Proceedings of IOE Graduate Conference, 2015
pp. 298–304

ARM Based Computing Technology for Sustainable Development (Performance Analysis on E-Learning)

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Abstract
E-learning is implemented and granted all over the world by many government, NGO and INGO's. Education with ICT has improve the learning methods and techniques with more interactive, student oriented and effective ICT based learning environment. In Nepal, OLE Nepal has implemented E-Learning project in association with OLPC and some other organizations. This research aims to finding out the relative performance of ARM Processor based OLPC which was deployed in public schools of some district in Nepal by OLE Nepal. So that either it is very effective to Nepalese students or students are not able to grabbing more knowledge and skills from this ARM based computing devices -OLPC. This learning methodology utilizes and harvest computing power from ARM based processors with custom build laptop which utilize less power than the traditional x86-64 bit processor. Which is the part of sustainable energy consumption and development. This research used qualitative research methodology with survey type of research method to determining the relative performance of e learning. After analysis the Nepalese scenario of this learning and teaching methodology, performance analysis and effectiveness of E-Learning with some direct/ indirect benefits will identified. Necessary improvement on the E-learning process and systems based on OLPC will suggested so that the overall performance of the student on E-learning will increased or improved.

Keywords
OLPC – laptop XO – ARM Based Computing Devices – E-Learning – ICT for Education – Pervasive Computing

1. Introduction

This research aims to analyze and find out the performance and effectiveness of the specific small end computing environment with the enhancement of ARM (Acron RISC Machine) based processing system for the E-learning. The OLPC (one laptop per child) are already installed for the ICT based education in public and private school on the urban and rural school of Nepal. By the help of already specified characteristics and features of the ARM processing unit by the manufacturer and researcher this research find out the performance of computing system on the rural society for the sustainable development and computing arena .

ARM put a lot of effort into various areas to ensure the Cortex-M0 processor could reach its low power-consumption target[1]. These areas include the following: small gate count, high efficiency, low-power features (sleep modes), logic cell enhancement, advance instruction pipelining and processing [2].

ARM Processor are becoming the part of the development and increasing the ubiquitous computing environment. This family can play vital role for the sustainable development. In the developing countries this family of processors are used for e-Education, e-medicine, industrial purposes, telecommunication, ICT (information and communication technology) for education, ICT for agriculture etc.[3]. This uses can reduce the dependent of the large RISC processor architecture (64 bit processor) to the 32 bit processor with most of the computing capability [4].

There is a common misconception that ICT-based Education is about teaching students computer skills. ICT-based Education is about using computers and technology as tools to enrich learning in various subjects such as English, Science and Mathematics. The computing

devices (laptops) for Rural area with new features which makes it a more suitable device for the rural public schools in terms of Processing capability, power consumption and user compatibility. It runs on ARM based processor which makes the laptop a much faster machine than the previous versions. It has more memory, storage and speed and consumes 40% less power and has a touchscreen feature [5]. Using low power Raspberry Pi's as digital library clients which is helpful to improve the quality of the E-Pustakalaya (E library) contents and efficient devices for digital library setup that uses low power. At present, the system-on-chip (SoC) devices like Raspberry-Pi and Odroid as low-cost low-power alternatives are used to provide easy access to resources at schools. Odroid is powerful enough to replace current school server and the setting up E-Pustakalaya (E library) server on an Odroid device is not complicated tasks.. This system can power up the whole computer lab with 10 to 12 Raspberry-Pi devices with a moderate sized battery without having to use power Inverter so that power conversion loss is zero [5].The overhead Solar P-V cell system can give sufficient power to the computing devices which is the relevant sources of renewal energy.

While Computing Power on the field of Agriculture the ARM based Embedded System Platform can be the efficient solution. In the space constraints of the traditional agricultural environment monitoring system, a small database called SQLite has to be transplanted into the ARM and Linux operation which could store and manage the field information. Users can get information anytime and anywhere through the GSM (Global System for Mobile Communication) network and the WSN (Wireless Sensor Network). In this design, instead of the inquiring from the PC (Personal Computer) which was widely used now ARM based Computing Environment is used. Sensors embedded in the environment, information spread in the air and capture by the handheld instruments, which is a typical application of pervasive computing [6].

This research is done for performance analysis on E-learning with ARM based computers-OLPC, which was distributed/implemented free of cost by the OLPC-OLE Nepal(Open Learning Exchange Nepal) project to different district's public schools of Nepal. This research has utilizes survey type of research and for survey two schools of Lalitpur are selected which have 124 and 86 number of OLPC distribution to students up to class 6. Students are used OLPC with bringing with their hone in initial phase , but after careless and misused of OLPC, OLPC are bring back it schools and a OLPC lab was established with running lab weekly for some hours for students to get information and knowledge from the devices. OLPC was distributed after teachers are trained , teachers were teaching through OLPC for relative teaching subjects like Mathematics, English, Social, Nepali, etc. the materials was developed by the OLPC-Project and different Government Organization, NGO and INGO's. Different types of e-learning materials and tutorials was developed and installed on OLPC. Materials are been accessed through Offline and some are accessed through online via internet connection and Local Area Networking Setup.

This research aims to find out the student performance in terms of relative results, skills and knowledge while they are issuing the OLPC from past two years and as traditional methodology in which they are also studying on white board for some subjects. It will be the findings of this research about student relative performance without the OLPC and after getting OLPC. What is its effectiveness of learning materials, how they feel, interact, behave through OLPC.

This research has been done at two schools of Lalitpur with stakeholders of e learning systems with teachers, administrators, students and views from parents of students where the OLPC has been deployed from past more than three years. This research done with survey type of research with students, OLPC-teachers and school administrations. A set of questionnaire was prepared with Multiple Choice questions and provided to students of class six on both schools to choose the appropriate or best answers. Along with students, teachers and administrations are also provided with relative questionnaire. Direct interview with the major stakeholders are also done for the research. After the qualitative data collection, the data are analyzed and interpretation with different mathematical tools, excel tools is applied for proper analysis and representation of obtained data. Pie charts are formed from each questionnaire of data collected and further analysis has been done respectively.

2. Methodology

The Research Followed the Qualitative Research Methodology with method of surveying for data collection. While Analyzing the Collected data graphical representation techniques are followed. Major stakeholder of E-learning are provided with the research questionnaire with multiple choice of answers. The Survey has been done in normal setup of class room and offices. Total 25 students, 5 teachers and 3 administrators are requested for filling the questionnaires and a short interviews has been done with parents of the students. Each stakeholder questions consists of mostly used e-learning methods, materials, relative difference on the learning process, understanding of the classes, and improvement in learning and teaching processes, and adoption of the e learning methodology by the students, teachers, administrators and parents. All the answer provided by stakeholders are the key content of data and analysis.

3. Analysis

This research has been done with students, teachers, and administrators of the school by distribution of multiple choice questions form for appropriate fill-up. It was collected and formulated for analysis through different mathematical and excel tools. Graphical representation represents data in accurate and analytical manner. All the collected data are represented with pie-chart representation and analytics are done. Some of the major analytics with e learning difficulties, improvement on learning and teaching processes, difficulties on methodology adoption and relative changes on the results of the students. Analysis has been done on the basis of students, teachers and administrator survey responses stated and presented below.

3.1 Student Survey Analysis:

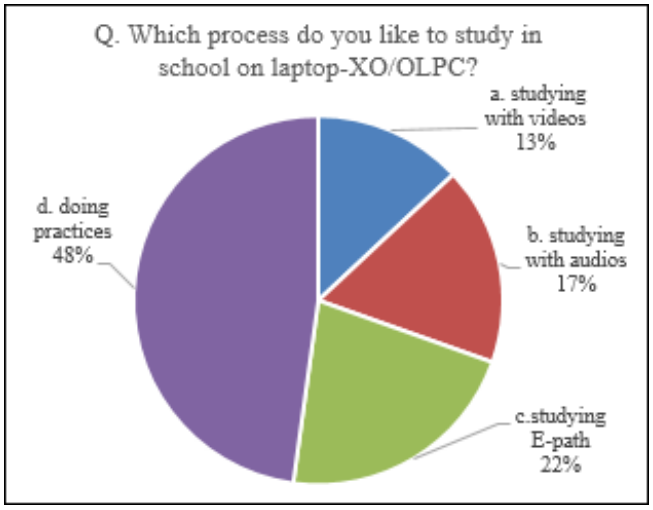

Figure 1: Selection of mostly liked different process and materials by students

Student Survey Analysis state that students are getting more knowledge with OLPC, they did many practices, understand classes more effectively than the conventional learning methodology.

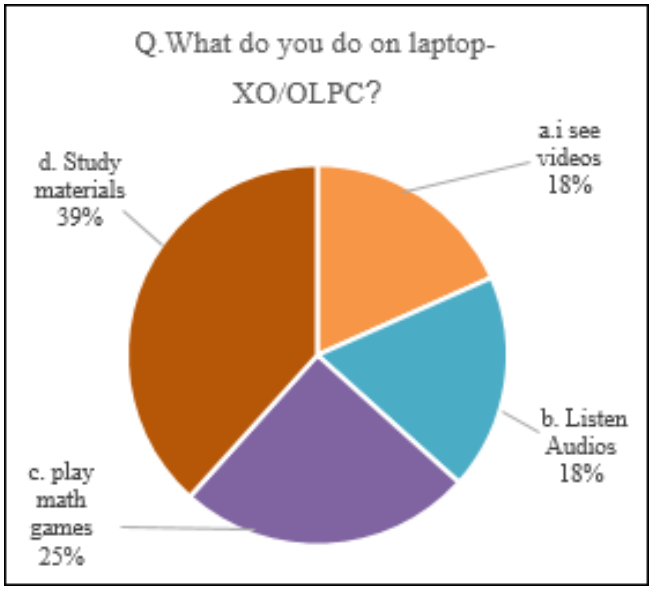

Figure 2: Student involved different types of exercises on OLPC

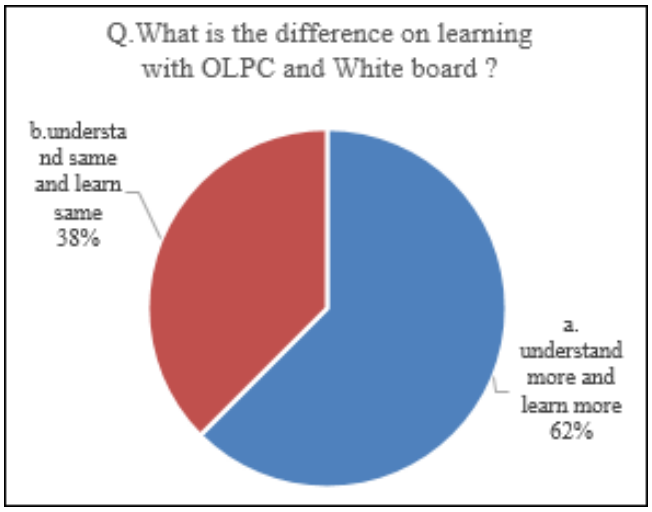

Figure 3: Measure of differences between white board and e-learning method

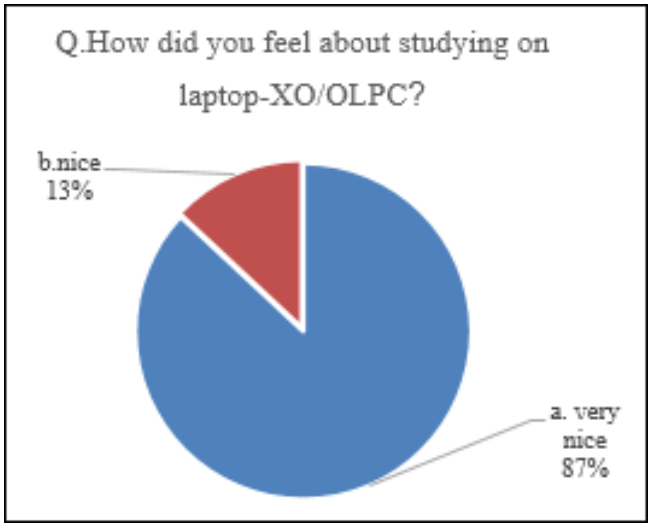

Figure 4: Feelings of student while getting and studying olpc

3.2 Teachers Survey Analysis:

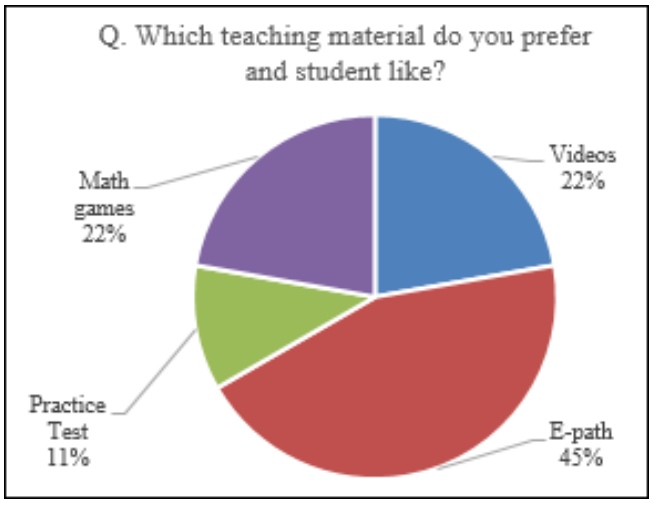

Figure 5: Teacher preference learning materials

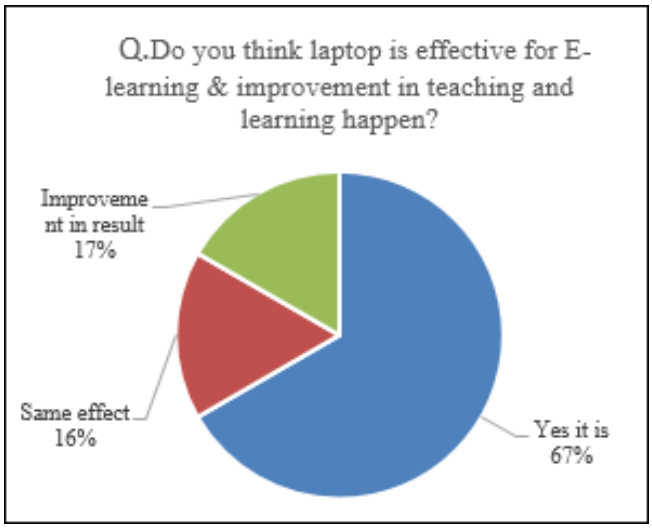

Figure 6: Relative measure of effectiveness and improvement in learning

Teacher survey analysis state that they have also adopted E -Learning easily. They prefer E path (e lesion), videos and math games mostly as well as practice tests which was preinstalled on OLPC. According to the teachers response the OLPC is effective for e learning which helps students for improvement in learning process and they become more interactive. So the overall performance, problem solving skill, understanding the classes of students has been increased.

3.3 Administrator Survey Analysis:

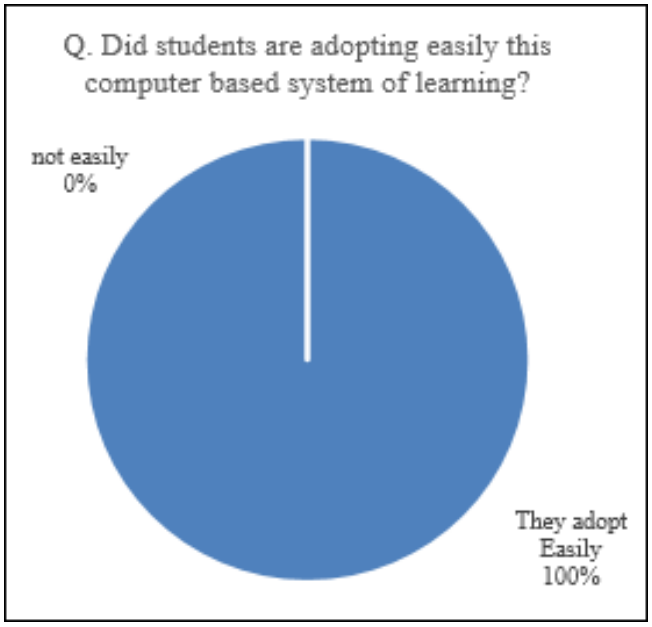

Figure 7: Representation of adoption of e learning methodology by students

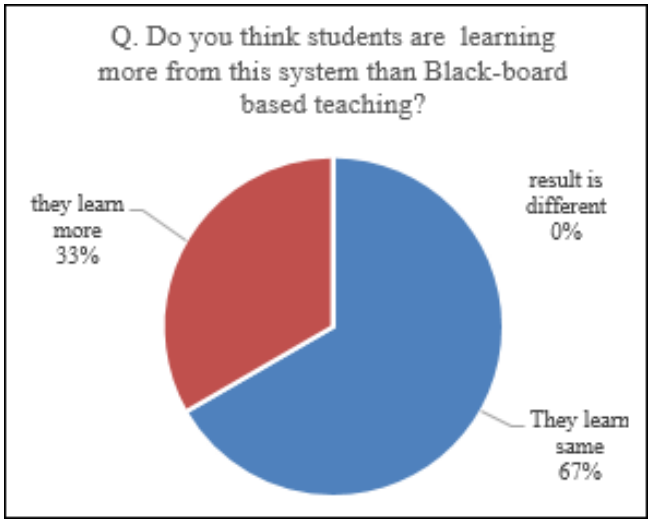

Figure 8: Comparision of board based teaching and OLPC based teaching

In the figures 7, 8, 9 and 10 administrator survey analysis has been done from that we can state that the students are being learning more, the results of students in exams have been improved but students are not doing well as expected. They think the OLPC might improve on results and learnings. Another finding from them is OLPC improves on computer and problem solving skills of students which might also help them for their studies.

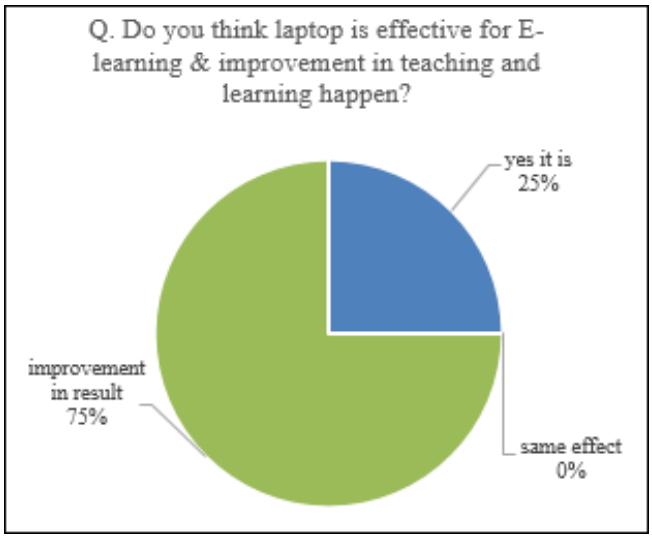

Figure 9: performance evaluation of e learning with administrator perspectives

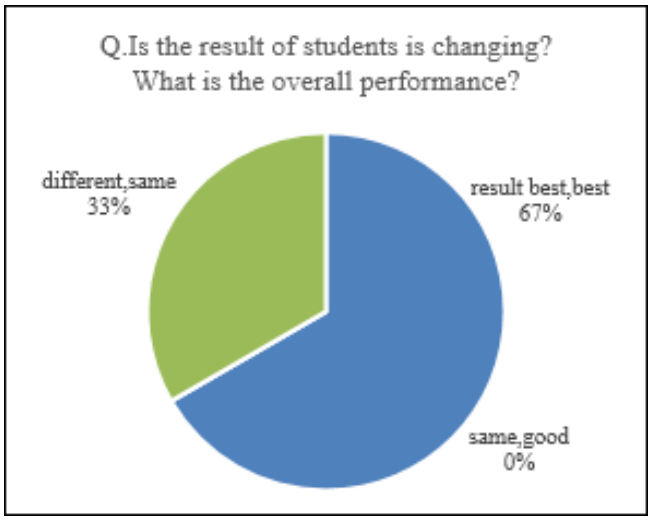

Figure 10: Result and overall performance measure of student

4. Interpretation

From the above analysis we can interpret the performance of the e learning environment. The graphical representation of each major questionnaire from teachers, students and administrator about their adoption difficulty, learning materials availability/interest, teaching methods, environment, OLPC fault occurrence and effec-

tiveness in terms of learning was determined and analyze from the analysis process.

This research interpret data with different analytical conditions/graphs from teachers, students, administrators to exact determine the condition as well as performance of the system. From the analysis , the review of all stakeholders can interpret about the improvement on learning and teaching processes, methodology adoption processes, changing performance , examinations results, improvement in student interactive skills, communicating skills, information and knowledge upgrade through offline and online learning material and also by internet surfing. This all parameters of learning with measure of math test, practice exams with results update after completion, games , e path(e-lesson) and all learning material makes learning process more effective, teaching more interactive and total knowledge acquired by the student is comparatively more than the previous conventional learning method without OLPC.

Students acquire more knowledgeable information through materials on OLPC, teachers feel and finds students are getting more information/knowledge some improvement in their results while on e-tests they get maximum improvement in results, teacher prefer mostly the e-path and they feel the improvement in teaching and learning happen with more effectiveness. Administrator stands that students are with better analytical skills and better performing on their examinations, learning faster, become cleverer, more interactive, improved and they develop effective problem solving skills.

5. Discussion

From this research analysis, this can be stated that the total performance of the students was increased, improved and skills are better than the conventional (white board) based learning method/techniques. Students are more interactive, their thinking skills, learning and communicating with teachers, parents was better. But due to lack of proper monitoring, updating systems with latest relevant learning materials performance is not improved well, for improvement on performance those are the necessary requirements. In learning process proper guiding and direction, interaction from teachers was the major part as well as parents have to be more conscious and careful about their children's study, So parents as well teachers has to be aware and their views about e leaning has to be enhance through trainings and other awareness programs. Adoption of e learning process is quite different and difficult, but students are adopting and grabbing knowledge very fast from OLPC which bring better comparative results outcomes than previous learning methodology.

6. Conclusion

In this 21st century of computers and computing technology this e learning methodology also helps student to understand the implications of Information and Technology in the real life. This also reduce the ratio of Digital divide and increases the technology based literacy rate. So the performance and benefits of this methodology are direct and indirect, while direct as stated performance of the learning, teaching process and material has been increased. In indirect this methodology increase the digital literacy which is major part of development of nation and it helps to build the foundation of digital society, nation with consuming less energy and manufacturing materials.

This research determine that the total outcomes and performance was improved/ increased and better however, it is necessary that some change on environment, continuous monitoring, maintenance and proper involvement of each stakeholder of e learning is necessary. So that it has to be adopted by stakeholders automatically for the continuous operation and functioning of the system as well as to increase in performance, computing skills of the students. More and more implementation of such type of system increases the sustainable societies on the basis of computing technology.

7. Recommendation

Designing the revised and effective learning materials on OLPC so that the performance of the student can be improved this can be done on further research work which is not covered by this research.

Acknowledgments

The authors are grateful to Prof. Sudarshan Raj Tiwari and Administrators, Teachers and Students of Siddeshor LSS, Navajyoti SS Lalitpur, OLE Nepal and Sandesh Chaulagain.

References

[1] Andrew N. Sloss, Dominic Symes, and Chris Wright. *ARM System Devloper's Guide*. Morgan Kufmannl, 2005.

[2] Steve Furber. *ARM System-on-Chip Architecturel*. Addison-Wesley, 2nd edition, 2000.

[3] Hameed Ahmed Khan. Sustainable devlopment and information technology. *Science vision*, 2010.

[4] David Abdurachmanov, Peter Elmer, Giulio Eulisse, and Shahzad Muzaffar. Initial explorations of arm processors for scientific computing. *Computational Physics (physics.comp-ph)*, pages 1–3, 2013.

[5] OLE Nepal. Ole newsletter, 2013.

[6] Hu Zhao, Sangen Wang, and Dake Wu. Perasive agricultural environment monitoring system based on embedded database. *IFIP Advances in Information and Communication Technology*, pages 166–176, 2011.

[7] David Seal. *Free ARMv7-AR, ARMv7-M, ARMv6-M and ARMv5 Architecture Reference Mannual Downloads*. Addison-Wesley Professional, 2004.

[8] Joshep Yiu. *The Definitive Guide to the ARM Cortex-M3l*. Newnesl, 2009.