Helping disadvantaged youth find employment in web development

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Abstract: The level of education of a large percentage of South Africans youth is not favourable for gaining meaningful employment according to Statistics South Africa. In disadvantaged areas, youth unemployment is at its highest. This research paper will consider the root causes of unemployment of South African youth and the factors that contribute to it. A case study of an intervention to improve the social development of disadvantaged youth by providing them with internships was studied. It focused on the expectations of interns and managers of an eLearning software solution to assist with intern training. A learning management software solution, designed to provide trainees with resources to learn web development; software engineering and prepare trainees with the necessary skills for employment in the corporate environment, was developed.

Keywords: information and communication technologies; internship; empowerment; learning management system; Moodle; e-learning; unemployment

1. Introduction

Unemployment amongst youth[1] is a huge problem in South Africa according to Statistics South Africa where 70% of youth (without disabilities) have remained unemployed since 2013; with black people[2] having the highest unemployment rates (Statistics South Africa. Pretoria, 2011). Reducing unemployment has been the government's plight for the last forty years (Lam, Leibbrandt, & Mlatsheni, 2008). A Labour Force (The World Bank, 2006) survey taken in March 2005 revealed that 42% of youth dropped out of their studies. Further research revealed that even students who have access to bursaries or scholarships still drop out (Cramm, Nieboer, Finkenflügel, & Lorenzo, 2013). When students were questioned about why they dropped out of their studies, students said that they would rather settle for average jobs to subsidise the income for their families than continuing with their studies and not earning a salary (Statistics South Africa. Pretoria, 2011). The use of social and other networks and personal contacts, which disadvantage youth don't have access to, often improve the chances of youth finding employment (Cloete, 2016). Unfortunately, most of the people in the networks of the disadvantaged youth, are also unemployed.

eLearning has the ability to reach groups of people in different regions, and has become the preferred level of learning for many individuals (Ellis & Kuz, 2014). Corporate eLearning is sought in businesses today and has become a driving force to offer customized training solutions to employees (Cross & Hamilton, 2002).

1.1 User Requirements

Youth in disadvantaged areas find it challenging to further their education and gain employment. This is due to little or no work experience and an absence of resources and strong networks (Cloete, 2016). An eLearning platform that can provide information technology training for interns from disadvantaged backgrounds was developed for a local company. This platform considered two types of users, a manager and an intern.

The manager would like to take on interns from disadvantaged areas, but lack the capacity to train them. He furthermore would want to track the courses an intern has done and their performance in these completed courses. As well as implement assessment opportunities for the interns using an eLearning software package that considers all the skills the intern needs to be exposed to.

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[1] Youth are ages between 15 and 24.
[2] In terms of the Broad-Based Black Economic Empowerment Act the term black people means African, Coloured or Indian persons who are natural persons.

The intern would like to access the Learning Management System (LMS) on multiple platforms and have access to content off-site in order to revise work even when not at work. They would like to receive feedback in order to review their progress. Since Wi-Fi access and data is expensive they would like to be able to download content and upload tasks when in a Wi-Fi environment. Interns would like to be able to code offline; thus be able to access a text-editor. And it will benefit them to collaborate with peers and mentors.

eLearning platforms such as W3Schools and CodeAcademy do not offer the above nor does it provide interns with case studies that can be utilised for programming.

1.2 – Data collection

The research methodology employed for this study used both qualitative and quantitative methods. The data for this study was collected through observation, literature reviews, semi-structured interviews and questionnaires. The research took place in the following locations:

• A digital agency known as *Responsive,* located in the suburb of Woodstock, Cape Town in South Africa. The company hosts an internship programme for 1 student per year. The aim of the internship program is to take on candidates from disadvantaged backgrounds. The program was initiated in 2017 when the company was approached by a non-profit organisation known as *Code4CT* (www.code4ct.com). The company, *Responsive*, intends to continue the program in the future, to improve their Corporate Social Responsibility (CSR) scorecard. One of the aims of the company is to provide opportunities for unskilled youth.

• The University of the Western Cape located in the suburb of Bellville, Cape Town in South Africa. The research participants included youths[3] from disadvantaged backgrounds who have an interest in computing, technology and web development, lecturers in the eLearning field and corporate companies who are interested in a program that employs disadvantage youth.

2. Requirement Analysis

The proposed eLearning solution is targeted at a corporate entity enabling them to employ disadvantaged youths without tertiary education. The South African Department of Education emphasized with an e-Education Bill, that the level of education in South Africa can be improved with eLearning (Takalani, 2008). Therefore corporate companies are able to apply for funding towards educating the disadvantaged youth. eLearning solutions are being used in many institutions and has been a good alternative for students from disadvantaged areas (Takalani, 2008). Information, Communication and Technology (ICT) has become an integral part of the modern world and it has made eLearning almost indispensable.

The software development system that was chosen for the development of this solution was Moodle. Moodle is an open source LMS that facilitates course creation. Moodle can be seen as a "technological Lego"—it comprises a set of plugins (similar to Lego blocks), which allows the developer to fully customise an application. It is open source and therefor also available for development without any cost to the developer.

The objective of this research was to develop a system that would give disadvantaged youth access to training and thus give them an equal opportunity for attaining employment and an improved quality of life.

3. Design

2.1 – High level design

In Table 1 the object used in the LMS are describes. These objects serve as a guideline for the implementation of the system.

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[3] All the participants in the study had obtained a National Senior Certificate (NSC). The participants are currently not studying at any tertiary institutions or are employed as unskilled workers.

Table 1 - Objects

Object	Description
User: Intern Admin: Manager	The manager is able to register interns to the LMS and the intern is able to login to their account
Dashboard	The manager is able to view a list of interns, which courses they have signed up for, completed, progress, and their performance level overall and within each course and when last the intern has logged in
Course manager	The manager is able to create, edit and delete courses and the intern is able to do courses they are enrolled in
Assignment and Feedback	The manager is able to add assessments and quizzes that can be graded. After assignments are completed or graded they can also provide feedback on the work the intern has done, this feedback is visible to the intern
Terminal	The intern is able to program on the platform. When programming, a checklist of requirements, which is expected from the intern, is ticked off when the specific program line is finished and working
History	The past work the intern has programmed should be recorded and the intern is able to refer back to it in the future
Upload and Downloadable content	The content on the site should be downloadable so the intern is able to view the work while at home where the intern does not have access to the internet. The interns should also be able to upload their own content
Chat	Messaging service where the intern is able to communicate with the manager of a course they are enrolled in
Announcements	The manager is able to sent out announcements of when assignments are due and when feedback is released
Collaboration	The interns are able to collaborate with other interns as well as mentors

2.3 – Class Diagram

The class diagram (Figure 1) depicts the flow of the LMS. It consists of all the objects used in the Moodle system and the relationship between the objects. The diagram considers three users namely administrator, course manager and intern. The manager role can assume both the administrator and course manager role.
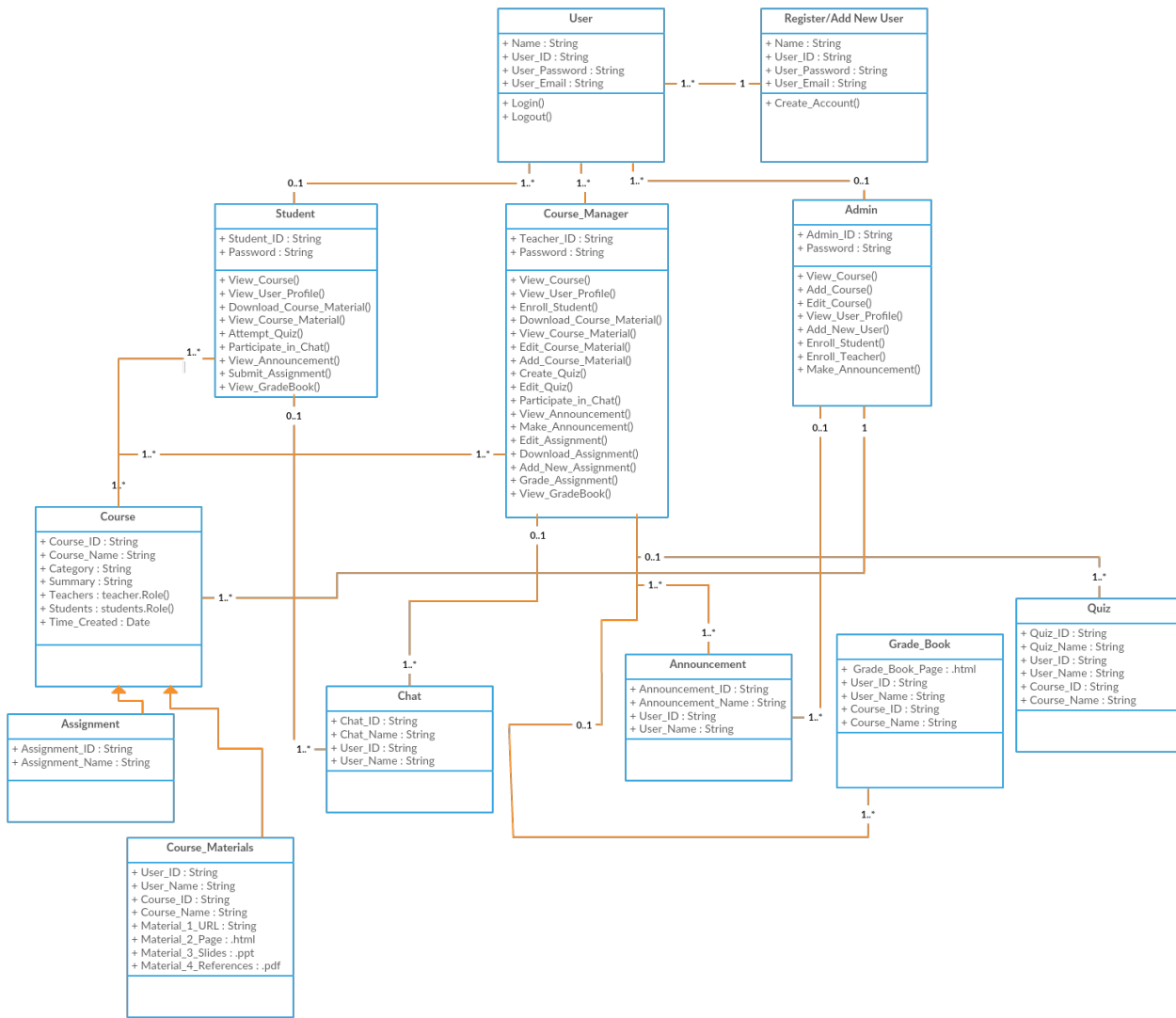
Figure 1 - Detailed Class Diagram (Authors own construction)

2.3 – State Diagram

Figure 2 depicts the state machine diagram for the LMS, the intern or manager first logs into the LMS. The system verifies the username and password of the intern or manager. Once the username and password of the intern or manager is verified, the system will display the relevant dashboard. The intern may search the courses available to them on the site. Then the intern may complete courses the intern is enrolled in and the information is stored in database. Once the intern has ended their session, they may logout. The manager is able to handle different events on the site such as, viewing interns, viewing reports, add and edit courses and assignments.
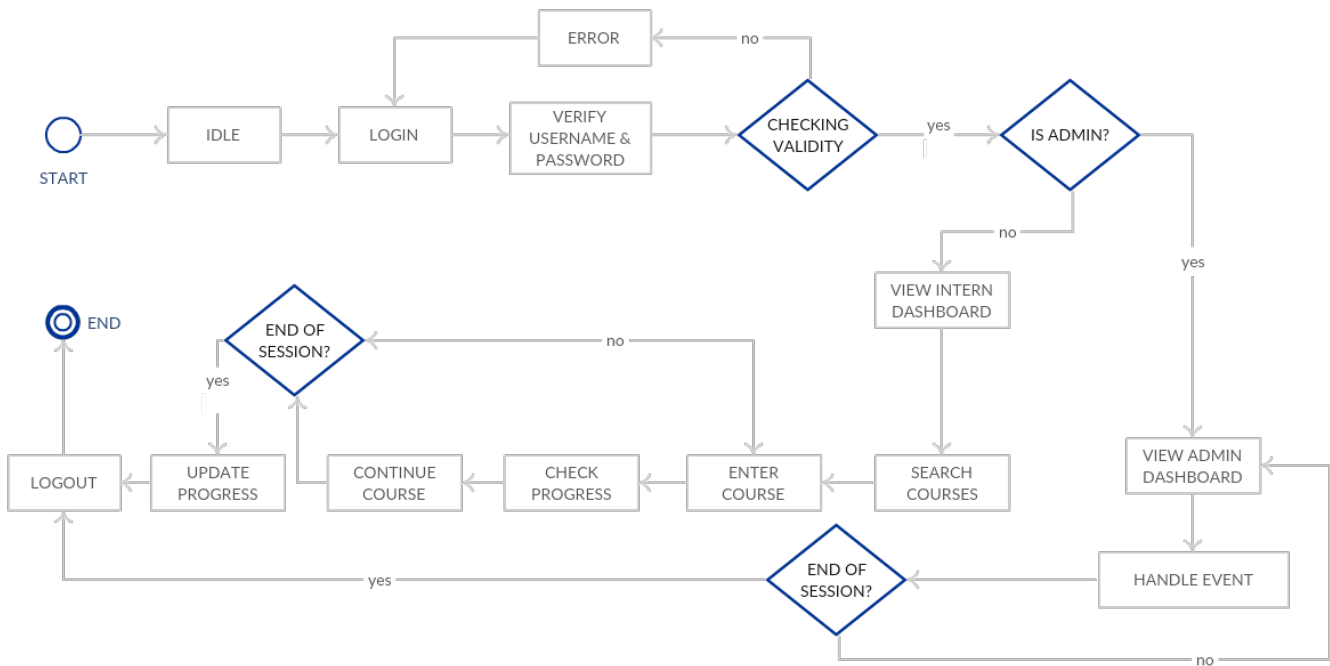
Figure 2 – The state machine diagram for Learning Management System - Moodle (Authors own construction)

4. User Interface and Prototype

The intern's user interface will consist of the following:

- Login Page – The intern is registered through the company and receives their login via email, the intern then logs in with the details provided. The intern is also able to logout after completing a session.
- Retractable Menu – This provides the intern with an easy view menu where the intern can navigate to calendar and private files, which include assignments, and uploaded files. (See top left of **Error! Reference source not found.**Figure 3)
- Notification and Messenger Icon – The intern is able to view notifications such as announcements, and assignment due dates and see messages they have received from the manager or other interns as well as create a new message. (See top right of **Error! Reference source not found.**Figure 3)
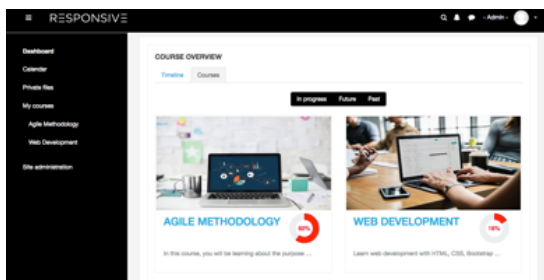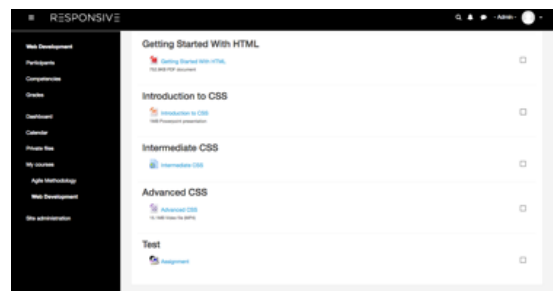

Figure 3 - Dashboard

Figure 4 - Course Outline

- Dashboard – The dashboard provides an overview of what the intern is able to do. (See **Error! Reference source not found.**Figure 3)
  - o Courses – Courses that the intern is enrolled in will be displayed here. The intern has to be enrolled for these courses by the manager.
    - ▪ Description – The description provides a brief overview of what the course is about.
    - ▪ Progress Donut – The progress donut gives the intern a clear indication of how far they are in the course.

- Curriculum – The curriculum of each course is available to the student under retractable bars. The intern is able to select a topic and view or download the content. Once the intern has completed the course, the intern is able to complete an assignment/quiz. (See Figure 4)
  - Download – Interns are able to download content in both document and video form.
  - Upload – Interns may submit assignments by uploading their own work.
  - Terminal – Interns may also submit assignments on the website by coding directly in the terminal. The student is able to code in several different tabs and submit once the intern has completed their work.

The manager's user interface will consist of the following:

- Login Page – The manager is able to login with the details given from the service provider. The manager is able to logout after they have ended their session.
- Notification and Messenger Icon – The manager is able to view notifications such as assignments received, assignments that need to be graded and when courses are starting and completing. As well as receive and create new messages.
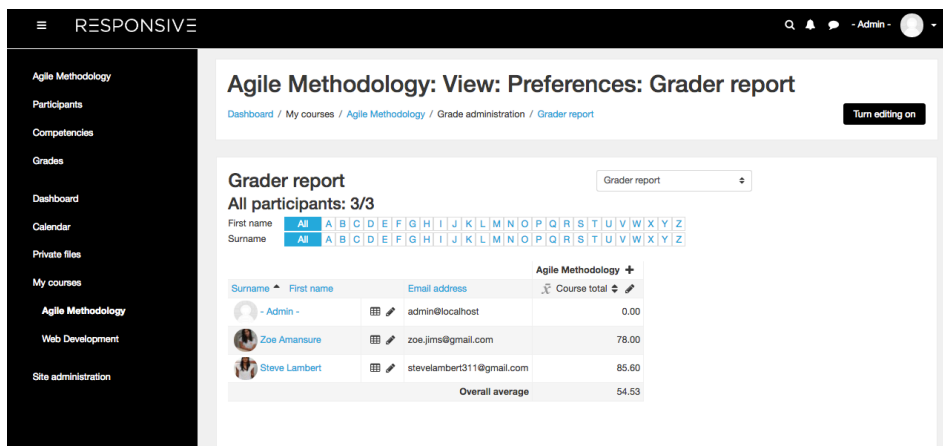

Figure 5 - Admin grader report

- Retractable Menu and Dashboard – This provides the manager with a easy view menu where the manager can navigate to the following menus:
  - Course Management – The manager can view and manage all courses. The manager may also add a new course. Here the manager has access to the following:
    - Edit the course content or dates
    - Send a message or announcement within the course
    - Enrol or un-enrol interns
    - View the grade book (See Figure 5)
    - Delete the course
  - Interns – The manager is able to view a list of all the interns and their individual courses and progress. (See Figure 6)
  - Calendar – The manager is able to view important dates such as assignments received, assignments that need to be graded and when courses are starting and completing.
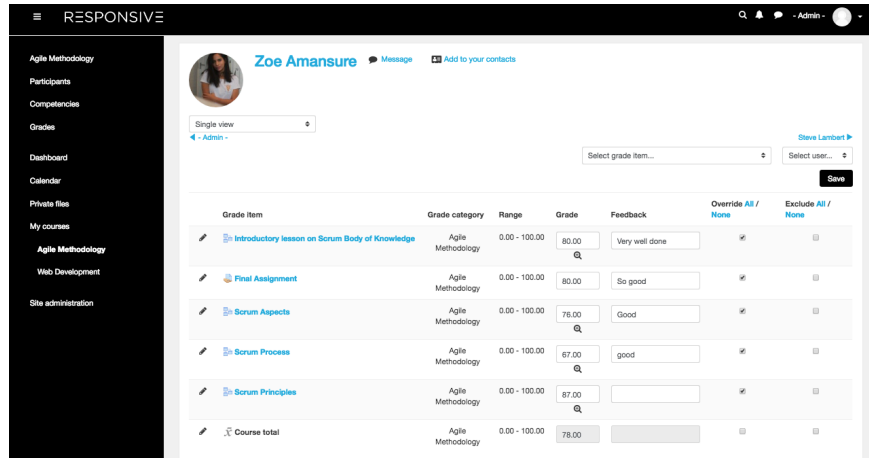
Figure 6 - Individuals progress

5. Implementation

The solution was developed in the form of a webpage using Moodle 3.3.7 (Build: 20180709). To develop the website Visual Studio Editor was used. Visual Studio is a code editor that is optimized for building web and cloud applications. The reason for using an editor was because it was easy to use and push the code to GitHub for version control. The programming languages included PHP, HTML, SCSS, JavaScript, Mustache and SQL. The prototype of the website was created with Photoshop and InVision. Photoshop is a graphic editing software. This software was used because it wasn't limited (other prototyping software expires after a certain period). InVision is a prototyping tool that allows one to create hotspots on pictures (.png/.jpeg). This software was used to bring the Photoshop static images to life. Youtube, a video sharing website, as well as Moodle Development Resource Documentation was used consistently throughout the implementation of the project for guidance and assistance when encountering errors.

Table 2 - Modules available on the Moodle Platform

No.	Activity	Module	Description
1	Creation	Database	Allows to build, display and search entries
2	Organization	Lessons	List of ordered topics summarizing the materials for specific courses
3	Delivery	Assignments	Allows manager to collect work from interns, for grading and feedback Allows student to upload or code assignments
4	Communication	Messenger	Allows synchronous conversation
		Forums	Communication tool where interns and manager can exchange ideas by posting comments
		Announcements	A special forum that allows for general announcements Allows manager to broadcast posts and emails
5	Assessment	Choice	Allows manager to ask questions and specify multiple choice answers
		Quiz	Allows managers to design and build quizzes with a variety of questions, such as multiple choice, true/false, short answer
		Survey	Allows teachers to gather feedback from students using prepackaged questionnaires
6	Admin	Graphing	The manager is able to view a graph displaying the progress of interns in a specific course

Table 3 - Modules created by the Author

No.	Activity	Module	Description

1	Terminal	Code Editor	Allows intern to code assignments in a terminal
2	Admin	Feedback	The manager is able to give feedback on interns assignments, quizzes and code
3	Intern	Downloadable Content	The intern is able to download documents and video from the course
		Progress Donut	The intern is able to view their progress of a specific course

6. Testing

The goal of testing is to evaluate the correctness, usability and effectiveness of the developed software. Thus to detect bugs as early as possible, confirm that the product meets the requirements and demonstrate how easy and logical the webpage is and how easy it is to find the required information. The testing methods used were functional testing, performance testing and usability testing.

6.3 Functional Testing

Functional testing is a testing method, which ensures that the functions developed meet the design requirements of the stakeholder. Functional testing tests the main functions of the software such as, text input, menus etc.

Test Case 1	Test procedure	Login with user account Username: kimsmith, Password: KSmith2018
	Expected Results	Proceed to login Error will display for incorrect credentials
	Results	Pass
Test Case 2	Test procedure	Add user to database – with only the following details Username: jimross Password: JRoss2018 (Select force password change) Name: Jim Surname: Ross Email: JRoss@responsive.com City: Cape Town Country: South Africa Description: Intern 2018
	Expected Results	User created and displayed on the user list New user displayed in the database Error will display for incorrect data types are entered or mandatory information are left empty.
	Results	Pass
Test Case 3	Test procedure	Edit user description of Jim Ross: Junior Developer 2019
	Expected Results	Users profile updated User updated in the database
	Results	Pass
Test Case 4	Test procedure	Upload an assignment
	Expected Results	Assignment successfully submitted and displayed under submissions
	Results	Pass
Test Case 5	Test procedure	Download an assignment
	Expected Results	Assignment successfully downloaded as zip file
	Results	Pass
Test Case 6	Test procedure	Download course material

	Expected Results	Assignment successfully downloaded
	Results	Pass

6.3 Performance Testing

Performance testing is a testing procedure, which determines how responsive the software is. The test was carried out on a MacBook Pro (Mac OS) device with Chrome developer tools. This test was carried out a total of 10 times and the results recorded in a line chart to assess its performance.
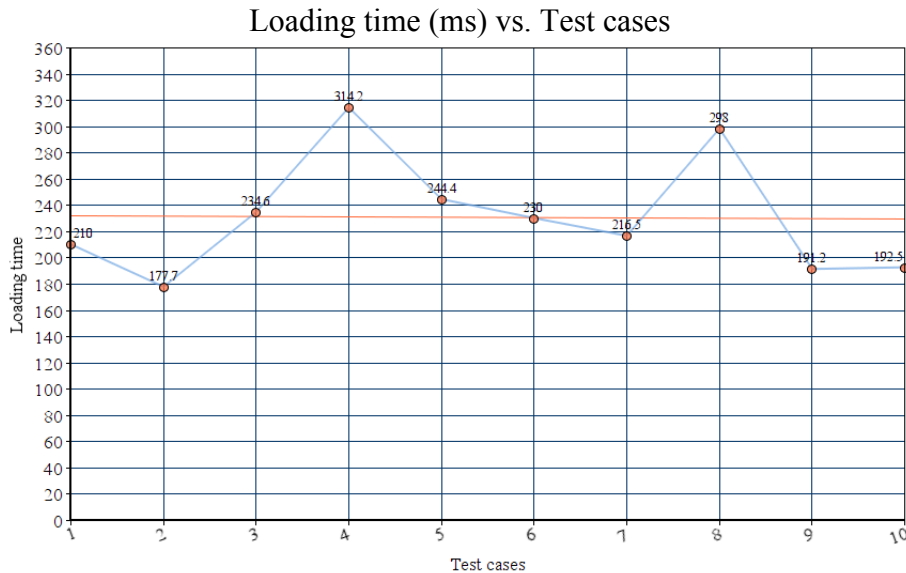

Figure 7 - Loading time (Authors own construction)

We can conclude that the average load time is 230,91ms (See Figure 7). According to surveys done by Akamai (Akamai, 2015), 47% of users expect a website to respond in less than 2 seconds. The website loads in less than 2 seconds which is efficient and allows the user to stay engaged with the website.

Performance testing was done on different environments to assess how the website performs (See Table 4). The website requirements started that the user should be able to view, complete and download content on their mobile phone. The website should be responsive on all types of devices namely, desktop computers, laptops, tablets and phones. The web site should also work on different platforms and software's. The website passed all relevant test to ensure that the website is fully responsive. The user can access the website through multiple devices and platforms.

Table 4 - Environment testing

Hardware	Operating System	Device Screen Size	Browser	Result
Dell	Windows	17"	Chrome	Pass
			Internet Explorer	Pass
			Firefox	Pass
MacBook	MacOS	13"	Safari	Pass
			Chrome	Pass
			Firefox	Pass
Samsung	Android	Phone (6.2")	Chrome	Pass
		Tablet (10.1")	Chrome	Pass
Apple	iOS	iPhone (5.5")	Safari	Pass
		iPad Pro (12.9")	Safari	Pass

6.3 Usability Testing

Usability testing was carried out after functional testing took place. The goal of usability testing is to identify usability issues on the participants' performance. It will also determine the users satisfaction

with the system. Jakob Nielsen's 10 usability heuristics for user interface design was implemented in the system to improve its ease-of-use (Nielson & Molich, 1990). Usability heuristics that were important while creating this system were "recognition rather than recall"— reduces the load on the user's memory and makes the system easy to understand; minimalistic design and efficiency of use. Having access to a user guide is also a top priority, thus if users struggle with the completion of a task, they can refer to the users' guide for assistance.

Five experts—who all have experience in computer programming and software development—were chosen to do a walkthrough since Preece et al. suggested that five or more experts will be able to identify approximately 75% of usability problems (see Figure 8) (Preece, Rogers, & Sharp, 2015).

The curve in Figure 8 depicts the ratio of problems within an interface identified by a heuristic evaluation using a number of evaluators ((Preece, Rogers, & Sharp, 2015) p409).

For the usability test, the participants had to complete a number of set tasks. The results were recorded with a survey using Google Forms. Before the survey was carried out, the website was explained to the participant and a users' guide was handed to the participant. The participant was given the open website

Figure 8 (Preece, Rogers &Sharp, 2015)

(on a laptop), the tasks as well as a link to the survey. Section 1 of the survey gathered information about the participant to identify whether the participant is as an "expert". The participants were given 4 tasks to complete on the website and then could progress to Section 2 of the survey. This section evaluated the ease of use of the websites and as well as the other heuristics. The data collected from the survey was analyzed and important changes were made to the website based on the feedback of the experts. All the participants completed the tasks successfully, some of the participants had to refer to the user manual because at first it was difficult to understand, but they grasped the website as they went along.

Some of the problem features from the user feedback could be changed and other features will be included in the future work section. The problematic features included the font text being too small, the font size was changed to a larger font. The logic of menus was also a problem as the participant wasn't able to distinguish the hierarchy as the indentations were all the same. This was changed so that the participant will be able to navigate more easily.

7. Conclusion

The issue of unemployment in South Africa can be decreased by assisting disadvantage youths, who do not have access to education, to acquire the skill necessary for employment. The eLearning platform will provide corporates with a resource that will enable them to train interns. The eLearning LMS was successfully implemented using the software development tool Moodle. Custom plugins were added for the website to suit the requirements of the stakeholder and users.

7.1 Recommendations and future work

This study was limited in time and financial resources. Other aspects that could be explored are: governmental funding; hosing the site on a server and detailed permissions of the manager and intern. The current platform is not able to evaluate code, which was initially intended. This makes it time consuming for the manager to go a manually mark code. This can be implemented in future work.

Based on the feedback acquired from the usability testing, the website can be improved by considering the following:
- Making the navigational process of the website easier for the user to understand and use.
- Provide a tool tip tutorial for first time users so that they are able to identify where key actions are located.
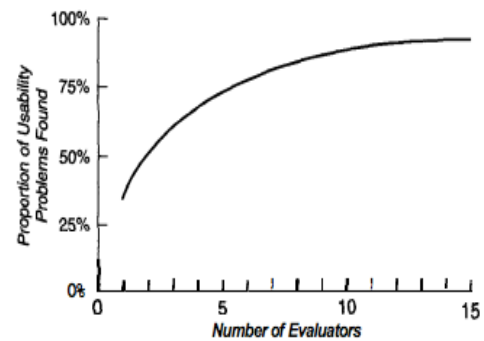
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