathematical and theoretical elements. This allows for a quiz to be designed with pre-set answers and feedback and does not require manual correction of each individual test (See Literature Review, Appendix C).

The literature review (See Appendix C) conducted as part of this project has shown that the use of online self-assessment in undergraduate education can have multiple favourable effects. These include:

- Reduced workload for lecturers by reduced time spent giving individualised feedback and manually correcting paper and pen tests;
- Promoting self-regulation and educating students in monitoring and managing their own learning; and
- Implementing varying degrees of best practices in undergraduate education (Chickering and Gamson, 1987).

Although previous research (Angus and Watson, 2009; Palocsay and Stevens, 2008) has shown that implementing an online chapter quiz into a statistics course has not shown any major improvement to a student’s overall grade, the majority of students who took part in this study agreed or strongly agreed that they would continue using the e-Stats quizzes if they had the option (See Section 7.1.1). This was due to the ‘enjoyment’ factor and perceived usefulness of the quiz. It was stated in the focus group that the ease of use added to the enjoyment of the site. Typically a student would return to such learning if it was found to be enjoyable and easy to use; this can foster continuous learning.

It was found that the features of the online quiz such as immediate feedback, use of colour images and the countdown timer are influential in the student learning process as they increase the enjoyment factor of using the quiz for students and support the best practices in undergraduate education (Chickering and Gamson, 1987); this was discovered through the survey (See Section 7.1.1). These practices would not be supported to such a high degree using a traditional paper and pen test which must be manually corrected by a lecturer. It was also found however, that the use of an online self-assessment tool cannot support all levels of Blooms Taxonomy (Bloom, 1956). Out of the six levels – knowledge, comprehension,
application, analysis, synthesis and evaluation – it was found that evaluation was too difficult to assess using an online self-assessment (Peat, 2000) as this would require a student’s thoughts and personal insights on a subject which would require individual correction by an examiner (See Literature Review, Appendix C).

The survey backed up the findings of the literature review and suggested that the quality of feedback was crucial to the success of a tool such as the e-Stats quiz. The majority of students surveyed did not research a question after the quiz if they answered it incorrectly; this indicates that the quiz feedback would be the student’s only source to discovering the correct answer, making the quiz feedback more meaningful to their learning. Nicol (2007) believed that feedback given to the student is just as important as the information the lecturer receives from the assessment about the students’ progress and knowledge base (See Section 7.1.1).

2.2. Recommendations

- The main recommendation of this project is to implement online quizzes in conjunction with a statistics module. To achieve the best learning results one quiz should be created for each lecture and published immediately after to allow immediate revision of that lectures’ content. To allow continuous learning the quizzes should remain published and allow unlimited quiz attempts (See Literature Review, Appendix C). The quizzes should also remain optional (See Section 7.1.2).

- Feedback for the quizzes should be designed to align with the seven principles of good feedback (Nicol and Macfarlane-Dick, 2006) (See Section 5.2.2).

- Questions for the quiz should be created to examine a student’s knowledge on a topic using the levels of Blooms Taxonomy. Developing questions to assess these levels is explained in further detail in the literature review in Appendix C.

- Multiple choice questions (MCQ’s) should be designed in a way to adhere to the requirements outline by Wit (2003). These requirements are explained in further detail in Quiz and Question Design in Section 5.2.2.

- The best method of evaluating an online self-assessment quiz was found to be that as outlined in Section 6.2.1. As explained in Section 6.3.1, a different evaluation method was used; however the optimum evaluation method would be that outlined in Section 6.2.1. A larger sample size would also yield more robust evaluation. The tool should be evaluated using this method in the future as discussed in Section 6.6.

- Future use of e-Stats should include the use of the system as a personal response system. The use of the site as such a system is explained further in Section 6.6.
3. **PROJECT OVERVIEW**

This chapter provides a high-level overview of the project. The project contained both a system design element and also a research and analysis element.

The aim of this project was to research various platforms that could be used to create an online quiz for students studying statistics, create an online quiz using the most appropriate platform found and evaluate this quiz. Through extensive meetings and consultations with the client the requirements were decided upon which can be seen in Section 5.1.1.

To begin, a literature review was conducted to determine the best practices for using online self-assessments in an undergraduate statistics course and to gain an insight into how a question and quiz that supports self-assessment and continuous learning is constructed. The research identified good practices in undergraduate education which were mirrored in the design and implementation recommendations of the e-Stats quiz. The review also identified the best principles in returning good feedback to students and the levels of Bloom’s Taxonomy (Bloom, 1956) which can be achieved through an online quiz. This literature review can be found in Appendix C.

Following this, various tools such as Microsoft Expression Web, commercial quiz creation sites and open source management frameworks were researched. These tools were used to create simple prototypes of a statistics quiz and checked to see if they met the client requirements. The tools were then compared against one another to find the most suitable tool which matched the most requirements. Details of this research can be found in Section 5.1.3. Throughout the previous steps meetings were held with eLearning experienced professionals to discover if a similar project had ever been undertaken in Trinity College Dublin previously and to identify suitable tools for creating online quizzes. Further details of meetings held can be seen in Section 5.1.2.

Design and development work on the system began after Christmas, once the creation tool and the quiz design were decided upon. Hosting was acquired through a web hosting provider and the site was made live. A system overview can be found in Section 4 and design and development work carried out during the project can be seen in Section 5.2.1 and Section 5.3.1. The quiz was made available to students through www.estats.ie. Quiz implementation is discussed in Section 5.4.2.

An evaluation method was chosen through research of previous evaluation models for online quizzes or response systems used in education and through consultation with an eLearning professional (Section 6.1.1). Students evaluated the quiz by taking three quizzes - one made available after each lecture - and completing a survey and focus group after these three quizzes. Details of the evaluation method can be found in Section 6.2.1 and Section 6.3.1 and details of analysis can be found in Section 7.

The final solution was delivered to the client with the supporting administrator manual (See Appendix D) and implementation recommendations. Details of these recommendations can be found in Section 2.2.
4. SYSTEM OVERVIEW

This chapter provides an overview of the online quiz tool. The chapter begins by outlining the system objectives and continues by explaining the technical environment and finishes with system overview diagrams.

4.1. System Objectives

The objective of this project was to create, test and evaluate an online assessment tool that can be used by students studying statistics to assess their own learning and revise material covered in lectures on a rolling basis. The website www.estats.ie has been created to host this tool and contains the quizzes which cover material from Dr Rozenn Dahyot’s' Time Series Analysis module. This website is currently live and fully functional.

As the website is available online it is accessible by all users regardless of their geographical location. The website also gives users the option to register and track their progress over time. The quizzes are designed to be dynamic, interactive and enjoyable to take. Each quiz displays one question at a time, gives immediate feedback after each answer to the user, has a timer and allows the use of LaTeX and images.

Ease of use is obtained through:

- The presence of the menu bar on all webpages. A search bar and navigation pane is also present on all web pages for all users. An administrative dashboard is present on all pages when an administrator is logged in.

- The use of a simple colour scheme that is continuous throughout all web pages and a minimalistic design. This is used to reduce the appearance of clutter and allow the user to focus on the content of the quizzes.

- The use of a consistent design template for all the quizzes to minimise the risk of confusion for the user.

These features will also ensure that the site can be maintained, edited and updated easily.

Ease of access is attained through the ability for users to use the site anonymously – i.e. they do not need to register for the site to view its content.

Not all lecturers have a knowledge of programming so the website has been designed to be simple to edit but also professional in appearance. The site allows for easy to use editing by those with little programming experience through the user interface but also allows for editing through PHP for a user with more experience in programming.

4.2. Technical Environment

Drupal 7 has been used as the back-end framework for the website. Drupal is a free, open-source content management framework distributed under the GNU General Public Licence. Drupal is written in PHP and, as of February 2014, there are more than 30,000 free
community-contributed add-ons (modules) available to customise Drupal's appearance and behaviour and add new features.

Drupal can be run on any computing platform that supports both a web server capable of running PHP and a database to store content and settings. The database used on this site is MySQL. The database web files are hosted by Blacknight Solutions on a Windows (Windows Shared Minimus 2008 R2) server.

The website has been successfully tested on multiple browsers and on multiple devices (See Section 5.5.1).

While PHP has been used to create the initial site, the questions in each quiz have been written in Hypertext Mark-Up Language (HTML). The website was developed through the use of the Drupal user interface. Certain modules and features were altered through PHP and HTML.

4.3. System Description

The e-Stats website is built on the framework of a content management system (CMS) – Drupal. This CMS comprises a website and a MySQL database. The sites MySQL database is used to store the systems information such as the individual pages, the registered users and quiz questions. The database forms the back-end of the website. An example of the interaction between the database and the quiz is shown through the 'quiz_take_quiz' function in Section E.1, Appendix E. The e-Stats website has two main features. Its high level content management system on which its framework is built upon and the quiz features. The key features of each are outlined below.

4.3.1. Key Features of the CMS

- Login - Users have the option to log in if they wish at any page on the site. Users can also register for the site by simply supplying a username and a valid email which is then sent to an administrator for approval. If registered a student can track their quiz results and monitor their progress easily.

- Administrator Panel – This is viewable when an administrator has logged onto the CMS. This panel allows the administrator to create, edit and delete content and to create reports on quiz usage. This is further explained in the Administrator user manual in Appendix D and a screenshot of the panel can be seen in Figure E.2.1, Appendix E.

- Ease of Navigation – A menu bar is present on all web pages and is consistent in design throughout. There is also a search bar available to users logged in.

- Content Viewing and Editing – Any user (logged in or not) can view published content. Administrators can create and edit content by using the administrator panel.
4.3.2. Key Features of the Quiz Module

- **Take Quiz** – All users can take the quizzes on the e-Stats site. These are accessed through the menu tabs at the top of each page.

- **Edit/Create** – Administrators can create and edit quizzes and questions through the administrator panel on each page. Administrators can choose whether or not to publish the new or edited content.

- **Reporting/Tracking** – Administrators can view reports on quiz usage. Registered users can track their own progress and keep record of their previous test scores.

Details of how these actions can be performed can be found in the administrator user manual in Appendix D.

**FIGURE 4.3.1**: Process Diagram for e-Stats System
A system diagram is shown in Figure 4.3.1. The interactions have been simplified to aid with the clarity of the description of the process. The user level represents the users of the system: the course lecturer (administrator) and the quiz user (registered or anonymous). The interface level contains a high level overview of the features of the system. The database level contains all the data processing – the reading and writing to the systems database.

4.3.3. Use Case Diagram for e-Stats Website

Figure 4.3.2 shows how different users can interact with the website. There are 3 possible types of users. The administrator has complete control over the system. This will be the module lecturer. The administrator can access the back-end of the website, edit and delete content such as articles or quizzes, un/install modules, change the appearance of the website and view all content and pages. Instructions detailing how to perform the above operations can be found in the Administrator User Manual located in Appendix D.

An anonymous site user is anyone who lands on the website over an internet connection. Anonymous site users can view all the web pages. They also have the option to register for the website. A registered site user is anyone who has previously registered on the site and uses those credentials to log in. Registered users can track their quiz progress and usage and post comments under certain content; anonymous users cannot do this. Neither anonymous nor registered users can view the administrator panel.

![UML Use Case Diagram](image)

**FIGURE 4.3.2: UML Use Case Diagram**
5. DESCRIPTION OF WORK DONE – SYSTEM & QUIZ DESIGN

This chapter provides a description of work completed throughout the project relating to the quiz and its system. This chapter cover various stages in the timeline of the project. These sections are shown in Figure 5.1. As stated in the Project Overview (Section 3), the project work was split between building the e-Stats system, quiz and question design and their evaluation. Figure 5.1 details the various elements of the project for each section. Evaluation of the quiz is discussed in Section 6.

FIGURE 5.1: Flowchart of Section 5
5.1. Requirements, Research and Planning

Defining the requirements for the online quiz was an integral part of completing this project. By ensuring the requirements and scope for the project was agreed upon, the quiz could be developed as close to the clients specification as possible. This was done through extensive client meetings, interviews with experienced professionals in the area of eLearning and research into various platforms and languages available to build such a tool.

5.1.1. Client Meetings

Numerous client meetings were held over the course of this project. During the initial client meeting the client specified the following requirements. The system should:

- Provide immediate feedback;
- Allow the use of LaTex;
- Reveal one question at a time;
- Allow the use of images in questions and answers;
- Provide the option of displaying a timer;
- Eliminate the need for manual correction required by an academic after each quiz;
- Allow users with little or no programming experience to create and maintain a quiz; and
- Allow compatibility on various smart devices with an internet connection.

In the initial meeting, the client also demonstrated examples of quizzes on other topics that displayed the features required in the e-Stats quiz. It was also made clear that the quiz may not have to be developed from ‘scratch’ and that there may be multiple platforms, such as plug-ins and modules for content management sites, available to create such a tool. The client stated that if these platforms existed they would be accepted.

5.1.2. Interviews with experienced professionals in eLearning

An interview was held with Theresa Logan-Phelan, Manager (eLearning) & Project Manager for Online Education, from the Centre for Academic Practice and eLearning (CAPSL), Trinity College Dublin. During this meeting Ms Logan-Phelan stated that all requirements could be met by using the “Assessments” tool on TCD Blackboard which allows an instructor to create quizzes which contain all the features requested by the client. A test module was created in Blackboard to allow a quiz prototype to be created. When this prototype was presented to the client, another requirement was stated; the quiz would need to be accessible by anyone. The client envisaged that users would not need to be registered or enrolled on a website/module to take the quizzes. The client also suggested that an open source tool would be preferable.

Ms Logan-Phelan suggested contacting Dr Rupert Levene, lecturer in the School of Mathematical Sciences at University College Dublin. Dr Levene lead a project which aimed to allow Moodle, a learning management system (LMS), use LaTex. Various pieces of
software were installed to allow LaTex to be integrated into the TCD Moodle pilot and Dr Leven described it as “rather complicated”. Dr Levene was contacted through email.

5.1.3. Research of platforms to build online assessment tool

Before any quiz could be formally constructed, a platform on which to build it had to be decided. There were many options available to build this online assessment. These included LMS’s systems such as Blackboard and Moodle, CMS’s such as Joomla and Drupal and commercial tools that offer free basic versions such as ProProfs or WordPress. The option to create the quiz from ‘scratch’ using PHP and HTML was also examined.

Each tool was reviewed and tested using the requirements set out by the client. (See Table 5.1.1)

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<th>PHP &amp; HTML</th>
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**TABLE 5.1.1:** Analysis of tools available to build quiz

In general, LMS’s, such as Blackboard and Moodle, possess a wide range of tools and functions for running a course or module. These include submitting assignments, taking quizzes, storing lecture notes and communication with both lectures and peers to name a few. These features were not required for this study. Additionally, Blackboard did not fulfil a major requirement - accessibility by anyone - as it required students to be enrolled in the module to view any content.

The commercial sites such as ProProfs and WordPress featured all the question format requirements asked for by the client but were not open source. This was a concern for the client if the company decided to revoke their free trial. The question of intellectual property rights was also brought up as commercial sites may have the ability to claim the quiz and its questions are their own if the quiz proved popular.
PHP & HTML were used to build a quiz in Microsoft Web Expression 4; however, a quiz with all questions showing at once and giving immediate feedback after each answer submission proved difficult to develop in the time-frame allowed. The option of containing a question per form and ‘hiding’ one form behind another and making it visible each time the quiz progressed; however, it was found that this would require the use of jQuery. The time-frame available did not allow for learning an additional language. Developing the quiz in these languages from ‘scratch’ would also require the questions to be typed into each page or to create a database containing questions, answers and feedback which the quiz creator would have to maintain and update. This would require that lecturers have knowledge of PHP, HTML and MySQL databases. This would also be necessary if the quiz created wanted to integrate LaTex and images into the quiz.

Ultimately, a content management system was chosen to create the quiz due to their suitable size and storage requirements and also the wide range of available plug-ins and modules. Joomla was originally chosen to create the quiz; however, after installing the quiz plugin it was found that it did not meet the client’s requirements. Only commercial plug-ins existed in Joomla which would meet format requirements; these would have to be paid for. This led to the selection of Drupal.

5.1.4 Quiz format research

A literature review was conducted to determine the best practices for using online self-assessments in an undergraduate statistics course and to gain an insight into how a question and quiz that supports self-assessment and continuous learning is constructed. Many researchers have implemented eLearning techniques in undergraduate statistics courses such as Angus and Watson (2009) and Palocsay and Stevens (2008). Palocsay and Stevens (2008) found that web-based homework can simplify the grading and creation of statistics assignments and provide a feasible platform for assessment testing while Angus and Watson (2009) stated that eLearning can save time in marking and the administrative costs of mark compilation. Both agree; however, that its effect on student learning is not yet known. The use of eLearning in statistics, as stated above, allows for immediate feedback and increased active learning. Student success ultimately requires practice and feedback (Palocsay and Stevens, 2008). The practice is achieved through continuous use and re-use of online self-assessment tools. Feedback can be instantaneous in eLearning and so flags problem areas earlier in the learning process. Ultimately, Angus and Watson (2009) found that exposure to regular, low mark, online quizzes improved student learning, which was independent of a student’s performance on each online quiz.

The use of a quiz as an online self-assessment tool can support, in varying degrees, the seven good practices in undergraduate education as suggested by Chickering and Gamson (1987). These include encouraging contact between students and faculty, developing reciprocity and cooperation among students, encouraging active learning, give prompt feedback, emphasize time on task, communicate high expectations and respect diverse talents and ways of learning. Nicol and Macfarlane-Dick (2006) identified seven principles of good feedback. These are discussed below in Section 5.2.2. MCQ’s and question types are also discussed throughout this literature review and the construction of a question and its answers is also addressed. The full literature review can be found in Appendix C.
5.2. Design

5.2.1. Website Design

The site was designed using the requirements and building tool (Drupal) agreed upon with the client. The requirements were to have an open-access and learning supportive, user and administrator friendly website. The website homepage can be seen in Figure E.3.1, Appendix E. A rapid prototyping model was used when designing the website which can be seen in Appendix E. This ensured that the client was involved with the on-going design, and could provide input and feedback throughout the design phase, through various simple prototypes, rather than on completion. As stated in Section 4.3, the MySQL database forms the back-end of the site. The CMS organises all table relationships and construction, eliminating the need for this to be done in the design phase.

5.2.2. Quiz and Question Design

The literature review (Appendix C) investigated the design of questions for self-assessment. Wit (2003) suggests four requirements of question options that can make a difference, these are: using comprehensible language, creating likely options, allowing the expression of ignorance and limiting the number of options. It was also found that the optimal number of options for an MCQ question should not exceed five, including the “I don’t know” option.

A timer was added to the quiz as discussed in Section 5.1.1. Each quiz has an average number of 10 questions with approximately 20 minutes for each quiz.

Nicol and Macfarlane-Dick (2006) identified seven principles of good feedback that can be used in self-assessment to support the development of learner self-regulation (Nicol, 2007). Good feedback practice:

- Helps clarify what good performance is (goals, criteria, standards);
- Facilitates the development of self-assessment and reflection in learning;
- Delivers high-quality information to students about their learning;
- Encourages teacher and peer dialogue around learning;
- Encourages positive motivational beliefs and self-esteem;
- Provides opportunities to close the gap between current and desired performance; and
- Provides information to teachers that can be used to help shape teaching.

The literature review also discussed the levels of Bloom’s Taxonomy (Bloom, 1956) that a self-assessment tool can utilise and revealed that self-assessment does not utilise the full range of Bloom’s taxonomy (Anderson et al, 2001). Of Bloom’s six cognitive categories, Peat (2000) considered evaluation too difficult to portray using e-assessment and was best assessed by other means. The various levels of Bloom’s Taxonomy which self-assessment tools can achieve are listed below in Table 5.2.1.
<table>
<thead>
<tr>
<th>Question type</th>
<th>Level in Bloom’s taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Choice</td>
<td>Knowledge, Analysis</td>
</tr>
<tr>
<td>Scale</td>
<td>Evaluation, Knowledge</td>
</tr>
<tr>
<td>True/False</td>
<td>Knowledge, Analysis</td>
</tr>
<tr>
<td>Matching</td>
<td>Comprehension, Analysis</td>
</tr>
<tr>
<td>Short Answers</td>
<td>Application, Synthesis</td>
</tr>
</tbody>
</table>

**TABLE 5.2.1:** Questions types and the level of Bloom’s Taxonomy which they can demonstrate

5.2.3. **Question Formatting**

The use of LaTeX was also researched and a simple solution was found through the use of the MathJax Content Delivery Network. MathJax is an open source JavaScript display engine for mathematics that works in all browsers. The use of MathJax in question creation is detailed further in Section 5.3.3. An example of the use of LaTeX in a quiz question can be seen in Figure E.3.7 in Appendix E.

5.3. **Development**

When developing the e-Stats website there were three main elements considered. Firstly, the software to use was identified. The second was installing his software and identifying any extensions or third party content that could be incorporated in the website. Finally, the content of the site had to be created.

5.3.1. **Software**

The website was created, as stated above, using Drupal 7. The website was hosted by Blacknight Solutions server. Files were uploaded to the Blacknight server through the FTP client FileZilla. PHP files were edited using Microsoft Expression Web 4.

5.3.2. **Coding and Extensions/Modules Required**

Drupal contains core modules when initially installed allowing it to perform routine operations with the default setup. Various Drupal modules were installed to make the site usable for the purpose intended.

Firstly, the ‘Quiz’ module (version 7.x-4.0-beta2) was installed. This allowed a site user to create interactive, multipage quizzes. With this module, came basic quiz functionality and contained the following question type options: drag and drop with lines, long answer, matching question, MCQ, scale, short answer, true/false. This quiz allowed for numerous extensions to be added increasing its functionality. To add the feature of a timer, the module ’jQuery Countdown’ (version 7.x-1.1) was installed. This also required the module ‘Date API’ (version 7.x-2.7) to be installed. A screenshot of the start page for first quiz can be seen in Figure E.3.2 in Appendix E.

The quiz module’s core functionalities did not contain a text editor, but rather a plain text input box. This did not allow for use of images which was a key requirement of the client. To overcome this, a ‘What You See Is What You Get’ or WYSIWIG editor (version 7.x-2.2) was
installed. This allowed content to be edited with client-side editors. A text editor was also required to complete the installation of the ‘WYSIWYG’ module. ‘CKEditor’ was chosen as it is open source and compatible with most major browsers including Internet Explorer, Google Chrome, Apple Safari, Opera and Mozilla Firefox. The version installed was a standard compliant toolbar for standard-based sites with 47 Plugins from ‘http://ckeditor.com’. There were issues involving this installation as it could not be uploaded through Drupal’s ‘Module Manager’. These issues are addressed in Problems Encountered and Rectified in section 5.6. All modules were downloaded from the Drupal module library found at: https://drupal.org/project/project_module

5.3.3. Creating Content i.e. quizzes

Question creation was initially out of scope for this project but was brought in scope as a result of the starting date of the statistics module (Time Series Analysis), which evaluation participants were part of, being brought forward by one week. Question content was designed on paper as part of this project and then reviewed and edited appropriately by the client. These questions were then written into the online quiz and checked again by the client to ensure the design and placement of each question suited the question being asked.

Content was taken from the lecture notes for the module, including images. Images were placed on the desktop and then uploaded through the WYSIWIG editor and saved to the root folder on the server. MathJax was used to display mathematical equations in LaTex in the e-Stats quizzes. MathJax allows LaTex to be written by simply placing the MathJax link shown in Figure 5.3.1 below into the HTML code of the question. The user can then write the question in LaTex through HTML. A manual detailing how to create quizzes can be found in the technical user manual in Appendix D.

```html
<script type="text/javascript"
    src="http://cdn.mathjax.org/mathjax/latest/MathJax.js?config=TeX-AMS-MML_HTMLorMML"></script>

FIGURE 5.3.1: MathJax link to be placed in HTML code of quiz question

Screenshots of quiz questions and feedback can be seen in Section E.3, Appendix E.

5.4. Implementation

5.4.1. Implementation of Quiz System

The website files are located on the wwwroot folder on the Blacknight Solutions server. The website is saved and backed up on the host site (www.blacknight.com), a server in the School of Computer Science and Statistics and on a USB device handed over to the client. Scores from the quizzes are stored in the site dedicated database created in the Blacknight Solutions account.
5.4.2. Implementing the Quiz to Students

As recommended in Section 2.2, a quiz was created after each lecture to review material covered that day and made available on www.e-Stats.ie. This implementation method was created from reviewing previous implementations of online chapter quizzes in statistics courses such as those in studies by Angus and Watson (2009), Palocsay and Stevens (2008) and Wit (2003). The system was tested, as described in Section 5.5.1 previous to implementing the quiz to students.

5.5. Testing

Testing was conducted alongside the development of the system and its quiz. Unit and system testing was carried out on a rolling basis. After each new functionality or module was added to the system the previous functionalities were tested to assess any ‘knock-on’ effects. Changes were then made accordingly.

5.5.1. Browser and Operating System Compatibility

The website was tested for appearance and compatibility on various platforms. The site was tested on both a PC and laptop in the four most popular web browsers (Google Chrome, Internet Explorer, Mozilla Firefox and Apple Safari). It was also tested on multiple mobile devices (Apple, Sony and Samsung) and mobile operating systems (iOS 7 and Android 9.2). All proved compatible with the site and usage of the quiz was easily possible. The advantage of using a CMS was evident here as this compatibility function is built into the Drupal 7 framework.

5.6. Problems Encountered and Rectified

There were various problems encountered during this project in relation to the quiz system. These problems are discussed in this section.

5.6.1. Joomla! Permissions

All prototypes were tested using the MacNeill server provided by the School of Computer Science and Statistics. The installation of Joomla proved difficult, as all the files necessary to install and run Joomla were un-writeable. These permissions were changed in Microsoft Windows through a Secure Shell (SSH) – PuTTY- using the ‘chmod 755 filename’ command which should allow the file owner to read, write and execute the file but did not. Permissions were also changed through the FTP client, FileZilla; however, this yielded the same result. After meeting with Colin Fowler, system administrator from the School of Computer Science and Statistics, it was discovered that by changing the tool for executing PHP scripts to suPHP the permissions could be altered and would remain so.

5.6.2. Using Drupal through Blacknight Solutions Application Vault

Blacknight Solutions Application Vault feature provides an auto installer service for various applications such as blogs and e-commerce applications. Drupal was installed initially through this feature; however the problem of permissions was raised once again when
installing a CKEditor, a WYSIWYG text editor. This module required that the files be saved to the same folder where modules are stored. As the framework was downloaded through the application vault, permissions did not allow for this happen. To rectify this, Drupal had to be installed manually into the wwwroot folder in Blacknight solutions account and the domain was then directed to this folder.

5.6.3. Installing Drupal Manually

Following manual installation of Drupal 7, the domain did not direct to the Drupal site but rather returned an error page stating “HTTP Error 500.19 – Internal Server Error”. This was resolved by editing the web.config file in the Drupal folder and adding the following code:

```xml
<configuration>
  <system.webServer>
    <httpErrors errorMode="Detailed" />
  </system.webServer>
</configuration>
```

5.6.4. WYSIWYG/CKEditor Installation

The Drupal 7 core installation only featured a basic text editor which allowed the user to create quizzes either in HTML or plain text and did not support image use. This was solved by installing a WYSIWYG CKEditor as explained in Section 5.3.2. Drupal's Module Manager did not recognise the CKEditor files. This was rectified through a patch discovered in Blacknight Solutions help online forum (https://help.blacknight.com/entries/22936826-Turning-on-PHP-error-logging) which follows:

In `.../modules/wysiwyg/editors/ckeditor.inc` the following line from the function `wysiwyg_ckeditor_version($editor)`:

```php
if (preg_match('@version:"(?:CKEditor )?([\d.]+)(?:.+revision:"([\d]+))?@', $line, $version)) {
```

was changed to

```php
if (preg_match('@version:"(?:CKEditor )?([\d.]+)(?:.+revision:"([\d]+))?@', $line, $version)) {
```

This changes version number search from single quotes version ('4.0') to double quotes version ("4.0").

5.6.5. Image Uploading

In the WYSIWYG editor there are 3 text input options – filtered HTML (allows use of certain HTML tags but also recognised plain text), full HTML and plain text. When these inputs were left as default (filtered HTML) images were not recognised in the web pages, although were recognised in the editor. This problem was overcome by setting all text inputs to full HTML which recognised all images.
6. DESCRIPTION OF WORK DONE – EVALUATION DESIGN

This chapter provides a description of work completed throughout the project relating to the evaluation of the e-Stats quiz. This involved interviewing an eLearning professional with knowledge in evaluating such technologies, designing the evaluation method to evaluate the usefulness of an online-assessment tool, implementing the evaluation method to students taking a statistics module and gathering the results.

6.1. Requirements, Research and Planning

As part of the requirements of the project, the e-Stats tool and quiz was evaluated as a learning tool using a group of students taking a statistics module.

6.1.1. Interviews with experienced professionals in eLearning

An interview was held with Dr Inmaculada Arnedillo-Sánchez from the School of Computer Science and Statistics in Trinity College Dublin. Dr Arnedillo-Sánchez has lectured in Learning Technologies in Trinity College Dublin since 2002. She was asked about the best way to evaluate the online quiz. Dr Arnedillo- Sánchez instructed on how to get the most out of evaluating the students and suggested methods of evaluation that would show that the online quizzes are an effective learning and self-assessment tool (See Section 6.2.1).

6.2. Design

6.2.1. Evaluation Method Design

After meeting with Dr Arnedillo-Sánchez, as discussed in Section 6.1.1, an approach to evaluating students perceived usefulness of the online quiz was decided upon. The preferred method was to split the test participants into two groups; one group would take four online self-assessment quizzes on the e-Stats website after each lecture while the other group would take a paper and pen test with the exact same questions. Each group would also take a pre-test, examining their knowledge on Linear Regression – a prerequisite to the module, and a post-test, examining their knowledge on the material covered in the previous 4 quizzes. Once all 4 quizzes had been completed, participants would be asked to complete a survey to analyse their perception of the impact of the quizzes and their opinions on the various functions that the quiz offers. The surveys questions can be seen in Appendix F.

Once the evaluation method was decided upon, ethical approval was sought and granted from the School of Computer Science and Statistics after approximately 3 weeks. Participants would also be invited to partake in a focus group. The focus group would measure participant views on the general appearance of the system and the quizzes. The survey questions were designed to investigate the user’s perceptions of the features and functionality of the quizzes such as the timer, immediate feedback etc. A previous study by Kibble (2007) on the “Use of unsupervised online quizzes as formative assessment” was used as a template for the survey questions. The remaining questions were designed to investigate if best practices in undergraduate education, as outlined by Chickering and Gamson (1987), were met by the quiz.
6.3. **Implementation**

6.3.1. **Evaluation Implementation**

Once the site had been fully developed and the quiz and its questions had been created, the user evaluation was carried out. Due to time constraints and a smaller class size than anticipated, it was not possible to carry out the evaluation as specified in Section 6.2.1. The evaluation methodology used involved the participants taking three online quizzes at www.e-Stats.ie. Each quiz related to a specific lecture and tested students on the material covered in that lecture. The design of the quizzes is explained in further detail in Section 5.2.2. Following completion of the online quizzes, participants were invited to complete a survey and partake in a focus group. The design of the survey and focus group is explained in Section 6.2.1. The system was tested, as described in Section 5.5 in advance to running the quizzes with students.

6.4. **Testing**

6.4.1. **User Testing**

User testing was carried out to examine the ease of use of the systems and the quiz and to gauge a potential users’ perception of the systems usefulness and effectiveness in their learning process. This testing focused solely on the input and output processes of various methods (See Section 7.1). An administrator account was created for the client when testing began. This allowed for both ends of the system to be tested.

6.5. **Problems Encountered and Rectified**

6.5.1. **Evaluation of Online Self-Assessment Tool**

Due to time constraints (See Section 5.3.3), the client only had time to help create 3 online quizzes. Furthermore, the number of students initially thought to be enrolled in the course was 50; however, this was found to be approximately 20. This number was too few to use the evaluation method designed in Section 6.2.1. To rectify this, the students were asked to take 3 quizzes only followed by a survey and a focus group.

6.6. **Future of the Tool**

Currently the website is live, fully functional and contains three quizzes. In the future, this quiz could be implemented alongside any statistics course keeping in mind the recommendations stated below. These include:

- The creation of one quiz for each lecture to be published immediately after the lecture to allow immediate revision of that content. Quizzes should remain published until after the modules final exam and unlimited quiz attempts should be allowed;

- Designing feedback for the quizzes to be aligned with the seven principles of good feedback (Nicol and Macfarlane-Dick, 2006). (See Section 5.2.2);
Creating questions to examine a student’s knowledge on a topic using all the levels of Blooms Taxonomy. Developing questions to assess these levels is explained in further detail in the literature review in Appendix C; and

Designing MCQ’s to adhere to the requirements outline by Wit (2003). (See Section 5.2.2).

There is potential to expand this site beyond the discipline of Statistics and implement it for a course such as Maths or Physics. It would be most suitable for a subject which has both theoretical and mathematical elements.

Additional question types could also be added, such as a “Drag and Drop” question with images where users must match images by dragging them alongside their corresponding answer. Videos or hotspot images could also be added. These types of questions would make the quiz more interactive and may encourage re-use if the questions are perceived as more “enjoyable”.

Another future use of the tool, if fully integrated into the course, could be to grant exam credit for completion of the quizzes. Students would then be encouraged to take the quizzes and would also engage in continuous learning. The quiz also has the optional feature of “user points” so these credits can be tracked through the site. This would increase the use of Chickering and Gamson’s (1987) best practices regarding communicating high expectations as students would be rewarded through credit for use of the site.

As stated in Recommendations in Section 2.2, the best evaluation method was found to be that outlined in Section 6.2.1. In the future, this quiz should be evaluated using this method to yield a robust evaluation of the system and the usefulness and effectiveness of it as an online self-assessment learning tool.

The quiz also has the potential to be used as a personal response system. Using the quiz and the administrator functionality the lecturer could designate a certain amount of time during a computer lab session for the quiz; for example, the students could be given 15 minutes to complete the quiz. Following this period, the lecturer (administrator) could view a statistical report of the quiz or quiz results to determine how the class performed overall. The quiz reporting could also be altered to allow an administrator to view the distribution of answers per question. This could be used to determine areas of confusion for students and be used to clear up any misconceptions. Students could also be encouraged to ask any questions during this time about the topics covered in the quiz.
7. ANALYSIS

This section provides a detailed analysis of the results obtained from the survey and focus group.

7.1. Student Evaluation of e-Stats Quiz as a Learning Tool

7.1.1. Survey

Survey participants of the Time Series Analysis module consisted of professionals who were working full-time during the day and attending a two hour class every Monday and Wednesday. The survey had approximately a 38% (n = 8) response rate. The main findings are discussed below.

It was found that all of the respondents accessed the quiz through a laptop or PC; however 25% also accessed the quiz through a smartphone or tablet (Figure G.4, Appendix G). This shows that although every respondent used a laptop or PC, some respondents also returned to the quiz using a hand-held smart device. This shows that there is a market for online assessments available on these devices to allow learning anytime and anywhere. The study aids that students most used were their lecture notes (57%); text books (14%), discussion with peers (14%) and internet search engines (14%). 43% of respondents completed the quiz using other study aids which included their own notes or no material at all (Table G.2, Appendix G)

![Study Aids Distribution](image)

*Figure 7.1.1: Use of Study Aids during Quiz Completion (n=8)*

The majority (87.5%) of survey respondents found the e-Stats website visibly appealing. One respondent commented that it was “easy to use”; however, another stated that “it was ok [and] could be more exciting” (Table G.1 and Figure G.9, Appendix G). There is potential room for extra content, besides the quiz, to be placed on the site to make it more exciting. All respondents agreed or strongly agreed that they liked that their quiz scores were not shared with their lecturer. This is a feature of the online quiz which could not be achieved from a...
paper and pen test. Another feature of the online quizzes is the timer which is visible during the entire quiz and gives the user warnings at 1 minute and 30 seconds remaining. This feature did not prove popular with respondents as 62.5% did not believe it helped with their learning (Figure G.10, Appendix G). This may have been due to the fact that the timer was set to one hour for the first quiz to ease students into the quiz.

Another feature which differentiates the online quiz from a traditional paper and pen test is the instant feedback. The majority (>65%) of students agreed or strongly agreed that the instant feedback was helpful and assisted their learning by identifying areas of weaknesses (Figures G.1, G.8 and G.11, Appendix G). The importance of high quality feedback was emphasised as 37.5% of respondents stated that answering a question incorrectly in the quiz did not motivate them to study or research that answer (Figure G.12, Appendix G). This means that the online quiz feedback is the only link a student has to arriving at the correct answer for that question. One survey respondent suggested that a hyperlink should be included in the feedback of an incorrect answer to direct a user to the section of notes containing the correct answer while another stated “It needs professional web design/development. In particular I often found it hard to understand the feedback”. (Table G.3, Appendix G). The latter comment once again stresses the importance of appropriate feedback using comprehensible language as outlined by Wit (2003).

Ultimately, the survey showed that students found the e-Stats online self-assessment tool as a useful tool for tracking their progress and highlighting their areas of weakness in learning. All respondents agreed that they would continue using the e-Stats quiz tool if made available. Surprisingly, even those who did not find the feedback helpful - 25% of students felt the online quizzes did not give them feedback about their learning and 15% felt the instant feedback did not assist their learning - or felt that online quizzes were not an appropriate replacement for formal in class paper and pen tests (37.5%) stated they would continue using the site (Figure G.7, Appendix G).

![Bar chart showing student responses to continuing using e-Stats quizzes](image)

**Figure 7.1.2**: Proportion of Students Willing to Continue Using e-Stats Quiz (n=8)
This, perhaps, indicates that students enjoyed the quiz and found it a useful tool for revising material at a time and place convenient to them.

Participants were asked if they had any other comments regarding the quiz at the end of the survey. These can be seen in Table G.3, Appendix G. The full survey can be seen in Appendix F and survey responses can be seen in Appendix G.

7.1.2. Focus Group

The focus group was held with 6 participants. During this session the e-Stats site was demonstrated to the students and their thoughts on the appearance and layout of the quiz and site was questioned. Although these were the main objectives of the focus group, some participants had strong opinions on the future use of the tool. The main findings from the focus group are detailed below:

- All participants agreed the overall design of both the quiz and the e-Stats website was simple and functional in appearance. Participants found the web site “neat” and “easily navigable”.

- One participant found the login box to be confusing. This participant assumed that, at first glance, registering to use the site was mandatory and explained this this may “scare” users off. Others agreed with this point once brought up.

- The majority of participants stated that question wording was very important in the quiz. It was agreed that this is important in a discipline such as statistics as there is much specific terminology with this subject. One participant suggested that perhaps an optional comment box be placed underneath each question or answer so users can highlight any areas of confusion or misconceptions that can be read by lecturer.

- One participant expressed the need for clear instructions on each quiz question and explained that confusion can occur between multiple choice questions with multiple answers and those with single answers. This participant felt that “the [radio] buttons look alike whether you’re allowed more than one answer or just one”.

- All participants felt the quizzes would be best kept optional. When the idea of earning credit for completing the quizzes was put to the group, it was suggested that this should still be optional. Participants suggested that if users wish to earn extra credit then they can complete the quizzes but there should be no negative marking or ‘lost marks’ to those who chose to not complete the quiz. One participant also suggested that there could be a mix of quizzes, some bearing no extra credit and quizzes which can earn a user credit. Another participant added that there should be a difference in level and difficulty between the optional ones for credit and those for no credit; the credit bearing quizzes should have a higher level of difficulty. This idea was supported by a third participant.

- If quiz completion allowed students to earn course credit then one participant suggested that there should be practice tests to help prepare for these credit earning quizzes.
Participants were asked about their opinion for the potential use of the quiz as a personal response system. One participant explained that, if used in class to show accumulative answers, the quiz results should still be anonymous so "students won't feel bad if they answered the question wrong".

These findings have been used in drawing up Conclusions and Recommendations in Section 2 and also in Future of the Tool in Section 6.6.
# APPENDICES

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A. ORIGINAL PROJECT OUTLINE

Client: Statistics Discipline
Project: e-Stats
Location: Lloyd Building
Client Contact: Rozenn Dahyot
Dept. Contact: Rozenn Dahyot

A.1 Client Background

The Statistics Discipline is providing courses in Statistics in Trinity College at both undergraduate and postgraduate levels. The teaching is mainly conveyed in class via lectures, tutorial and labs.

A.2 Project Background

Smart devices (e.g. tablets, laptops, mobiles) are becoming more pervasive amongst the student population in Trinity and this project aims at investigating how these devices could be used to help students to learn Statistics in an entertaining way outside the classroom. For instance online games and quizzes could be designed to help memorize and understand course content.

A.3 Client Requirement

The objective of this project is to review the technologies (e.g. HTML, PHP, CSS, JavaScript, etc.) that can be used to design online quizzes and design a quiz template appropriate for testing students in statistics (i.e. the quiz should support high quality text and mathematical writing, images and possibly videos). The resulting template should be easily usable by teaching staff such that no or little programming code is required to let teachers focusing only on the question/answer contents of the quiz. It is particularly important that the proposed solution allows reusing efficiently digital materials already written by lecturers (e.g. lecture notes in latex file format).

A.4 What is involved for the student?

This project will give a student an opportunity to go through all of the phases in an IT application package specification and implementation process. It will also provide an opportunity to think creatively about the application design.
B. **INTERIM REPORT**

Client: Statistics  
Discipline: Dr Rozenn Dahyot  
Project: e-Stats  
Student: Niamh Collier  
Supervisor: Aideen Keaney

B.1 **Review of Background and Work to Date**

Smart devices (e.g. tablets, laptops, mobiles) are becoming more commonly used amongst the student population in Trinity. Learning outside the classroom can now be accommodated more easily; for example online games and quizzes could be designed to help memorize and understand course content. The objective of this project is to create an online quiz that can be used to help students self-assess their progress and assist revision outside the classroom in an undergraduate statistics course. The application must support images, videos and the use of LaTeX to allow the reuse of current teaching materials. The client has specified that the quiz should be easy to use by teaching staff and thus require little or no programming experience to implement.

The following work has been conducted to date:

- Conducted an initial review of the literature relating to self-assessment, best practices in undergraduate teaching and online learning and online quizzes.
- Interviewed and contacted TCD staff and support services such as CAPSL (centre for academic practice and student learning) to investigate if any application such as this already exists within the College.
- Applications to create an online quiz have been reviewed these include: Blackboard, online quiz creation sites such as Moodle and ProProfs and languages such as HTML and PHP.
- Met with Dr Dahyot to discuss design preferences and scope of project.

B.2 **Terms of Reference**

- Identify best practices for using online assessments in an undergraduate statistics course.
- Identify the best platform on which to create an online quiz based on best practices.
- Design and build the quiz using the most appropriate platform. Question creation is not within scope of this project.
- Research methods of evaluating the quiz and evaluate the quiz using most appropriate method found.
• Make recommendations as to how the quiz should be implemented in class that are aligned to best practices of self-assessment and undergraduate assessment.

B.3 Further Work

The review of best practices and Dr Dahyot’s requirements and preferences will be combined to create a model for the quiz. This will then be used to construct the completed quiz that will be tested in Dr Dahyot’s Diploma course. Analysis and evaluation of the quiz system will be conducted and the impact (if any) of the introduction of the quiz to a statistics course will be measured.

B.4 Conclusions

TCD Blackboard has the ability and features to create a quiz aligned with best practices however Dr Dahyot does not wish to use this platform. Dr Dahyot would prefer an application that is open source.

Languages such as HTML and PHP do not currently easily support the design favoured by Dr Dahyot. Many online platforms exist that do support this such as Moodle or ProProfs.

The use of online assessment in a statistics course has the potential to be an effective tool in helping students learn and revise outside the classroom if its implementation follows those of best practices in undergraduate teaching. It is hoped that the model used in this quiz will be easily transferable and relevant for the creation of online assessments in others courses besides statistics.
C. LITERATURE REVIEW

C.1 Introduction

Teaching undergraduate courses has become increasingly difficult with increased class sizes and reduced resources; it is increasingly becoming recognised as a complex and multifaceted product of many variables (Peris and Beh, 2012; Nicol, 2007). The influence of many unknown variables and the level of abstraction make learning and teaching statistics difficult for many students and educators. The classical approach to teaching statistics of standing at the top of a classroom and explaining the topic is not fully engaging for students. Many argue that an approach to teaching and learning statistics that are linked to students’ experiences in the world is more tractable to students and that undergraduate education needs to be improved (Chickering and Gamson, 1987; Peris and Beh, 2012). This can be achieved through the use of online assessments in undergraduate statistics courses.

The use of online assessments can engage students and allow self-assessment. The following literature reviews examines the use of online quizzes in an educational environment and explores the best format of such a quiz, its’ implementation and benefits.

C.2 Teaching and Learning Statistics

Students looking to master statistics require a great deal of statistical and mathematical literacy, reasoning and thinking. Society demands “lifelong capable learners” (McLoughlin and Reid, 2002: 1) who demonstrate competencies such as problem solving, critical thinking, questioning, judging and searching for and evaluating information. One explanation for the lack of these competencies amongst statistic graduates is that traditional approaches to teaching statistics focus on skills, procedures and computations, which do not lead students to reason or think statistically (Ben-Zvi and Garfield, 2004). This has been echoed by various other experts in the field such as Conners et al (1998) and Garfield et al (2002). Harrington et al (2004) found it challenging to engage students practically and intellectually in undergraduate statistics and states that keeping students interested in statistics and motivating students are challenges which surface year after year to even the most seasoned professor. Historically, statistical courses have be seen by students as difficult to understand and unpleasant and have been viewed as frustrating and unrewarding to teach by many instructors (Garfield et al, 2002); curricula have tended to favour theory over application and cursory attention over practice and competency (Harrington et al, 2004). Despite education reforms, many statistics students continue to view their course as a set of tools and techniques that are inevitably forgotten after the course has finished (Ben-Zvi and Garfield, 2004). Hogg (1992) outlined the goals of a statistics course (Garfield et al, 2002). The course should:

- Emphasize the elements of statistical thinking;
- Incorporate more data and concepts, fewer recipes and derivations where possible, automate computations and graphics; and
- Foster active learning, through the following alternatives to learning:
o Group problem solving and discussion;
o Laboratory exercises;
o Demonstration based on class-generated data;
o Written and oral presentations; and
o Projects, either group or individual.

Ben-Zvi and Garfield (2004), similarly, suggest a selection of these goals with their recommendations for teaching statistics. They suggest incorporating more real data and to foster active learning. Wherever possible, technological tools should be used to automate computations and graphics and alternative assessment methods should be used to better understand and document student learning (Ben-Zvi and Garfield, 2004).

Conners et al (1998) identifies four major challenges unique to teaching undergraduate statistics: motivating students to study material that they think is uninteresting, handling math anxiety, dealing with performance extremes and making the learning memorable. Ben Zvi and Garfield (2004) recognize these challenges; however, they add that any challenge lies in the ‘one right answer’ mentality bred into students through their un-comfortableness with the “messiness” (Ben-Zvi and Garfield, 2004) of data and the different possible interpretations that data is subject to in such a course. McLoughlin and Reid (2002) agree that the ‘one right answer’ mentality should be avoided and found that traditional assessment incorrectly valued a student’s ability to memorise facts and then recall them during a test situation.

In the next section, it will be shown how the use of online self-assessment can overcome some of these challenges in statistics learning and teaching.

C.3 Online Self-Assessment

Self-assessment involves students reflecting on their work quality, rather than relying on their lecturer as the sole source of feedback. The main benefit of introducing self-assessment into a module is that learning and achievement can be boosted and academic self-regulation can be promoted. Students learn to monitor and manage their own learning (Andrade and Valtcheva, 2009).

Traditionally, assessments have been used, primarily to assign grades and give periodic feedback to students; however, in recent year’s assessment has been altered to better inform an instructor of a student’s progress and understanding of a subject matter, to develop a students learning skills and improve instructional practices (Chance and Garfield, 2000). There are various dimensions of assessment for individual student evaluation which Ben-Zvi (1999) outlines (See Figure C.3.1). Newer methods of assessments which display these dimensions include individual or group projects, case studies or authentic tests, concept maps and critiques of statistical ideas or concepts in the news (Chance and Garfield, 2000). Elements of the majority of these methods can be examined through an online self-assessment quiz.
Figure C.3.1: Dimensions of assessment (Chance and Garfield, 2000)

Chickering and Gamson (1987) have outlined seven good practices in undergraduate education which include encouraging contact between students and faculty, developing reciprocity and cooperation among students, encouraging active learning, give prompt feedback, emphasize time on task, communicate high expectations and respect diverse talents and ways of learning (Chickering and Gamson, 1987).

**Encouraging contact between students and faculty**

Frequent student-faculty contact in and out of classes is the most important factor in student motivation and involvement. Knowing a few faculty members well enhances students’ intellectual commitment and encourages them to think about their own values and future plans (Chickering and Gamson, 1987)

**Developing reciprocity and cooperation among students**

Working with others often increases involvement in learning and can enhance learning when it is more like a team effort than a solo race (Chickering and Gamson, 1987). In groups, students can share ideas and sharpen their own thinking and understanding by responding to others.

**Encouraging active learning**

Students do not learn much just by sitting in a classroom listening to teachers, memorizing pre-packaged assignments and spitting out answers. They must take part in what they are learning, write about it, relate it to past experiences and apply it to their daily lives (Chickering and Gamson, 1987).
Give prompt feedback

Students need appropriate feedback on performance to benefit from courses. Students need chances to reflect on what they’ve learned, what they still need to know, and how to assess themselves (Chickering and Gamson, 1987).

Emphasize time on task

Students must learn to use their time well and need help in effective time management. Allocating realistic amounts of time means effective learning for students and effective teaching for faculty (Chickering and Gamson, 1987).

Communicate high expectations

Chickering and Gamson believe that if you expect more, you will get more. Expecting students to perform well becomes a self-fulfilling prophecy when teachers and institutions hold high expectations of them and make extra efforts (Chickering and Gamson, 1987).

Respect diverse talents and ways of learning

Students need the opportunity to show their talents and learn in ways that work for them. Then they can be pushed to learning in new ways that do not come so easily (Chickering and Gamson, 1987).

Research has clearly shown that feedback promotes learning and achievement and also shows that students themselves can provide feedback through self-assessment (Andrade and Valtcheva, 2009). The use of online self-assessment can show varying degrees of the application of the four of the seven good practices in undergraduate education: ‘emphasize time on task’, ‘encourage active learning’, ‘give prompt feedback’ and ‘develop reciprocity and cooperation among students’ (Hodgson and Pang, 2012). Time on task is emphasized by the presence of a timer on the quiz. Active learning can be encouraged as students are physically active with the quiz and may require further research online to answer a question. Reciprocity and cooperation among students can also be encouraged if students work in groups to answer questions. The correct answers are shown either at the end of the quiz or after the student has answered each question; this supports the principle of giving prompt feedback.

Nicol and Macfarlane-Dick (2006) have identified seven principles of good feedback that can be used in self-assessment to support the development of learner self-regulation (Nicol, 2007). Good feedback practice:

- Helps clarify what good performance is (goals, criteria, standards)
- Facilitates the development of self-assessment and reflection in learning
- Delivers high-quality information to students about their learning
- Encourages teacher and peer dialogue around learning
- Encourages positive motivational beliefs and self-esteem
• Provides opportunities to close the gap between current and desired performance
• Provides information to teachers that can be used to help shape teaching

The above principles show that the feedback given to the student is just as important as the information the lecturer receives from the assessment about the students’ progress and knowledge (Nicol, 2007).

Blooms taxonomy refers to a classification of the different objectives that educators set for students). This taxonomy divides educational objectives into three ‘domains’: Cognitive, Affective and Psychomotor (Anderson et al, 2005). Skills in the cognitive domain revolve around knowledge, comprehension, and critical thinking on a particular topic. They are listed below, from lowest to highest order:

<table>
<thead>
<tr>
<th>Level</th>
<th>Question example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>What are the health benefits of eating apples?</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Compare the health benefits of eating apples vs. oranges.</td>
</tr>
<tr>
<td>Application</td>
<td>Which kinds of apples are best for baking a pie, and why?</td>
</tr>
<tr>
<td>Analysis</td>
<td>List four ways of serving foods made with apples and explain which ones have the highest health benefits. Provide references to support your statements.</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Convert an &quot;unhealthy&quot; recipe for apple pie to a &quot;healthy&quot; recipe by replacing your choice of ingredients. Explain the health benefits of using the new ingredients.</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Do you feel that serving apple pie for an after school snack for children is healthy?</td>
</tr>
</tbody>
</table>

Table C.3.2: The 6 levels of Bloom’s Taxonomy and example questions (Anderson, et al, 2005)

These levels can be supported by the use of online self-assessment. Knowledge and content can be tested by using the traditional MCQ questions which are discussed in depth below; however comprehension would require a textual input from the student also (Peat, 2000). Analysis can be tested by minimal use of MCQ but should also have question formats requiring students to build diagrams, flowcharts etc. Finally, synthesis needs the student to be able to synthesise information in response to a question, e.g. involve writing prose (Peat, 2000). Self-assessment does not utilise the full range of Bloom’s taxonomy (Anderson et al, 2001). Of Bloom’s six cognitive categories, Peat (2000) considered evaluation too difficult to portray using e-assessment and was best assessed by other means.
### Table C.3.3: Questions types and the level of Bloom’s Taxonomy which they can demonstrate

<table>
<thead>
<tr>
<th>Question type</th>
<th>Level in Bloom's taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Choice</td>
<td>Knowledge, Analysis</td>
</tr>
<tr>
<td>Scale</td>
<td>Evaluation, Knowledge</td>
</tr>
<tr>
<td>True/False</td>
<td>Knowledge, Analysis</td>
</tr>
<tr>
<td>Matching</td>
<td>Comprehension, Analysis</td>
</tr>
<tr>
<td>Short Answers</td>
<td>Application, Synthesis</td>
</tr>
</tbody>
</table>

#### C.4 Improvements to the classroom

Our increasing use of new technologies and computer networks enable more flexibility in the delivery of MCQs, e.g. with delivery at times and places more in tune with student needs (Nicol, 2007).

Online quizzes can also alleviate some of the workload on lecturers and instructors by providing a convenient way of evaluating students’ knowledge and progress and provide immediate feedback. Compared to paper-based assessment, the use of computer-assisted assessment reduces the hours spent correcting tests and those spent giving written or face-to-face feedback (Tinoco, Fox, Ehrich and Fuks, 1996, Nicol 2007). This type of assessment also addresses the issue of reuse and portability.

Various question types can be used in an online quiz. Bloom’s taxonomy can be used to categorise questions according to the cognitive they require. By using these types of question designs, automated quiz type questions can avoid implying a narrow focus on simply a student’s memory and may assess a range of learning processes (McLoughlin and Reid, 2002).

The introduction of an online multiple choice question (MCQ) test provides an opportunity to reinforce the learning of other pedagogic elements. The structure of many statistics courses can lead to a gap of many months between the last formal teaching of a topic and the final examination. MCQ quizzes can provide students with another opportunity to cover this material when and where it suit’s them (Clarke et al, 2004). MCQ’s can also cement students’ understanding, deepen students’ knowledge and frame educational expectations (Clarke et al, 2004). Online quizzes also have an advantage in providing timely feedback to students and more importantly, can encourage students to work consistently over a semester (Hodgson and Pang, 2012).

Allowing students to collaborate with others in seeking and discussing the answer to the questions enhances the learning experience. Working in team situations often increases involvement in learning and sharing one’s ideas and responding to others’ reactions heightens understanding and sharpens thinking (Chickering and Gamson, 1987).

MCQ’s are not without their criticisms. Many researchers discourage the use of MCQs, arguing that they promote memorisation and factual recall and do not encourage high-level cognitive processes; however, others maintain that this depends on the construction of the question and believe that they can be used to evaluate learning (Nicol, 2007). Additionally,
the feedback provided through MCQ's is usually quite limited as there is little scope for personalisation of feedback (Nicol, 2007).

Although there are downsides to using MCQ's, the positives definitely outweigh the negatives.

C.5 Design

Hodgson and Pang have designed quizzes to provide a flexible learning space to foster independent thinking and believe that this should be echoed in the design of any academic quiz. It should be challenging but not so hard as to be discouraging (Hodgson and Pang, 2012). The use of MCQ's as the most suitable questioning type is evident through many studies (Clarke et al, 2004; Hodgson and Pang, 2012; Wit, 2003). However, McCoubrie (2004) believes that MCQ–based exams are reliable only because they are time-efficient and a short exam still allows breadth of sampling of any topic (McCoubrie, 2004). To make testing both fair and valid, MCQ's should be used strategically to test important content, and mixed with practical testing of statistical competence (McCoubrie, 2004).

Wit explains that although they can be seen as restrictive and assessing only a certain type of knowledge, multiple-choice questioning can be used to evaluate everything from plain definitions to intrinsic interpretation (Wit, 2003). Furthermore, well-constructed MCQs can test a range of skills such as interpretation, synthesis, and application of knowledge rather than testing factual regurgitation (McCoubrie and McKnight, 2008).

The wording of the question is particularly important as it can sometimes be helpful to use trick questions or ‘brain-teasers’ to recharge students’ attention halfway through the lesson (Wit, 2003). Common misunderstandings can be used as options to clear up notoriously misunderstood concepts. These challenging MCQ’s promote Chickering and Gamson’s sixth principle of good practice – ‘communicate high expectations of learning’ (Chickering and Gamson, 1987). These questions may also encourage the practice of ‘encouraging active learning’ as the student may have to seek additional reading to answer these higher-level questions.

Once the design of the question has been tackled, the hurdle of coming up with several answers must be faced. Wit provides four requirements of MCQ options that can make a difference: ‘comprehensibility of the language’, ‘likelihood of the options’, ‘preventing guessing by allowing the expression of ignorance’ and ‘limiting the number of options’ (Wit, 2003).

Comprehensibility of the language

Statistics comes with its’ own set of jargon that may distract from the issue that is truly being tested (Wit, 2003). Wit suggests avoiding the use of statistical jargon. Harrington et al (2004) recognise the difficult language associated with statistics and explain that this can lead to basic statistical misconceptions. This will avoid any confusion for the student and will ensure that they are being tested on the conceptual issue and not just the jargon.
Likelihood of the options

Students commonly approach multiple-choice questions strategically, extracting the least likely answers and then evaluating those remaining, preventing them from engaging with the question and weakening the strength of feedback. Answers should be devised that are logical in form and structure as well as probable from the point of the student (Wit, 2003).

Preventing guessing by allowing the expression of ignorance

The addition of an “I don’t know” option can eliminate guessing which reduces the educational value of these quizzes (Wit, 2003). This allows for the lecturer and students to see the students true capability and progress. McCoubrie and McKnight found that this ‘guessing’ technique is a large drawback to the true/false MCQ’s and problems with this format have led to the phenomenon of studying the exam itself rather than the subject (McCoubrie and McKnight, 2008).

Limiting the number of options

Wit’s experience has shown that the number of choices should not exceed five, including the “I don’t know” option (Wit, 2003) to reduce time spent sorting through the options and transfer that time onto thinking about the question itself.

Combined with the above requirements, the type of questioning should be varied constantly (Wit, 2003). This keeps the attention of the student fresh and appeals to different problem solving skills, thus touching on the seventh principle for good practice in undergraduate education – “respect diverse talents and ways of learning” (Chickering and Gamson, 1987).

C.6 Conclusion

The introduction of an online self-assessment quiz has been proved to promote self-regulation and student engagement in the articles listed throughout this literature review. However, self-assessment should be aligned with learning and combined with practical methods (McCoubrie, 2004). The use of an online weekly quiz can also be used to achieve a variety of the seven good practices in undergraduate education (Chickering and Gamson, 1987). This can all be achieved if the quiz follows a suitable format and questions and answers are derived carefully. The format of the e-assessment which these papers support is quiz supporting the question types in Table X.X with immediate formative feedback and which allows students to discuss the questions and possible answers amongst themselves with a time limit to complete the quiz set in place. High motivation and student engagement in learning have consistently been linked to high levels of student success (Harrington et al, 2004); as seen above, both of these can be influenced by the use of an online self-assessment quiz. E-assessment can be an effective tool for both lecturers and students and has the capability to become an integral part of any statistics course.
D. ADMINISTRATOR USER MANUAL

The administrator user manual for the e-Stats website is attached as a separate document. It contains detailed instructions on how to use the system as an administrator to create, edit and view quiz content.
E. DESIGN DOCUMENTATION

E.1 Rapid Prototyping Model

This is the rapid prototyping model used during the design, development, and implementation of the website. Prototypes were developed for each possible tool available to create an online quiz (e.g. Moodle, Blackboard, ProProfs etc.). These prototypes usually showed the main features of each tool and whether or not they met the client’s requirements. These prototypes were created using a local server and then when a final prototype was agreed upon, it was developed on the Blacknight Solution server.

Use of this model ensures that the delivered product meets the client’s needs as its benefits include improved system usability, a closer match to users’ real needs, improved design quality and improved maintainability.
E.2 Sample Source Code

The following code is taken from the quiz.module PHP script. This script holds the majority of the functions available to allow the creation of interactive quizzes for site visitors.

```php
function quiz_take_quiz($quiz) {
    global $user;
    $allow_skipping = $quiz->allow_skipping;

    if (!isset($quiz)) {
        drupal_not_found();
        return;
    }

    // If anonymous user and no unique hash, refresh with a unique string to prevent caching.
    if (!$user->uid && arg(4) != NULL) {
        drupal_goto('node/'.$quiz->nid .'/take/'. md5(mt_rand() . time()));
    }

    // Make sure we use the same revision of the quiz throughout the quiz taking session.
    if (isset($_SESSION['quiz_' . $quiz->nid]['quiz_vid']) && $quiz->vid != $_SESSION['quiz_' . $quiz->nid]['quiz_vid'] && variable_get('quiz_auto_revisioning')) {
        $quiz = node_load($quiz->nid, $_SESSION['quiz_' . $quiz->nid]['quiz_vid']);
    }

    // If the session has no data for this quiz.
    if (!isset($_SESSION['quiz_' . $quiz->nid]['quiz_questions'])) {
        // We delete questions in progress from old revisions.
        _quiz_delete_old_in_progress($quiz, $user->uid);

        // See if the current user has progress for this revision of the quiz stored in the database
        $rid = $user->uid > 0 ? _quiz_active_result_id($user->uid, $quiz->nid, $quiz->vid) : 0;

        // Are we resuming an in-progress quiz?
        if ($quiz->allow_resume && $rid > 0) {
            _quiz_resume_existing_quiz($quiz, $user->uid, $rid);
        }

        // First time running through quiz.
        elseif (quiz_start_check($quiz, $rid) && (_quiz_take_quiz_init($quiz) === FALSE)) {
            return array('body' => array('#markup' => ' '));
        }
    }

    $q_passed_validation = FALSE;
    $repeat_until_correct_error = FALSE;
```
if (quiz_availability($quiz) !== TRUE) {
    drupal_set_message(t('This quiz is not available anymore.'), 'error');
    return array('body' => array('#markup' => t('This quiz is closed')));
}

if (isset($_SESSION['quiz_' . $quiz->nid]['question_duration'])) {
    $SESSION['quiz_' . $quiz->nid]['question_duration'] -= REQUEST_TIME -
    $SESSION['quiz_' . $quiz->nid]['question_start_time'];
}

// For quiz progress block
// To be able to jump from one question to another
if (isset($_GET['jump_to_question'])) {
    if ($quiz->allow_jumping || _quiz_is_int($_GET['jump_to_question'])) {
        quiz_jump_to($_GET['jump_to_question'], $quiz, $_SESSION['quiz_' . $quiz->nid]['result_id']);
        // Doing drupal_goto() to prevent showing message last question was skipped
        // and also for skip to work as expected.
        drupal_goto("node/{$quiz->nid}/take");
    }
}

if (!isset($_POST['op'])) {
    // @todo Starting new quiz... Do we need to show instructions here?
}
elseif (isset($_POST['question_nid']) && ($_POST['question_nid'] != $_SESSION['quiz_' . $quiz->nid]['quiz_questions'][0]['nid'])) {
    // The user has pressed the navigation buttons multiple times...
}
elseif (isset($_SESSION['quiz_' . $quiz->nid]['question_duration']) && $_SESSION['quiz_' . $quiz->nid]['question_duration'] < -2) {
    // Timed quiz where the time has gone out 2 seconds ago. Do not store the users results...
}
elseif ($_POST['op'] == t('Next question')) {
    drupal_goto("node/{$quiz->nid}/take");
}
elseif ($_POST['op'] == t('Finish') || $_POST['op'] == t('Next') || $_POST['op'] == t('Back') && $quiz->backwards_navigation) {
    // We maintain two lists: previous questions and upcoming questions.
    // When we go backward, we pop one from the previous and prepend it to the
    // upcoming.
    // @todo This can be maintained more efficiently with a single array of all
    // questions and then a pointer to the current question. That makes
    // rewinding much easier.
    // Check for answer submission.
    if ($POST['op'] == t('Finish') || $POST['op'] == t('Next') || $POST['op'] == t('Back') && $quiz->backwards_navigation) {
        // Previous quiz questions: Questions that have been asked already. We save
        // a record of all of them so that a user can navigate backward all the way
        // to the beginning of the quiz.
        $SESSION['quiz_' . $quiz->nid]['quiz_questions'][0]['rid'] = $SESSION['quiz_' . $quiz->nid]['result_id'];
        $SESSION['quiz_' . $quiz->nid]['previous_quiz_questions'] = $SESSION['quiz_' . $quiz->nid]['quiz_questions'][0];
    }
    // Feedback time set to show after each questions
    elseif ($POST['op'] == t('Next question')) {
        // Previous quiz questions: Questions that have been asked already. We save
        // a record of all of them so that a user can navigate backward all the way
        // to the beginning of the quiz.
        $SESSION['quiz_' . $quiz->nid]['quiz_questions'][0]['rid'] = $SESSION['quiz_' . $quiz->nid]['result_id'];
        $SESSION['quiz_' . $quiz->nid]['previous_quiz_questions'] = $SESSION['quiz_' . $quiz->nid]['quiz_questions'][0];
    }
}
$former_question_array = array_shift($_SESSION['quiz_' . $quiz-nid]['quiz_questions']);
$former_question = node_load($former_question_array['nid'],
$former_question_array['vid']);

// Call hook_evaluate_question().
$types = _quiz_get_question_types();
$module = $types[$former_question->type]['module'];
$result = module_invoke($module, 'evaluate_question', $former_question,
$_SESSION['quiz_' . $quiz-nid]['result_id']);
$q_passed_validation = $result->is_valid;
$check_jump = TRUE;
if ($q_passed_validation === TRUE) { quiz_store_question_result($quiz, $result, array('set_msg' => TRUE, 'question_data' =>
$former_question_array));
}
elseif ($quiz->allow_jumping && _quiz_is_int($_POST['jump_to_question'])) {
  $_POST['op'] = t('Leave blank');
  $allow_skipping = TRUE;
  $jumping = TRUE;
}
if ($quiz->repeat_until_correct && $_POST['op'] != t('Back') && $q_passed_validation ===
TRUE) { // If the question was answered incorrectly, repeat it
if ($result && !$result->is_correct && $result->is_evaluated) {
  $last_q = array_pop($_SESSION['quiz_' . $quiz-nid]['previous_quiz_questions']);
  array_unshift($_SESSION['quiz_' . $quiz-nid]['quiz_questions'], $last_q);
  drupal_set_message(t('The answer was incorrect. Please try again.'), 'error');
  $repeat_until_correct_error = TRUE;
  unset($_SESSION['quiz_' . $quiz-nid]['feedback']);
}
}
elseif ($_POST['op'] == t('Back') && $quiz->backwards_navigation) {
  $quiz_id = 'quiz_' . $quiz-nid;
  // We jump back two times. From the next question to the current, and then
  // from the current to the previous.
  for ($i = 0; $i < 2; $i++) {
    $last_q = array_pop($_SESSION[$quiz_id]['previous_quiz_questions']);
    array_unshift($_SESSION[$quiz_id]['quiz_questions'], $last_q);
  }
}

// Stash feedback in the session, since the $_POST gets cleared.
if ($quiz->feedback_time == QUIZ_FEEDBACK_QUESTION && $_POST['op'] != t('Back')
&& $q_passed_validation === TRUE && $repeat_until_correct_error === FALSE) {
  // Invoke hook_get_report().
  $report = module_invoke($module, 'get_report', $former_question_array['nid'],
$former_question_array['vid'], $_SESSION['quiz_' . $quiz-nid]['result_id']);
  $path = drupal_get_path('module', 'quiz');
  require_once DRUPAL_ROOT . '/' . $path . '/quiz.pagen.inc';
  if ($report) {
    $report_form = drupal_get_form('quiz_report_form', array($report), TRUE, TRUE,
TRUE);
    $report_form['op'] = array(}
'type' => 'submit',
'value' => t('Next question'),
);
return $report_form;
}

// If anonymous user, refresh url with unique hash to prevent caching.
if (!$user->uid && $q_passed_validation === TRUE) {
  drupal_goto('node/' . $quiz->nid . '/take', array('query' => array('quizkey' => md5(mt_rand() . REQUEST_TIME))));
}

// Check for a skip.
if (isset($_POST['op']) && ($_POST['op'] == t('Leave blank') || $_POST['op'] == t('Leave blank and finish')) && $allow_skipping) {
  if (!isset($_SESSION['quiz_' . $quiz->nid]['result_id'])) {
    $_SESSION['quiz_' . $quiz->nid]['result_id'] = quiz_create_rid($quiz);
  }
  $q_passed_validation = TRUE;
  // Advance the question.
  if (!isset($jumping) || (isset($jumping) && !$jumping)) {
    $_SESSION['quiz_' . $quiz->nid]['previous_quiz_questions'][] = $_SESSION['quiz_' . $quiz->nid]['quiz_questions'][0];
    // Load the last asked question.
    $former_question_array = array_shift($_SESSION['quiz_' . $quiz->nid]['quiz_questions']);
    $former_question_node = node_load($former_question_array['nid'], $former_question_array['vid']);
  }
  // Call hook_skip_question().
  $module = quiz_question_module_for_type($former_question->type);
  if (!$module) {
    return array('body' => array('#markup' => ' '));
  }
  $result = module_invoke($module, 'skip_question', $former_question, $_SESSION['quiz_' . $quiz->nid]['result_id']);
  // Store that the question was skipped:
  quiz_store_question_result($quiz, $result, array('set_msg' => TRUE, 'question_data' => $former_question_array));
}

if (isset($check_jump) && $check_jump) {
  if ($quiz->allow_jumping && is_int($POST['jump_to_question'])) {
    quiz_jump_to($POST['jump_to_question'], $quiz, $_SESSION['quiz_' . $quiz->nid]['result_id']);
  }
}
$show_validation_message = FALSE;

// If this quiz is in progress, load the next questions and return it via the theme.
if (!empty($_SESSION['quiz_' . $quiz->nid]['quiz_questions']) || is_string($q_passed_validation)) {
    // If we got no error when validating the question
    if (!is_string($q_passed_validation) || $_POST['op'] == t('Back') && $quiz->backwards_navigation) {
        $question_node = node_load($_SESSION['quiz_' . $quiz->nid]['quiz_questions'][0]['nid'],
            $_SESSION['quiz_' . $quiz->nid]['quiz_questions'][0]['vid'],
        );
        if (isset($_SESSION['quiz_' . $quiz->nid]['quiz_questions'][0]['rid'])) {
            $question_node->rid = $_SESSION['quiz_' . $quiz->nid]['quiz_questions'][0]['rid'];
        } // We got an error message when trying to validate the previous answer
    } else {
        $question_node = $former_question;
        $show_validation_message = TRUE;
        array_unshift($_SESSION['quiz_' . $quiz->nid]['quiz_questions'], $former_question_array);
        if (is_array($_SESSION['quiz_' . $quiz->nid]['previous_quiz_questions'])) {
            array_pop($_SESSION['quiz_' . $quiz->nid]['previous_quiz_questions']);
        } // Avoid caching for anonymous users
        if (!user->uid) {
            drupal_set_message($q_passed_validation, 'error');
            drupal_goto('node/' . $quiz->nid . '/take', array('query' => array('quizkey' => md5(mt_rand() . REQUEST_TIME))));
        }
    } // Added the progress info to the view.
    $number_of_questions = quiz_get_number_of_questions($quiz->vid);
    $question_number = $number_of_questions - count($_SESSION['quiz_' . $quiz->nid]['quiz_questions']);
    $question_node->question_number = $question_number;
    $content['progress']['#markup'] = theme('quiz_progress', array(
        'question_number' => $question_number,
        'num_questions' => $number_of_questions,
        'allow_jumping' => $quiz->allow_jumping,
        'time_limit' => $quiz->time_limit));
    $content['progress']['#weight'] = -50;
    if (count($_SESSION['quiz_' . $quiz->nid]['quiz_questions']) + count($_SESSION['quiz_' . $quiz->nid]['previous_quiz_questions']) > $number_of_questions) {
        drupal_set_message(t('At least one question have been deleted from the quiz after you started taking it. You will have to start over.'), 'warning', FALSE);
        unset($_SESSION['quiz_' . $quiz->nid]);
        drupal_goto('node/' . $quiz->nid . '/take');
    }
}
if (isset($_SESSION['quiz_' . $quiz->nid]['question_duration'])) {
    $time = $_SESSION['quiz_' . $quiz->nid]['question_duration'];
    if ($time < 1) {

$time = 1;
}
db_update('quiz_node_results')
->fields(array('time_left' => $time))
->condition('result_id', $_SESSION['quiz_'.$quiz->nid]['result_id'])
->execute();

if ($time <= 1) {
    // Quiz has been timed out, run a loop to mark the remaining questions
    // as skipped.
    quiz_jump_to(count($_SESSION['quiz_'.$quiz->nid]['quiz_questions']) +
                count($_SESSION['quiz_'.$quiz->nid]['previous_quiz_questions']) + 1, $quiz,
                $_SESSION['quiz_'.$quiz->nid]['result_id']);
    $quiz_end = TRUE;
    unset($content['progress']);
    $show_validation_message = FALSE;
    drupal_set_message(t('You have run out of time.'), 'error');
} else {
    // There is still time left, so let's go ahead and insert the countdown
    // javascript.
    if (function_exists('jquery_countdown_add') && variable_get('quiz_has_timer', 1)) {
        $js = <<<EOM
        function finished() {
            // Find all buttons with a name of 'op'.
            var buttons = jQuery('input[type=submit][name=op], button[type=submit][name=op]');
            // Filter out the ones that don't have the right op value.
            buttons = buttons.filter(function() {
                return this.value == $button_op1 || this.value == $button_op2;
            });
            if (buttons.length == 1) {
                // Since only one button was found, this must be it.
                buttons.click();
            } else {
                // Zero, or more than one buttons were found; fall back on a page refresh.
                window.location = window.location.href;
            }
        }
        EOM
        drupal_add_js($js, array('type' => 'inline', 'scope' => JS_DEFAULT));
    }
    $_SESSION['quiz_'.$quiz->nid]['question_start_time'] = REQUEST_TIME;
}
if ($show_validation_message) {
drupal_set_message($q_passed_validation, 'error');
}

// If we're not yet at the end.
if (empty($quiz_end)) {
    $content['body']['question']['#markup'] = quiz_take_question_view($question_node, $quiz);
    $content['body']['question']['#weight'] = 0;
    // If we had feedback from the last question.
    if (isset($_SESSION['quiz_' . $quiz->nid]['feedback']) && $quiz->feedback_time == QUIZ_FEEDBACK_QUESTION) {
        $content['body']['feedback']['#markup'] = rawurlencode($_SESSION['quiz_' . $quiz->nid]['feedback']);
        $content['body']['feedback']['#weight'] = -100;
    }
    drupal_set_title($quiz->title);
    unset($_SESSION['quiz_' . $quiz->nid]['feedback']);
}

// Else we're at the end of quiz.
else {
    drupal_set_title($quiz->title);
    $quiz_end = TRUE;
}

// If we're at the end of the quiz.
if (!empty($quiz_end)) {
    // IMPORTANT: Because of a bug _quiz_get_answers always have to be called before 
    // quiz_end_scoring... :/
    $questions = _quiz_get_answers($quiz, $_SESSION['quiz_' . $quiz->nid]['result_id']);
    $score = quiz_end_scoring($quiz, $_SESSION['quiz_' . $quiz->nid]['result_id']);
    if ($quiz->feedback_time == QUIZ_FEEDBACK_NEVER) {
        $content['body']['#markup'] = theme('quiz_no_feedback');
    } else {
        // Get the results and summary text for this quiz.
        $summary = _quiz_get_summary_text($quiz, $score);
        $data = array(
            'quiz' => $quiz,
            'questions' => $questions,
            'score' => $score,
            'summary' => $summary,
            'rid' => $_SESSION['quiz_' . $quiz->nid]['result_id'],
        );
        // Get the themed summary page.
        $content['body']['#markup'] = theme('quiz_take_summary', $data);
    }
}
if ($score['is_evaluated']) {
    _quiz_maintain_results($quiz, $_SESSION['quiz_' . $quiz->nid']['result_id']);
}

// Remove session variables, save $rid
$_SESSION_data = $_SESSION['quiz_' . $quiz->nid];
unset($_SESSION['quiz_' . $quiz->nid]);
// NOTE: End actions might redirect the user somewhere. Code below this line might not get executed...
 quiz_end_actions($quiz, $score, $session_data);
}

return $content; }
E.3 SCREENSHOTS

**FIGURE E.3.1**: e-Stats homepage as seen by an administrator

**FIGURE E.3.2**: Lecture 1 quiz front start page on e-Stats website
FIGURE E.3.3: Quiz multiple choice question showing feedback for correct answer

FIGURE E.3.4: Quiz true/false question showing feedback for incorrect answer
Consider the time series airpass and the ACF below.

Is this ACF computed for the time series airpass?

Choose one

- True
- False
- I don't know
**FIGURE E.3.6:** Quiz matching questions feedback format

**FIGURE E.3.7:** Quiz true/false question using LaTeX
F. SURVEY FOR QUIZ USER TESTING PARTICIPANTS

FIGURE F.1: e-Stats user testing survey page 1
**eStats: Online Quiz Participant Questionnaire**

5. Online quizzes are an adequate replacement for formal in class pen and paper quizzes

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

6. I like that my score is not shared with my lecturer

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

7. If I had the option, I would continue using the weekly quizzes.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

8. The instant feedback assisted my learning

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

9. Did you find the website 'www.estats.ie' and the quiz visibly appealing?

- [ ] Yes
- [ ] No

Comment:

![SurveyMonkey](https://www.surveymonkey.com/)

**FIGURE F.2:** e-Stats user testing survey page 2
FIGURE F.3: e-Stats user testing survey page 3
G. SURVEY RESULTS

The online quizzes gave me feedback about my learning

![Bar chart showing responses to Question One (n=8)]

**FIGURE G.1: Response to Question One (n=8)**

The online quizzes helped me identify areas of weakness

![Bar chart showing responses to Question Two (n=8)]

**FIGURE G.2: Responses to Question Two (n=8)**
FIGURE G.3: Responses to Question Three (n=8)

FIGURE G.4: Responses to Question Four (n=8)
Online quizzes are an adequate replacement for formal in class pen and paper quizzes

**FIGURE G.5**: Responses to Question Five (n=8)

---

I liked that my score is not shared with my lecturer

**FIGURE G.6**: Responses to Question Six (n=8)
FIGURE G.7: Responses to Question Seven (n=8)

FIGURE G.8: Responses to Question Eight (n=8)
Did you find the website 'www.estats.ie' and the quiz visibly appealing?

![Pie chart showing 87% Yes and 13% No responses.]

**FIGURE G.9**: Responses to Question Nine (n=8)

<table>
<thead>
<tr>
<th>Response Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 13, 2014 10:01 AM</td>
<td>It was ok. Could be more exciting</td>
</tr>
<tr>
<td>Mar 10, 2014 2:21 PM</td>
<td>easy to use</td>
</tr>
</tbody>
</table>

**TABLE G.1**: Comment Responses for Question Nine
FIGURE G.10: Responses to Question Ten (n=8)

FIGURE G.11: Responses to Question Eleven (n=8)
FIGURE G.12: Responses to Question Twelve (n=8)

FIGURE G.13: Responses to Question Thirteen (n=8)
<table>
<thead>
<tr>
<th>Response Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 13, 2014 10:10 AM</td>
<td>I suggest a hyperlink to the relevant part of the lecture notes would help when getting a wrong answer</td>
</tr>
<tr>
<td>Mar 13, 2014 10:09 AM</td>
<td>Own notes</td>
</tr>
<tr>
<td>Mar 10, 2014 2:22 PM</td>
<td>none, just what I remembered from class</td>
</tr>
</tbody>
</table>

**TABLE G.2**: Comment Responses to Question Thirteen “Other, please specify” option

<table>
<thead>
<tr>
<th>Response Date</th>
<th>“Other” Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 13, 2014 10:10 AM</td>
<td>None - I didn’t have time to consult anything</td>
</tr>
<tr>
<td>Mar 13, 2014 10:09 AM</td>
<td>Own notes</td>
</tr>
<tr>
<td>Mar 10, 2014 2:22 PM</td>
<td>none, just what I remembered from class</td>
</tr>
</tbody>
</table>

**TABLE G.3**: Responses to Question Fourteen

<table>
<thead>
<tr>
<th>Response Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 13, 2014 10:08 AM</td>
<td>I suggest a hyperlink to the relevant part of the lecture notes would help when getting a wrong answer</td>
</tr>
<tr>
<td>Mar 13, 2014 10:02 AM</td>
<td>Found them helpful but would prefer feedback on wrong answers at the end not after each question</td>
</tr>
<tr>
<td>Mar 11, 2014 8:09 PM</td>
<td>It's a good idea and I think it helps.</td>
</tr>
<tr>
<td>Mar 11, 2014 6:39 PM</td>
<td>I would like to know that the questions are relevant to the final exams (obviously they can't be exam style questions, but if they were typical of part of an exam question it would be good).</td>
</tr>
<tr>
<td>Mar 10, 2014 8:39 AM</td>
<td>It needs professional web design/development. In particular I often found it hard to understand the feedback.</td>
</tr>
</tbody>
</table>
H. REFERENCES


## GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
<td>Content management system; a computer program that allows publishing, editing and modifying content as well as maintenance from a central interface</td>
</tr>
<tr>
<td>Domain</td>
<td>Web address; This is knowledge of a specific area or field - e.g. <a href="http://www.estats.ie">www.estats.ie</a></td>
</tr>
<tr>
<td>eLearning</td>
<td>the use of electronic media and information and communication technologies (ICT) in education</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol; a standard network protocol used to transfer files from one host to another host over a TCP-based network, such as the Internet</td>
</tr>
<tr>
<td>LaTex</td>
<td>a document preparation system and document mark-up language</td>
</tr>
<tr>
<td>LMS</td>
<td>Learning management system; is a software application for the administration, documentation, tracking, reporting and delivery of e-learning education courses or training programs</td>
</tr>
<tr>
<td>Server</td>
<td>The piece of hardware that which facilitates data storage</td>
</tr>
<tr>
<td>Personal</td>
<td>A system which facilitates a type of interaction associated with the use of audience response systems, to create interactivity between a presenter and his/her audience</td>
</tr>
<tr>
<td>Response</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td></td>
</tr>
<tr>
<td>Smart Device</td>
<td>An electronic device, generally connected to other devices or networks via different protocols such as Bluetooth, NFC, Wi-Fi, 3G, etc., that can operate to some extent interactively and autonomously</td>
</tr>
<tr>
<td>SSH</td>
<td>Secure Shell: a network protocol for secure data communication, remote command-line login, remote command execution, and other secure network services between two networked computers that connects, via a secure channel over an insecure network, a server and a client</td>
</tr>
<tr>
<td>Web-Hosting</td>
<td>A service provided where a website is stored on a server and is made available all over the World Wide Web</td>
</tr>
<tr>
<td>WYSIWIG</td>
<td>“What You See Is What You Get” editor; a system in which content (text and graphics) displayed onscreen during editing appears in a form closely corresponding to its appearance when printed or displayed as a finished product</td>
</tr>
</tbody>
</table>
Management Science and Information Systems Studies

Administrator User Manual

E-Stats for Statistics Discipline, Trinity College Dublin

Niamh Collier March 2014
D. **ADMINISTRATOR USER MANUAL**

D.1. **Introduction**
This manual gives a brief guide to using the www.estats.ie website. It is written for administrator users of the system.

The following commands will be described:

<table>
<thead>
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<th>NO.</th>
<th>COMMAND</th>
<th>PAGE</th>
</tr>
</thead>
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<td>E.2</td>
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<td>D.3</td>
<td>View Already Created Quiz Content</td>
<td>E.3</td>
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<td>D.4</td>
<td>Editing Quiz Content</td>
<td>E.4</td>
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<td>D.5</td>
<td>Create a New Quiz</td>
<td>E.5</td>
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<td>D.6</td>
<td>Add Questions to a New Quiz</td>
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<td>D.8</td>
<td>Viewing Quiz Reports</td>
<td>E.13</td>
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<tr>
<td>D.9</td>
<td>Using LaTex in Quiz Content</td>
<td>E.14</td>
</tr>
<tr>
<td>D.10</td>
<td>Inserting Images</td>
<td>E.15</td>
</tr>
</tbody>
</table>
D.2. Login/Out

To log in, enter an administrator username and password in the log in box shown below in Figure D.2.1. The homepage will then be displayed with the administrator toolbar at the head of each page for user convenience. The User Login box will then be replaced by a search bar and navigation box as seen in Figure D.2.2.

![Figure D.2.1: e-Stats homepage to a non-logged-in user](image1)

To log out, select Log out in the extreme top right hand corner. This can be seen in Figure D.2.2 below.

![Figure D.2.2: e-Stats homepage to a logged-in administrator account](image2)
D.3. View Already Created Quiz Content

To view content, select *Find Content* from the administrator tool bar in the far left-hand corner. See Figure D.3.1.

![e-Stats homepage as seen by an administrator](image1)

**FIGURE D.3.1**: e-Stats homepage as seen by an administrator

This will present a pane displaying all created content such as articles, quizzes and quiz questions as seen in Figure D.3.2. Click on the title of any content to view a preview of that content.

![Content panel](image2)

**FIGURE D.3.2**: Content panel
D.4. **Edit Quiz Content**

Follow instructions as shown in *Viewing Already Created Quiz Content* instructions (Page E.3) and select the content you wish to view. For example if the “eStats Quiz” content was chosen, the page shown in Figure D.4.1 would be shown.

![eStats Quiz content page](image)

**FIGURE D.4.1: e-Stats Quiz content page**

From this page, select *Manage Questions* as shown in Figure D.4.1 in the red box. Then follow the instructions under the *Add Questions to a New Quiz* instructions on page E.10.
D.5. Create a New Quiz

Select *Add Content* from the Administrator Panel shortcuts in the top left-hand corner. This will display the *Add Content* panel as shown in Figure D.5.1. From this panel, select *Quiz* as shown in red box in Figure D.5.1.

![Add Content panel highlighting option to create quiz content](image)

**FIGURE D.5.1: Add Content panel highlighting option to create quiz content**

The *Create Quiz* panel will then be displayed as can be seen in Figure D.5.2, Figure D.5.3 and Figure D.5.4. Enter a name for the quiz in the *Title* input box.

![Create Quiz panel – upper portion](image)

**FIGURE D.5.2: Create Quiz panel – upper portion**
FIGURE D.5.3: *Create Quiz* panel – middle portion

FIGURE D.5.4: *Create Quiz* panel – lower portion
The options available for the tabs shown in the red box in Figure D.5.3 are explained below.

D.5.1 **Taking Options**
Select the options you wish to have from those shown in the orange box in Figure D.5.3. The action each of these performs is explained underneath each checkbox option. If you wish to randomize the questions, this can be selected under the *Randomize Questions* heading.

Feedback options are displayed under the *Feedback* heading. These options indicate at what point the feedback for each question will be displayed to the quiz taker. Whether or not the correct answer is shown to the quiz taker can also be determined here under the *Feedback* heading.

Select the number of attempts a quiz taker is allowed for this quiz through the *Allowed number of attempts* under the *Multiple Takes* heading.

By selecting the *Quiz Addons Properties* option the panel expands to display an input box to allow the quiz creator to set the time limit in seconds (See Figure D.5.5).

![FIGURE D.5.5: Maximised Quiz Addons Properties option](image)

D.5.2 **Pass/Fail Options**
To set the pass rate for quiz takers, enter the score, as a percentage, into the *Pass Rate for Quiz* input box (See Figure D.5.6). Two bodies of feedback text can also be created here; one for users who pass the quiz, and one for those who fail.

![FIGURE D.5.6: Pass/fail options tab](image)
D.5.3 **Pass/fail options**
Here a general feedback message can be set for up to five result percentage ranges. See Figure D.5.7.

![Figure D.5.7: Result Comments Tab](image)

**FIGURE D.5.7: Result Comments Tab**

D.5.4 **Availability Options**
This option allows a quiz maker to select the dates, between which, the quiz will be made available to users. The option of *Always Available* can be selected to ignore these dates (See Figure D.5.8).

![Figure D.5.8: Availability Options tab](image)

**FIGURE D.5.8: Availability Options tab**

D.5.5 **Menu Settings**
These settings determine whether or not a menu link is provided. If this box is checked the options below in Figure D.5.9 will be visible. Here, a name can be given to menu link, a description can be written which will be seen when a user’s mouse hovers over the menu link, a parent item can be selected and a weight can be given to the link. This weight
determines the positioning of the menu link. Smaller weighted links are displayed before those with larger weights.

![Menu Settings tab](image1)

**FIGURE D.5.9: Menu Settings tab**

**D.5.6 Comment Settings**
Select *Open* to allow users to post comments after completing the quiz. Select *Closed* to not allow users to posting comments.

**D.5.7 Authoring Information**
Use the *Authored by* text box to display who created the quiz. The date of creation can also be set here but if left blank this will be filled in automatically.

**D.5.8 Publishing Options**
If the *Publish* check box is selected, the quiz will be published and site users will be able to take it. Select the *Promote to Front Page* checkbox to show on the e-Stats *Home* page. To make the content visible permanently on the Homepage select *Stick at top of lists.*

![Publishing Options tab](image2)

**FIGURE D.5.10: Publishing Options tab**

Finally, select *Save* to create the quiz.
D.6. **Add Questions to a New Quiz**

Follow the instructions under “Create a New Quiz”. This will display the *Manage Questions* tab as shown in Figure D.6.1. Under the heading *Create New Question* select the question type you wish to create. For demonstrative purposes, *Multiple Choice Questions* will be selected.

![Manage Questions tab](image)

**FIGURE D.6.1: Manage Questions tab.**

The question type (*Multiple Choice Question*) editing panel is displayed. Firstly, enter the question text into the *Question* text box. The text format can be changed to “Filtered HTML” – allowing HTML content, “Full HTML”- requiring HTML scripting or “Plain Text” – allowing no HTML (See Figure D.6.2). To use LaTex see the *Using LaTex* instructions, page E.14. To insert an image see *Inserting Images* instructions, page E.15. A title for the quiz can be entered in the *Title* text box.

Under the *Settings* header (shown in red box in Figure D.6.2), select the *Multiple Answers* check box if this question allows multiple answers and deselect if only one correct solution exists in the options. The *Random Order* check box randomizes the option choices. The *Simple Scoring* option awards the quiz taker maximum points if everything is correct and zero points otherwise. Select as required.

Select the Alternative 1 header (shown in the blue box in Figure D.6.2) to display the available settings for the first answer options. This will display the *Alternative Option* settings (See Figure D.6.3.).

Write the answer option in the text box provided. To select this answer option as the correct choice, select the check box to the left of the text box, shown in the red circle in Figure D.6.3. To insert feedback choose the *Advanced Options* header shown in the red box in Figure D.6.3.
FIGURE D.6.2: *Create Multiple Choice Question* panel

FIGURE D.6.3: *Alternative Option* settings
In the Alternative Options advanced settings, shown in Figure D.6.4, enter feedback for user if they select this answer option in the Feedback If Chosen text box. Similarly, feedback for not choosing this answer option can be written in the Feedback If Not Chosen text box. A score for choosing this answer can be set in the Score If Chosen text box (see blue circle in Figure D.6.4) and a score for not choosing this answer can also be set in the Score If Not Chosen text box (see red circle in Figure D.6.4). These can be positive or negative scores.

**FIGURE D.6.4: Alternative Option advanced settings**

Repeat these steps for as many alternatives as desired. To add another alternative answer option, select the Add More Alternatives button as shown in the green box in Figure D.6.2.

Select Save at the bottom of the panel to finish editing the question and to return to the Manage Questions tab.
D.7. Viewing Quiz Reports

Select Quiz from the administrator panel at the top of any page on www.estats.ie. The quiz administration panel will be displayed as shown in Figure D.7.1. From here select Quiz Reports and Scoring as shown in the red box in Figure D.7.1.

![Figure D.7.1: Quiz administration panel](image)

To view quiz results, select Quiz Results as shown in the red box in Figure D.7.2. Following this, select the quiz that the results should be taken from.

![Figure D.7.2: Quiz Reports and Scoring panel](image)

In the quiz reports an administrator can view the users who have taken this quiz, at what time they took that quiz, the time the quiz was taken and the users final quiz score.

To view a quiz usage report, return to the quiz administration panel and select Quiz Statistics as shown in Figure D.7.2 in the blue box and select the quiz whose statistics wished to be viewed. Alternatively, the Statistics tab can be selected that is visible when the scoring report is shown. This report shows quiz activity in the last 30 days, the top quiz scorers, the status for all attempts made to answer the quiz and quiz grade range per attempts.
D.8. Using LaTeX in Quiz Content

In the content editor select "Full HTML" from the Text Format drop down box as shown in red in Figure D.8.2.

Select Source from the content editor toolbar, shown in blue in Figure D.8.2. Insert the code from Figure D.8.1 into the content editor. This will load MathJax into the page and equations in LaTeX can be written into the code between the <body> tags.

```html
<html>
  <head>
    ...
    <script type="text/javascript" src="/MathJax/MathJax.js?config=TeX-AMS-ML_HTMLorMML"></script>
  </head>
  <body>
    ...
  </body>
</html>
```

**FIGURE D.8.1:** HTML code with MathJax code to insert into content editor

**FIGURE D.8.2:** Content editor
D.9. Insert Images

In the content editor select “Full HTML” from the Text Format drop down box as shown in red in Figure D.8.2.

Select the Image icon from the content editor as shown in green in Figure D.8.2. This will display the Image Properties dialog box as shown in Figure D.9.2.

To insert an image select Browse Server. This will display the File Browser dialog box as shown in Figure D.9.1.

To use a previously uploaded image, select that image from the server in the pane to the right.

To upload a new image, select Upload as shown in the red box in Figure D.9.1. Select Choose File and select the desired image from the desktop.

After choosing the image, select Upload to upload the selected image to the server. To use this image in the content editor double click the image from the file details pane in the File Browser dialog box. Set the desired width and height using the text boxes shown in Figure D.9.2 in the Image Properties dialog box. Select OK from the Image Properties dialog box.

![File Browser dialog box](image-url)

**FIGURE D.9.1**: File Browser dialog box
FIGURE D.9.2: Image Properties dialog box