Preliminary Use of an E-learning Pilot System for Secondary Educational Institutions in Tuvalu: The Initial Implementation.

Atufenua Maui, Tony Kwato'o, Ronald Vetter, Yoshifumi Chisaki, and Tsuyoshi Usagawa

Abstract—**The focus of this study is on the preliminary use and implementation of an e-learning pilot system based on an open source Learning Management System (LMS), the Moodle 2.0, within a secondary school in Tuvalu. Tuvalu is one of the worlds Least Developed Countries (LDCs) which have insufficient band width currently available, inadequate infrastructure and resources such as electricity and a lack of skilled manpower. The recent innovations of e-learning and Information and Communication Technologies (ICTs) in the classroom have been enthusiastically met by students, teachers and administrators. The performance of the students who participated in activities designed for the Computer Studies subject and the data collected from questionnaires and surveys confirm the system's potential for improving student skills in the use of technology and their motivation towards study. This includes the potential to bridge the wide gap Tuvaluan students previously faced when entering tertiary level of education outside Tuvalu, and proposals for education within Tuvalu in relation to e-learning and will outline the Education Department's plans to introduce ICTs into education in an attempt to stay abreast with the rest of the world.**

Index Terms—**E-learning pilot system, least developed countries (LDCs), learning management system (LMS), Tuvalu**

I. INTRODUCTION

The vast potential for using e-learning as an instructional tool to deliver content and learning experiences has, in recent years, become an important focus For researchers worldwide. Its benefits have been proven, not just in the field of education, but in many other areas including business, industry, government and the workforce in general.

In general e-learning describes instructional content or learning experience delivered or enabled by electronic technologies [1], and it refers to the process of learning that is facilitated by the computer technology in a web based environment. When introducing e-learning, it is important to note that e-learning is not a substitute for a strong relationship between teachers and students. Rather, it can and should be used to nourish, transform, and enrich student-teacher relationship and promote a more active, student-centered

learning [2]. As one of the world's Least Developed Countries (LDCs), Tuvalu, has been struggling to keep up with the changes in education precipitated by the increased use of Information Technology (IT). The use of Information and Communication Technology (ICT) not only applies to the content delivery but also to the interaction between participants via Internet and extranets, satellite broadcast, and interactive TV [2]. These technologies have the potential to encourage collaboration between teachers and students and enhance the quality of education in Tuvalu.

Still, the lack of man-power with adequate skills as well as limited bandwidth available in the geographically remote islands scattered in the radius of approximately 365km pose a great challenge for the implementation of e-learning system in Tuvalu. According to the information provided [3], Modular Object Oriented Dynamic Learning Environment (Moodle) was identified as one of the worlds' most used Learning Management System (LMS) in 2011 with 300 million users around the world. It has many great advantages, but most notable are free service charges and ease of installation. A newer version of Moodle, Moodle 2.0 and Moodle 2.1 introduced very simple navigation functions which are more suitable to the needs of Tuvalu islands faced with the shortage of skilled manpower. Another effort to address this problem was made by offering workshops to the students and teachers. During these sessions students and teachers in Tuvalu refined their IT skills and gained greater knowledge and confidence in their ability to embrace e-learning. Not having a consistent 24-hours supply of electricity remained another obstacle to the implementation of e-learning system in Tuvalu. Unfortunately, this was a problem that was not as easy to address as it was initially thought. However, The Tuvalu Electrical Corporation is now searching for a solution to this problem. Because the Tuvalu islands are scattered over an area of 28.5 square kilometers, satellite networks are used to provide Internet access. Each island in Tuvalu relies on a satellite dish for communication.

Currently, while the available bandwidth is only 512 kbps uplink, and 1.5 Mbps downlink, there are more than 900 subscribers who want to use the service [4]. This inevitably slows down the speed of the entire system. Therefore, in order to best serve students and teachers, a local server must be installed in each island. Meanwhile, many teachers and students have shown enthusiastic interest in the e-learning system during the initial stages of its implementation. Student's confidence and motivation towards their studies have noticeably increased with their recently improved skills in technology. The current innovations and proposals concerning e-learning will greatly assist the Department of

Education's plan to incorporate ICT into Tuvalu's educational system in their attempt to stay abreast of developments in the rest of the world. Furthermore, this endeavor concerning e-learning will contribute to bridging the wide gap between students who stayed in Tuvalu and students who decided to pursue tertiary level of education outside of Tuvalu.

In this study we focus on demonstrating an e-learning pilot system that could work in Tuvalu. Some overviews of the e-learning implementation were mentioned with the ICT situation in all of the educational institutions in Tuvalu, and the discussions of the findings from the activities that were held in order to support this initial e-learning implementation.

II. Overview of the E-Learning System Implementation In Tuvalu

A. Internet Connectivity in Tuvalu

The current settings connectivity is through satellite dishes installed on each islands. The two main internet services provider (ISP), one is the Government owned ISP, which is operated under the ICT department. It distributes the internet to all Government ministries and their department only on the capital island Funafuti. Another site that is operated under the Government ICT department is the only government owned secondary school, Motufoua Secondary School (MSS). The available link between the two sites is 512kbps uplink for the Government office link and 128kbps uplink for the school link; with 1Mbps downlink shared between them.

The other ISP is the Tuvalu Telecommunication Cooperation (TTC) which distributes the internet connection to the rest of the outer islands with a hub located in the main island and with the connection available for both 3Mbps uplink and downlink.

B. Initial Plan for the E-learning System

The initial plan for this e-learning system implementation was to have all the schools or institutions running their own local Moodle servers.

Fig. 1. The initial plan for e-learning system for tuvalu. Arrow lines represent updating collaboration of content between the moodle systems.

A synchronization technique that is now available can be employ in the near future in order to transfer the e-learning content efficiently due to the limited band width available. The differential synchronization technique is having a Moodle Master server updating any Moodle content Client server by sharing their contents over a limited band width without disturbing the contents of another Moodle server. It only updates the changes that were made in a Moodle Master server [5].

However currently, the teachers can only update the content by working collaboratively over the internet via email and the mail function of the Moodle 2.0 system.

C. Initialization of the E-learning System

The introduction of an e-learning system in Tuvalu was selected to be piloted in Motufoua; the government owned secondary school, MSS. One of the first decisions to be made was about the selection of the subject and building of the content. This was most important, as a successful implementation of e-learning is dependent on successful delivery of contents [6]. Therefore, getting the content setup and run was simply done with the Computer Studies (CS) subject for the two forms/grade levels, form 5 and form 6 (age 16 and 17). The consistent on-going collaboration between the teacher responsible for the subject at MSS the second author, and the first author here in Kumamoto over the net by email was such that it fast-tracked the teachers skills and competency in the developing of the online content of the CS subject. Obviously there was an expectation that more subjects by other teachers could be implemented as soon as further training and workshops were completed. Therefore, the main aim of this first step was to equip the teachers and students with the skills to competently and confidently begin using the e-learning system. The one thing that is a must, according to debate results on strategies in implementing successful e-learning in LDCs, was the need for training of teachers and students [7].

D. Experimental Review

Three Moodle servers were set up for the experiment; one in the main school of MSS, the other one in the main island of Funafuti in the government office of Tuvalu, and the third in the author's laboratory in Kumamoto University. The reason for this was obviously because of the limited bandwidth available and to have a Moodle server located in MSS where they can easily access in a faster time. The server in Funafuti was to be a main server that has the backups and the original contents stored. The third server was the content development server while the author is working from Kumamoto University. In terms of updating each Moodle content, the conventional method is being used. That is backing up the database from the original development content server and restore to each servers.

Details of servers:

All the three servers were just laptops, and were the only ones available for the experiment, and also with all the same specifications including:

CPU: Intel Celeron 2.0 GHz

HDD: 160 GB

RAM: 2GB

OS: Ubuntu 10.10 (Maverick Meerkat)

E. Design Content of the Computer Studies Subject

The CS class runs 7 times a week. Everyday a double period except for Tuesdays a single period and Thursday no CS class. Each period runs for 45 minutes. The initial pilot was run for 13 weeks in total and the same with the current

study period.

The Fig. 2 is a snapshot of the CS subject content of week 3 and 4 in the Moodle system. The course work was organized in weeks. There are notes, lab exercises, and quiz activities posted up each week.

The first period of the pilot system was on the third study period from August 22 to November 25, 2011. Most of the time the classes were held in face-to-face and it was only when doing lab activities and quiz exercises student used the e-learning system. During preparatory times the students also had access into the system.

The second study period is currently being held is the first academic term and runs from January 25 to April 23rd, 2012. The teacher responsible for the CS subject has been practicing teaching the subject face-to-face and has the students accessing the e-learning system at the same time, following the online notes of each week's classes.

During this current study period, one of the new approved Internal Assessment is to assess the students ability to access the e-learning system, been able to edit their profile with a picture, editing their personal details and how well they can attempt a given quiz.
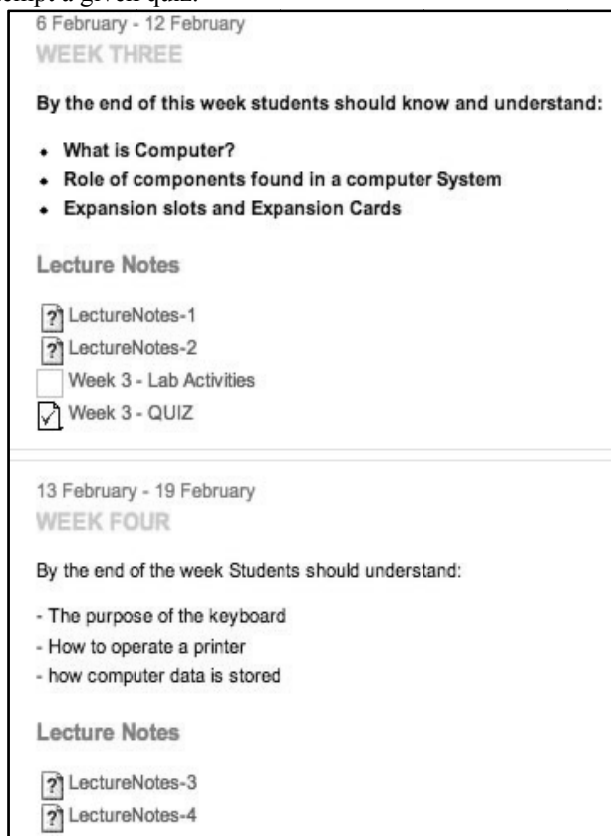
Fig. 2. A snapshot of the CS content of week 3 and 4.

III. ICT IN EDUCATIONAL INSTITUTIONS IN TUVALU

A. Primary Institutions

In all the primary level of institutions in Tuvalu, ICT has not yet been fully introduced to the full extent where both students and teachers can enjoy and experience success. Currently, in all the primary institutions of the islands only about 3-5 computers and a printer have been deployed to each school for teachers use only. These computers are to be used for typing examinations and preparing class work. However,

in the capital island, Funafuti, a computer lab has been organized, also for teachers only, with about 8 PCs and a printer. This is the primary institute with the most number of student's enrolled with up to 938 according to [8].

B. Secondary Institutions

There are two main secondary institutes in Tuvalu. One is owned and run by the Tuvalu Church, and the other one by the Government. The Church owned secondary institute, Fetuvalu High School (FHS) follows a syllabus from Cambridge in England. MSS, the Government owned institute, uses the Tuvalu Ministry of education system's syllabus. It was very fortunate and with great timing that ICT in secondary education happened to be extended to the students with the introduction of the Computer Studies (CS) subject for the form 5 and form 6 levels only. Therefore, having implementing this e-learning within the school could be a great beginning for the CS subject history and hopefully other subjects too. Currently, there is only one computer laboratory with 20 PCs available for the students to use. Another small computer room for the teachers with only 4 PCs is also available at the moment. However, the church institute is yet to extend ICT to the students. It is to be hoped that this pilot e-learning would help them witness and decide to extend ICT to students.

C. Augmented Foundation Program (AFP)

The AFP has been introduced by the government for students who finish high school/senior high school before entering tertiary level/universities. The Ministry of Education uses AFP as a filter to check eligibility for university entrance. According to [9] the AFP students performed poorly with a 51% completion rate. Many reasons have been raised about this issue, an obvious one being the lack of computer experiences and skills of the students. Therefore many of them neglected to attend schools and complete their studies because most of their school activities required computer knowledge which they were lacking in. It is here that a digital gap between high school/senior high school students and the AFP even to the tertiary level was witnessed.

IV. RESEARCH METHOD

During the implementation stage some workshops were held to train the teachers in operating the LMS, Moodle 2.0. The teachers were then given a question to survey their confidence level with operating the Moodle 2.0.

A training workshop was also held for the students to familiarize them with the Moodle 2.0. Basics skills were taught and revised. In the end of the final week throughout the trial period of the e-learning system from the third study period of August 22 to November 25, 2011, a questionnaire was also given to determine their responses to the training and their thoughts about the implementation of the e-learning system, with areas such as; the contribution of the system to improving their computer skills, making learning convenient, fair marks of quizzes, flexibility of learning, identify their weaknesses/strength and if it gives them any motivation and enjoyment of study. During the first academic term from January 25 to April 23rd, 2012 the same questionnaire was

also sent to the students to review their experiences with the Moodle 2.0 system.

Alongside the training workshops an open online survey from a website was prepared by the author [10], with the aim to collect responses from random people in the whole of Tuvalu of how many would support the implementation of e-learning in Tuvalu.

Sample population size

Form 5 students = 23,
Form 6 students = 22,
Teachers = 19,
Volunteers = 59.

V. RESULTS AND DISCUSSIONS

A. Teacher's Workshop Training

The 19 teachers were given the questionnaire with the 5 Likert scale to identify their level of confidence operating the Moodle 2.0 system.
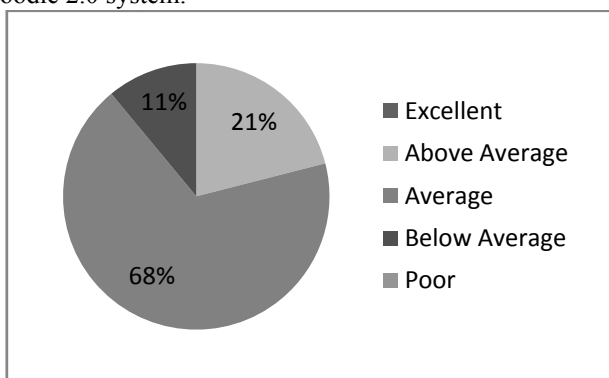
Fig. 3. Level of confidence in using computers.

As indicated on the pie graph in Fig. 3, 89% of the teachers are well in the 'average' and 'above average' level with their confidence level. However, only 11% of the staff where feeling less confident after the training.

B. Subject Content in the Moodle 2.0 System
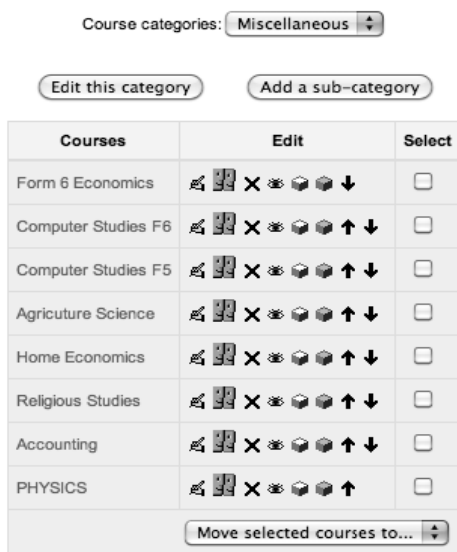
Fig. 4. Courses available in the moodle 2.0 system.

The initial focus of the subject content was only the Computer Studies (CS) subject. However it ended up that the Moodle 2.0 system is currently running 8 subjects in total with well designed content by the teachers, as shown in Fig. 4.

This great result shows that out of the total number of the teachers that were trained 42% of them took the initiative and opportunity to create their courses. This is a very successful progress given this is only a pilot e-learning implementation, and considering the limited infrastructure that is currently available.

C. Online Survey

The purpose of this websites was to find out what the public/Tuvalu citizens and other interested viewers outside Tuvalu would think about having e-learning implemented in Tuvalu for the first time in all locals' educational institutions. Therefore, the questionnaire adopts the similar e-learning knowledge scale in [6].

According to the survey most of the respondents fall in the 'good' knowledge of e-learning as shown in Fig. 5. Well above 58% of the respondents are familiar with e-learning. This shows the awareness level of e-learning is in the majority of the respondents, which are from the Tuvalu government civil servants. Here, the potential that the e-learning system in the eyes of the Tuvalu Government is quite a clear one. So, the formal implementation of e-learning in Tuvalu educational institutions would be very easily supported by the majority.
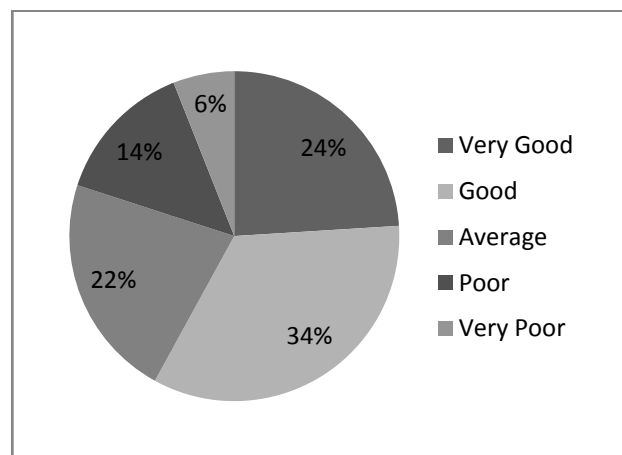

Fig. 5. Percentage of knowledge level of e-learning.

D. STUDENT results From Survey Questions – Last Week of the 3rd Term Academic Period, 2011.

The survey results for this period which was also the first period of the pilot system shows in Fig. 6, that 100% of the students 'strongly agreed' or 'agreed' that the e-learning system contributes to improving their computer skills. About 87% also 'strongly agreed' and 'agreed' that it gives then motivation and enjoyment of learning and studying. Also the other four items of the questionnaire of learning convenience, fair marking of quizzes, identifying their weaknesses and strength, and makes learning flexibilities where well above 60% of the students responded 'strongly agreed' and 'agreed'.

While most of the items in the questionnaire were identified and responded to positively, a slight percentage of 19% students who responded 'disagreed' in fair marks of quizzes and learning convenience, and about 30% 'disagreed'

in learning flexibility of the system. These were due to the fact that some of the students still have not gained confidence in using computers, and the same reason goes out to the 'undecided' students' responses.

E. Student Results From Survey Questions – Middle of the 1st Term Academic Period, 2012.

The survey results for this second period of the pilot system, the result shows in Fig. 7 were practically similar but with a more positive response to each item in the questionnaire, with 100% of the students this time 'strongly agreed' or 'agreed' that the system contributes to improving their computer skills and increasing their level of motivation and enjoyment of learning and studying. About 90%

and learning flexibility. This reason is due to the facts that their accessibility to the computer rooms is not really flexible and the inconvenience of the electricity for 24 hours. This really proves the inadequacy of the infrastructure available and currently in place.

However, the 'undecided' students still remain with the reason that they are still coming into terms with their confidence level and skills in operating computers. This means that time could only tell that they would be very familiar with computers with more exposure to this e-learning system and learning from their peers' everyday during their schooling times.
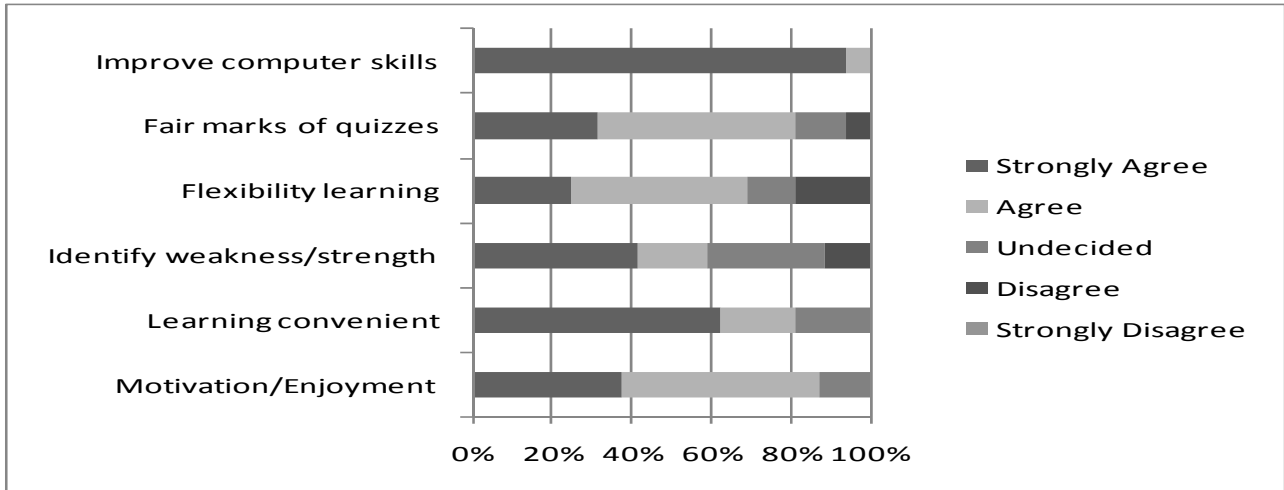
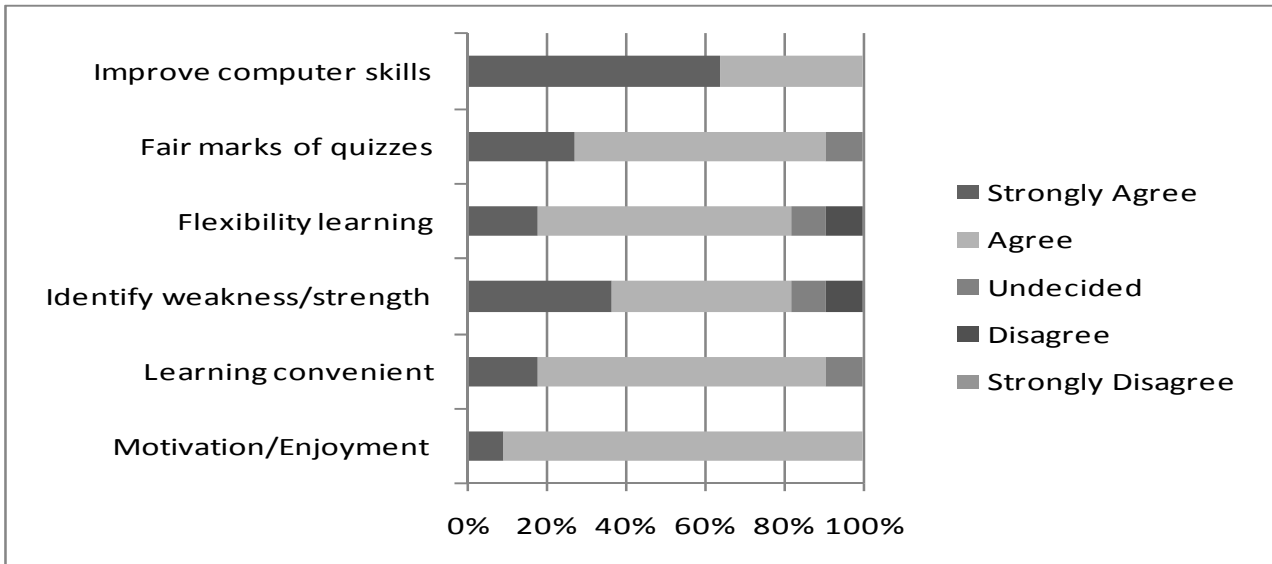Fig. 6. Students' respond results from the initial pilot period from August 22nd to November 25th, 2011.

Fig. 7. Students' respond results from the second pilot period in the middle of the study period from January 23rd to April 23rd

'strongly agreed' or 'agreed' that the e-learning system had fair marks of quizzes and made learning more convenient for them. Also 80% 'strongly agreed' or 'agreed' to the flexibility in learning and identifying their weaknesses and strength.

In contrast to the previous results of the responses from the first trial period, surprisingly in the responses of 'disagreed'; it shows that only around 100% of the students disapproved of the system in identifying their strength and weaknesses

VI. CONCLUSION

In conclusion, the implementation of this e-learning pilot system has shown the potential for using e-learning as an instructional tool to deliver content and learning experiences in educational institutions in Tuvalu. Further exposure of both students and teachers to the system will continue to enhance their levels of computer skills and knowledge. It

will provide them with a greater range of subjects to choose from and will also increase their confidence and potential to be ready and eligible to enter tertiary levels of education

The enormous advantages it will bring to the teaching/learning process have been recognized. The Education Department immediately requested to have an official e-learning program running as soon as possible.

Therefore, the initial proposal for an e-learning program in Tuvalu will officially be in operation in the near future after the completion and approval of policies which are currently being collaboratively reviewed.

However, the decision to officially implement the e-learning system requires further detailed studies to be undertaken. The structure of the e-learning program from and to all educational institutions in Tuvalu is now a priority area for the Department of Education to develop.

Therefore, it is crucial that further research be continued in this area so that the best possible quality programs can be produced and implemented. E-learning covers such an extensive field and, as such, may require some time to fully develop, especially in a LDC such as Tuvalu.

Follow-up research in this area will be required to ensure continued success in the implementation of a fully functioning, high quality program for the educational institutions of Tuvalu.

VII. FUTURE WORKS

Possible areas for further research in this field which could make an important contribution towards its on-going success may include:

- Ongoing review and assessment of the quality and content of students' activities, such as the on-line quizzes, to ensure that they are regularly updated and in line with the current curriculum.
- Installation and running the synchronization technique to test updating and upgrading Moodle content from each Moodle site.
- Professional development opportunities for students and staff to update their training and empower them in the use of the Moodle e-learning system as they need to become exposed to new LMS.

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