

THE ONLINE MATHEMATICS DIAGNOSTIC TEST AT USP: A TOOL TO IDENTIFY NUMERACY GAP

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Abstract

The Curriculum - Bridging gap between secondary level education and tertiary level is a major problem which is always unnoticed by many Universities. The Faculty of Science Technology and Environment at The University of the South Pacific has designed an Online Mathematics Diagnostic Test (OMDT) for all its first year undergraduate students to bridge the gap in areas of Mathematics. Many universities issue mathematical diagnostic tests to incoming first-year students, covering a range of basic concepts which the students are supposed to bring with them from their secondary school of studies. It provides an early indication of areas where students are likely to need additional help (online remedial), and hopefully encourage such students to take advantage of extra support mechanisms at an early stage before hardcore university studies begins. However, it is not clear that students recognise these intentions and there is a fear that students who score poorly in the test will have their confidence further damaged in relation to mathematics and will be reluctant to seek help. Thus this paper showcases the extent of OMDT designed for new students at USP and the offering of remedial through the eLearning Platform with the detailed analysis of the research carried out with its implementation.

Key Words: Bridging gaps, Online Diagnostic Test, Online Remedial, Pacific Region

1. Introduction

A continuing cause for concern in higher education institutions is the poor core mathematical skills of incoming students. In recent years the number of students entering higher education has increased dramatically. This growth in numbers has brought with it an increase in diversity of educational background.

The University of the South Pacific was set up in the South Pacific region in 1968 by its 12 member countries namely – Cook Islands, Republic of Fiji, Kiribati, Marshall Islands, Nauru, Niue, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu. A total of 14 campuses are spread over an area of 30 Million square kilometers of the Pacific Ocean [2]. This geographical separation of the countries necessitates a commitment of its member countries. Therefore, coming up with better learning and teaching tools and culture-inclusive curriculum for region is one of the aortal aims of the university [1].

Online Mathematics Diagnostic Test (OMDT) progressively outlines different topics of mathematics taught at different levels (i.e. Year 12 and Year 13) in all the member countries of USP.

The movement from secondary to tertiary education is not always easy. For some students the transition is smooth and clear but for others it is variable, with sub-optimal outcomes. An educational gap is created once a student leaves secondary education system and joins tertiary level. Different levels of mathematics knowledge is brought by students, since they come from different assessment systems (i.e. form 7, SPBEA NZ curriculum, etc.) and hence different emphasis and importance are placed on different topics/areas of mathematics. This problem is further compounded by the in-experience, lack of relevant teaching qualification and teachers with weak mathematics background. Therefore to identify the weak spots in mathematics for individual students a diagnostic test was designed and developed by the Faculty of Science, Technology and Environment (FSTE). Most of the Faculty courses comprises mathematics knowledge and hence comparing the mathematics taught in Pacific Region in Yr 12 and Yr 13 few topics in curriculum are over-seen and discarded as compared of that taught at tertiary level.

This project tries to outline the major areas of weakness in students and would like to provide online Mathematics Test, containing 40 multiple choice questions, which are randomly generated from a bank of 1200 questions from 20 different topics. These topics have already been covered in Year 12 and Year 13 mathematics course at secondary level. This project aims to diagnose the area of weakness in participating students and hence provide a fully functional remedial for them before they continue to the first semester of undergraduate programmes at USP.

2. Related Works

A number of related works exist on the Mathematics diagnostic test at different universities around the world, mainly in New Zealand, Australia, England, The United States of America and UK. The system of diagnosis provides and improvised student performance when entered in the undergraduate programme of study in major fields.

In [7], the university tries attempts to ensure that the entire first-year university student, who increasingly exhibits a wide diversity of entrance qualifications, had a common foundation in a range of key skills (including communication, numerical, ICT, problem-solving and team-working), as well as both science and career management skills.

Diagnostic tests have also been carried out using different mode of delivery (i.e. Paper based and Computer based) in different universities. The authors of [7] designed and implemented online mathematics diagnostic test, which was piloted to students at University of the York.

However, nowadays it is an essential tool in assessing student's mathematical knowledge. It is used to help individual students identify their level of attainment and to provide support for those who fall below acceptance range.

3. System Overview

The system designed and proposed is a cost effective simplified system that uses all the resource which are currently at the university. The University of The South Pacific (USP) uses the Modular Object-Oriented Dynamic Learning Environment (Moodle), which is an open source eLearning software, widely recognised as the Learning Management System or a Virtual learning environment, designed based primarily on the celebrated philosophies of the Constructionist and the social constructionist approach (see for example

<http://en.wikipedia.org/wiki/Moodle>), allowing students participatory learning. It also allows educational professionals to act as facilitators of learning and not necessarily the subject experts.

This OMDT is a unique project and is the first of its kind to be implemented in the South Pacific. It allows students to do their online test from anywhere around the university campuses and as well as from their homes using laptops, smart phones, tablets with internet connectivity.

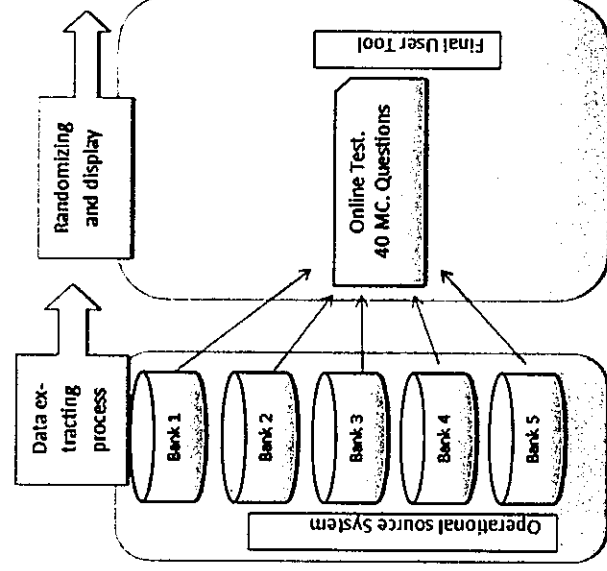
For this test, the students need to have a valid USP ID number and a system acceptable password with which they could login to the universities eLearning Platform (Moodle). The online test consist of 40 questions which have been randomly pulled from 4 different categories of more than 2000 questions.

The time allowed for this test is 60 minutes with an alert message at every 15minutes of the time spent during the test. This notification feature helps the student to be on par with the exam pressure and having a concern to complete the test before the session runs out. However, when an online test is completed, an immediate online feedback will be available to the students. Thus the review for each question they have attempted consecutively will also be available to them to cross check with their choice of the answers. Following the online Diagnostic Test, a fully function online remedial will be available to the students who lack and are variably weak in different areas of mathematics. This feature of remedial detection is a major and the core area of the project. Furthermore, the OMDT team has used the AI arms to figure the detection of which remedial module should be available to which student based on the marks they attain in the online test. Each remedial module available either online and face-to-face will contain certain concepts of areas of concern. It will include clear examples with step-by-step instructions to tackle mathematics problems as well as exercises with précised notes on each sub-topics. For any students entering USP, the online test is entirely free and the remedial that will be proposed for each student will be free as well. The remedial will later be available to students in their campuses face-to-face.

4. OMDT Design And Architecture

The figure below (fig 1.0) illustrates the project design and the architecture which has been developed on the online learning Platform (Moodle) which USP uses widely for the online learning and teaching. This architecture clearly shows how the random questions are generated from 20 different question banks.

Fig 1.0. Project Design and 1-tier Architecture on Moodle



The above diagram shows the project segregated into 1-tier, which helps in presentation, application processing, and thus data management functions are logically separated. Hence, a user-friendly application is being designed for the end-users. Different level of programming practice and language has been used to enable all the features work and function in accordance with the project final product.

A simple PHP and JavaScript Random Question generator algorithm is used for getting the questions from the question bank. The algorithm below is a quick overview as how the questions pop-up from the question bank (Database).

```

<script type="text/javascript">
var questions = [
    "Evaluate  $\frac{dy}{dx}$  of  $\ln\{x\}$  $$?",
    "Evaluate  $\ln\{x^2\}$   $\frac{dy}{dx}$  {  $dx$  } $$?",
    "Find derivative of  $y = \ln\{6x\}$  $$?";

var question = questions[ Math.floor( Math.random() * questions.length ) ];
document.write( '<div id="TheQuestion">' + question + '</div>' );
</script>

```

The algorithm is based on server side programming and is being integrated into Moodle using HTML and CSS. Each question bank has two category of questions (easy and hard preferably) and thus upon generation, one from each category is pushed from each question bank for the final 40 multiple choice online test. The questions which are pulled from the question bank are being tracked and the result of each question attempt by any user or multiple users will appear in the Back-end Grade-Book and thus these results will later help in deciding as to which remedial module should be available to the students upon completion of the test.

5. OMDT Pilot Run And Results

In order for any project to reach an accomplishment point, some survey and analysis play important role to determine the success of the project. The OMDT team set up a pilot run of the project in order to identify potential problems and prevent them from escalating as well as to accomplish several goals before full implementation occurred [3]. Since mathematics deal with calculations, our major focus was to determine whether a student needs calculator or not. Table 1 shows the comparative result of calculator and non-calculator test, which were carried out on a set of first year FSTE students.



Table 1.0 : Comparative Analysis

	With-out Calculator	With Calculator
N# sat	864	405
N# Pass	199	171
% Pass	22.92	42.22
Max	95	95
Min	0	0
Average	30.1	45.37
Stdev	22.57	17.15
90-100	2	2
80-89	6	8
70-79	19	26
60-69	64	53
50-59	108	82
40-49	152	97
30-39	137	78
20-29	91	37
<20	287	22

The result was evident enough for the project to allow students to use calculators during the online test.

1. OMDT Online And Face-To-Face Remedial Analysis

The students also actively took part in the face-to-face and online remedial provided to them. These remedials were divided into different modules and were delivered to students at all the campuses. Students in Laucala Campus were provided with 45minutes face-to-face remedial. Some sessions recorded full attendance of around 40 students. Each topic remedial module was prepared and was proof-read by the senior Mathematics staff of USP.

Recommendation And Conclusion

OMDT is a great accomplishment for the Faculty of Science Technology and Environment. It tries to identify and bridge the educational gap which is found in students and prepares them well before the end core university studies resume. The test will be followed by a fully functional online remedial available to the student who face difficulties and are comparably weak in certain areas of Mathematics. Hence this project is a sum up the design of an efficient and innovative project at The University of the South Pacific, which has already been piloted twice with comparable results and the delivery of the online remedial to students in the Faculty of Mathematical support.

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