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Improving Performance of Science Subjects in TVET Institutions by Computer Supported Collaborative Learning: Reference to Uganda

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Abstract

This study was aimed at finding out why there was high rate of failure of science subjects in Ugandan higher education Institution of learning, proposing the way to improve students' performance and find out whether students support and use the proposed model. The students' failure in science subjects has been attributed to lack of science laboratories, lack of teachers in basic teaching strategy, failing of girls' students in business Technical and Vocational Education and Training (BTVET) examinations because of pregnancy. Moreover, the students' fail in science subjects because of lack of interest, inadequate practice; lack of practical materials, long distance from school and home, and also the poverty of the country hindrance the economic development. Most of the skill Engineers and Doctors are hired from outside of the country. Computer-Supported Collaborative Learning (CSCL), as methodology of teaching and learning may address all these problems in Uganda. A survey was taken within three secondary schools and three (BTVET) institutions and it was found that 85.6% of both Secondary schools and(BTVET) institutions were in support of using(CSCL) in the their institutions while 20.5% of both Secondary schools and(BTVET) institutions were using (CSCL) in the their institutions and at home.

Keywords: Science Subjects, TVET, Computer Supported Collaborative Learning (CSCL).

Introduction

According to Bloom education is widely accepted as an instrument for promoting economic growth [4]. Education was highlighted in Uganda's Poverty Eradication Action Plan [2] as one of the mechanisms for enabling poverty eradication in the country. And progress in science subjects helps students take on Technical and skilled courses which according to the Education minister Jessica Alupo (2013) was the sure way to curb youth unemployment. The quality of education is highly dependent on how well students are taught and how much they learn [10]. This can subsequently have an impact on how long they stay in school and how regularly they attend.

The objectives of the study were (i) to find out reasons why many students fail science subjects in Uganda and end up choosing a wrong career and (ii) to show that CSCL can be used to make students improvement in their science subjects.The scope of the study covers upper secondary schools and then Technical and vocational institutions in Uganda. The goals for the development the paper was to ensure Youths are empowered with Knowledge and Skills through science and technology in order to ensure Employment in the country.

Recent Reforms Towards Business Technical and Vocational Education Training Institutions (BTVET): Uganda has undergone a number of reforms to enable it to step up to this enormous task. These reforms include: (i) UniversalPrimary Education (UPE) as recommended by the Education Policy Review Commission (1989); (ii)Uganda Post Primary Education and Training/Universal Secondary Education (UPPET/USE) started in 2007(iii) Uganda Post Primary Education and Training/Universal Secondary Education (UPPET/USE)started in 2007 (iv) The BTVET Act 2008 which relieves Uneb of the examination duties and introduces the UgandaBusinesses and Technical Examinations Board; (v)There has been increased awareness and acknowledgement inGovernment of Uganda, the public and among development partners on TVET issues and their importance foreconomic and social development aspirations of the country; Legal strengthening of the Vocational QualificationFramework (UVQF) and the increased acceptance of this framework. (vi)The ongoing development of TVET standards

(related occupational profiles, assessment instruments, and modular curricula) based on the Uganda'sVocational Qualification Framework (UVQF); More than 80 TVET institutions offer employment-oriented vocationalorientation programs for school leavers; (vii) The Uganda Association of Private Vocational Institutions UGAPRIVIhas experienced the increase in members (in total now more than 250), the higher training and consultancy demandfrom members, the increased training of trainers efforts, and the improved regional outreach. (viii) The testing of newinformal TVET approaches (e.g., 'LearnNet Uganda': self-organized and self-financed learning groups) hasexperienced a high share of female participants, some income improvement of trainees, and significant increase insocial capital; - Establishment of new strategic partnerships with other development partners in the TVET area.

Composition of Business, Technical and Vocational Education Training Institutions (BTVET): BTVET institutions comprise of Community Polytechnics, Farm Schools, Technical Schools, Technical Institutes, Vocational Training Institutes, Technical Colleges, Uganda Colleges of Commerce, Health Training Institutions and other Specialized Training Institutions that include Agriculture, Forestry, Fisheries, Wildlife, Meteorology, Survey and Cooperatives [10]. Uganda's vocational education system is three–tiered so one can join a BTVET institution on completion of primary school, after O' level and at tertiary level. Primary school leavers can enroll for three-year full-time courses, leading to the award of a Uganda Junior Technical Certificate. Students who have completed O' level can also obtain a craft certificate (Part I and II) from technical institutes on completion of three-year full-time courses. The Institute of Teacher Education, the Uganda Polytechnic, the National College of Business, four technical colleges, five colleges of commerce, and 10 national teachers colleges and many private technical and Vocational institutions are administered by the Ministry of Education [3].

*Educational Structure of Uganda:*Pre-primary and nursery education is for children aged 2/3-5 years; attendance is not compulsory. They are mainly in the private sector and urban areas [15]. Primary education lasts seven years and in principle it is free and compulsory for all children aged 6 [15]. According to the new curriculum (2010), primary education is divided into three phases: lower primary (grades 1-3 or P1-3), transition year (grade 4 or P4), and upper primary (grades 5-7 or P5-7). At the end of grade 7, pupil takes the Primary Leaving Certificate examination. The Universal Primary Education (UPE) programme was introduced in 1996. Secondary education, leads to the Uganda Certificate of Education (UCE) examination, the second two-year cycle, or upper secondary education, leads to the Uganda Advanced Certificate of Education (UACE) examination (previously the GCE A-level). The UACE is the principal examination required for university entrance and other tertiary level education. Business, technical and vocational education and training (BTVET) is offered at community polytechnics, farm schools, technical schools and institutes, vocational training centres and technical colleges. At the lower secondary [4] level, farm and technical schools as well as vocational training centres offer three-year programmes (four-year programmes in the case of community polytechnics) leading to the Uganda Junior Technical Certificate or Trade Test Certificate, Grade 2 – DIT-T.T.II. At the upper secondary level, technical and vocational training institutes offer two-year programmes leading to the UNEB Craft Certificate DIT-T.T.I. Primary Teachers Colleges offer two-year programmes to UCE holders leading to the award of the Grade III Teacher Certificate, which is the minimum qualification for teaching in primary schools.

Literature Review

*Academic Process in Ugandan Higher Education Institutions:*Academic years begin October 1 and end on June 30, or August 30 for four term courses. During the first year of study each student must take and pass three subjects before being allowed to advance to their second year of coursework [10]. Lectures, discussions, and laboratories are supplemented with tutorials and library studies, research, and practical training. Undergraduate students have facilities for relaxation, sports facilities, chaplaincies, health care, and opportunities to participate in student government and social clubs. The science courses are offered in fields such as medicine, dentistry, veterinary science, agriculture, engineering, commerce, statistics, forestry, physics, chemistry, biology, zoology, environmental studies, mathematics, and computer science.

Quality of Science Education in Uganda: Quality education cannot easily be exclusively defined. Irwin (1967) defined quality education as the maximization of the schools' systems performance and ability to: (i) Prepare students for the adult role as citizens; (ii) Train them to fill an appropriate adult role; (iii) Develop personality, especially inter-personal skills; (iv) Remove the recipient from an unemployed status. Enrolments and performance of science [6] students at

different levels to a large extent reflect the quality of science education therefore we need to take a look at Uganda's previous year performance in various science subjects at different levels [9].

Science Performance in Primary Pupils: The Uganda National Examinations Board (UNEB) grades performance ranging from the best (distinction one) to the worst (grade X). If a pupil scores pass 8 or worse in Mathematics or English, then they will drop a grade lower in the overall ranking. Performance in sciences at this level has consistently been very poor as has been reflected in PLE results. Statistics from UNEB show that far fewer pupils score distinctions and credits in mathematics than those who fail. The data further reveal that most pupils are clustered around the 'pass' grade. Performance in science has been equally poor although an improvement was registered in 2009. Of the pupils that were registered to sit for the science examination, 0.7% scored D1 while 14.8% obtained F9. The majority of pupils (17%) scored C6. Compared to mathematics performance in the period 2005-2009, pupils performed better in science.

*Science Performance in Lower Secondary Ordinary "O" Level***:** Majority of students who sat for the UNEB examinations between 2005 and 2008 scored failures in the core sciences with chemistry and physics being the worst performed subjects. During the same period, the performance in Arts subjects was better than mathematics; In general, students are mainly failing the lab-based courses of chemistry, physics and biology Students in O' level study a wide range of subjects (up to 20 in some schools) within a limited period of time, which subsequently leads to a more theoretical coverage of the subjects. Due to the design of the curriculum, time constraints, inadequate facilities and inappropriate pedagogy, practical teaching is not usually done, resulting in students developing apathy towards science subjects. The quality of science education at this level is to a large extent affected by the curriculum design.

Science Performance in Upper Secondary Advanced "A" Level: Data for the period 2005-2008 shows that science subjects occupied the last four positions out of the best eleven subjects done by students at this level. Poor performance in sciences at A' Level can be attributed to a lack of career guidance, poor practical preparation at O' Level and inadequate infrastructure, among other factors. Science performance by students in rural areas is worse than that of their counterparts in urban schools. According to Womakuyu (2009), 50% of the students in urban schools passed sciences while 80% of their rural counterparts had low grades or failed sciences altogether. Urban schools balanced their performance in both arts and science subjects, but these represented only about 20% of the schools that sat UACE in 2007. Overall, schools outside the central region posted better grades in the arts subjects, with about 80% failing sciences. Schools in rural areas have inadequate science teachers (quality and number), equipment, exposure, and some of them get to handle laboratory glassware for the first time during their final national examinations.

Performance in BTVET: In UNEB report 2010, about half of all BTVET registrants for UNEB examinations failed to pass their examinations. In 2012 BTVET exams report, there was average 50% pass rate, however ministry's drive of skilling Uganda' registered a drop down when 2012 saw a sharp decline as only 13,637 sat for exams compared to 30,827 in 2011. In 2011, with support from the Belgian Development Cooperation and the World Bank, Uganda designed a new Strategic Plan for Secondary Education and Business, Technical, Vocational Education and Training (BTVET) under the name 'Skilling Uganda'. The main aim was to raise standards and expand coverage of training, and to create employable skills and competencies relevant to the labor market instead of educational certificates but the increased failure rates in science subjects remain a challenge to the strategic plan. In 2012, a new project was launched to improve the quality of teaching in secondary education and BTVET through the support of teacher and instructor colleges in the country.

*Reasons why students fail science subjects in Uganda:*UNEB Executive Secretary Mathew Bukenya (2012) said the poor performance was mainly due to ill-equipped laboratories and lack of time given to students to have practice before the exams. While many private schools have no laboratories, some have laboratories without the necessary equipment. The government schools that have both laboratories and equipment were found not to have utilized them properly. As a result, many students met the scientific experiments for the first time in the examination. "…although most schools (especially USE schools) have adequate laboratory chemicals and apparatus, the laboratories are more of stores than rooms for science practical work," MrBukenya said: "The non-use of these facilities results in lack of practice by the candidates."Wilson Oringor, a tutor at Uganda College of Commerce, Tororo, noted that students fail business calculations due to lack of mathematical skills. The teachers who teach are less experienced and lack enough skills to ensure teaching and learning of such subjects. Therefore the students end

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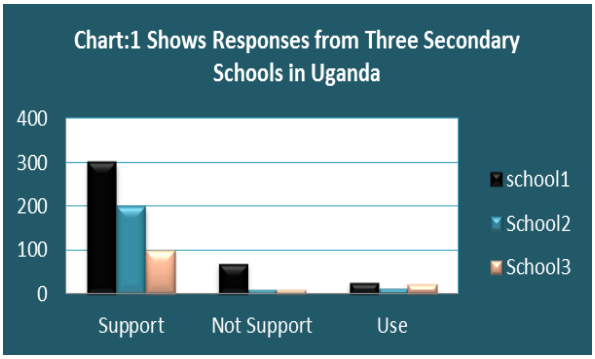
up less confident in the subjects. Others pushed the blame on the fact that most students who register for BTVET certificate courses are "*academically very weak*".

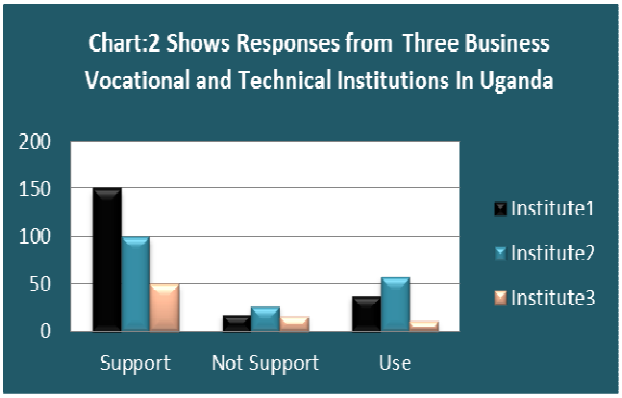
Day students travelling long distances before arriving in school decreases their productivity since they arrive in school already tired. Participation and performance in any subject is then hampered.Tutors have attributed the high failure rate among girls studying business, vocational and technical education training (BTVET) certificate courses to pregnancies and maternal problems. because more than half of the female candidates who sat for business and technical exams last year in 2012, according to the results released by the education ministry. The results indicate that 932 (57%) of the 1,639 female candidates compared to 46% of their male counterparts failed the exams.The poor science infrastructure in schools and the teaching and learning methods those are largely theoretical.

Methodology

A survey was conducted in (3) three secondary (Jinja S.S,Mbogo S.S andKiira High School) and (3) three Business, Technical, Vocational Education and Training (BTVET) institutions in Uganda, focused at knowing whether students use *(CSCL)* and were in support of the use of *Computer-Supported Collaborative Work and Learning (CSCL)* or not. Majority of the students did not know all about *(CSCL)* but when the teacher and the researcher explained it to the students as described above, the students got the clear idea *(CSCL)* and some realised that they had been using that kind of learning at home and at school, on that basis the researcher supplied questionnaires to the students to respond either in support of *(CSCL)* or not in support, results are shown in Chart 1 and 2 below. In the three secondary schools studied, 86.9% of the students were in support of *(CSCL)*, 13.04% percent were against *(CSCL)*. The student's use of *(CSCL)* was very low at 15.9% of the three secondary schools but lower as compared with that of (BTVET) institutions



The Business, Technical, Vocational Education and Training (BTVET) Institutions included Tororo College of commerce, Nile Vocational Institute, Uganda Institute of Information and Communication Technology. The results show that 83.1% of the students were in support of *(CSCL)* and 16.9% were against the idea of *(CSCL)*, the student's use of *(CSCL)* was law at 29% in the three (BTVET) Institutions but greater as compared with secondary schools.



The results were analyzed and found that majority of the students both secondary and (BTVET) institutions were in support of *(CSCL)* an overall percentage of 85.6% and those against were 14.4% and the overall usage of *(CSCL)*in both secondary and (BTVET) institutions was also law at 20.5% in the six schools as shown in chart 1 and 2 above.

*Findings and Cases of Implementation of Group Support Systems (GSS) Technology:*Finding show that more students in secondary schools were in support of (CSCL) as compare with support from (BTVET) institutions. However the students from (BTVET) institutions used (CSCL) more than those of secondary schools.In Uganda, group support systems are implemented on TV [shows where experts in science subjects are brought to discuss in a TV show and then later questions are asked on the subjects from all the

listeners around the country but these discussions are mainly for ordinary levels and Advanced levels secondary schools [14]. If implemented at also Business Technical and Vocational exams, then it would help students pass exams very well. Despite the fact that some TV stations have tried to implement collaborative Work and Learning, few students access it, because of no access to TVs and because of frequent power cut offs. Newspapers publish questions and answers of science subjects [8], [11]. This help the students discuss with their colleagues in order to and pass their exams. This method is so popular in Uganda since many students can afford to photo copy the questions and answers published in Newspapers, Students who have computers...check for these questions on online websites of the newspapers. In many countries with stable economies like America, France and United Kingdom, United Arab Emirate, "discussion forums" are made available for students to discuss different issues related to their subjects they offer this makes life easy for the students to learn and pass exams [12], [13].

Advantage of Computer-Supported Collaborative Work and Learning (CSCL): **Anonymity** – drive out fear leading to better decisions from a diverse hierarchy of decision makers; **Parallel Communication** – eliminate monopolizing providing increased participation, better decisions; **Automated record keeping** – no need to take notes, they're automatically recorded; **Ability for virtual meetings** – only need hardware, software and people connected; **Portability** - Can be set up to be portable… laptop; **Global Potential** - People can be connected across the world**No need for a computer guru** – although some basic experience is a must. Easy transfers of knowledge and skills with students and teachers, this is done by sharing Education problems and solving them together within the group.

Findings: The Proposed Model

*Computer-Supported Collaborative Work and Learning (CSCL):*Group or team-based work and collaborations are becoming an integral part of education and learning environments [6]. With the advance of information and communication technologies, there has been growing potential for utilizing computerized systems to support idea generation, project assignment, instant communication among the IT-age students and educators. The phenomenon has arrested the interest of both educational field and information systems (IS) researchers. In education realm, an emerging area in the instructional technology field called computer-supported collaborative learning (CSCL) has focused on the ways to support group learning in different forms of technologies; the technologies include electronic discussion environments, distance learning systems, and intelligent agents.

Computer-Supported Collaborative Work and Learning is an acronym for Computer Supported Cooperative Work. It is the scientific discipline that motivates and validates groupware design [6]. CSCL is technology independent which means technology is not the major driving force behind the discipline. Instead, CSCL is socially dependent. It looks at the way people interact and collaborate with each other, and attempts to develop guidelines for developing technology to assist in the communication process. In Information System literature, Group Support Systems (GSS) started as an interactive, computer-based system that facilitated solution of unstructured problems by a set of decision-makers working together as a group, especially groups of managers, in analyzing problem situations and in performing group decision making tasks. However based on the success of using GSS technology to support groups in nonacademic settings, researchers have begun to explore ways to apply GSS technology in classroom to support and enhance group-based [7].

In figure. 1Typical Architecture is given below where, GSS Data base represents the data base of the group Support system software, GSS software system Models, represent the Group Application software that runs on the GSS Database; External Users, represent Students outside the University that can contribute to the different topics in the discussion group; Internal Users represent students with the campus who can contribute to the discussion group; User Interface is the part of the Group software that will interact with the Student.

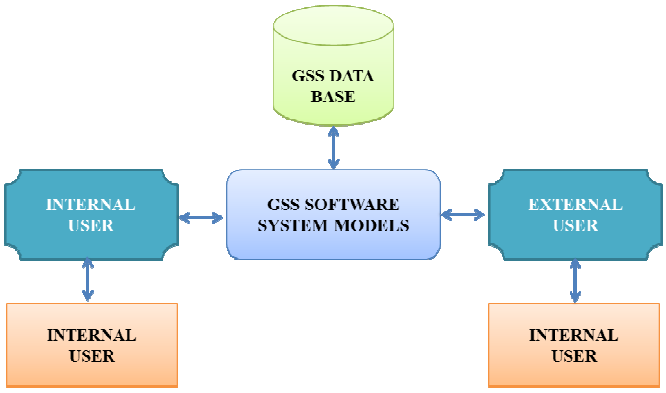


Figure. 1 Illustration of Computer-Supported Collaborative Work and Learning

Learning and Group Support ystems (GSS) Technology: Collaborative learning, as compared to

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individual learning, is helpful and important for understanding and exploring the process of learning. Embedded within the definition of cooperative learning is an enormous diversity of cooperative approaches [5]. These may be informal as short meetings to simply discuss and share information, or formal approaches where structure is imposed with specific ways of forming teams. Students may be working together on projects or other creative activities involving specific contents.GSS are defined as computer-based systems that support group decision making which is the result of the integration of communication, information processing and computer-based group structuring and support. The CSCL research shows encompasses benefits derived from GSS applications to support group-oriented methods of instruction, including network discussion environments and distance learning systems [6].

Group Size: Research on the effects of group size in non GSS-supported group work has a long history [6]. The general consensus is that as group size increases, effectiveness increases because there are more individuals who will contribute the knowledge and skills. However, upon the reach of a certain optimal value, the difference in participation becomes more pronounced so that a few members will dominate the group meeting and thus the effectiveness and member satisfaction will decrease. The optimum size for groups without GSS support is suggested to be no more than six. But the optimum size of the GSS-supported group meetings group is unknown. GSS research has found that larger groups benefit more from GSS use than smaller groups [15]. Theories suggest that GSS can reduce the following process losses which are common to non GSS groups: air time, Learning Blocking, evaluation apprehension, free riding, and cognitive inertia. The example of Groupware is given below:

Figure. 2 Key examples of Groupware

The key examples are showing the systems components of *Groupware*. These systems enable affective learning objectives related to interactive communication and teamwork to be achieved, on top of meeting the traditional cognitive learning objectives. *Problems faced by non-GSS-supported group meetings:* (i) Decreased user satisfaction in larger due to the decreased performance, (ii) Increased evaluation apprehension and (iii) The lack of equality of participation.

Conclusion

There are many ways that can help in increasing students' performance in science subjects, among them include, the use of the best teaching strategy, having basic science knowledge by the teacher, use of media in teaching and learning, the use of assurance model of teaching and learning introduced, but the use of group support systems in form of computer supported collaborative work and learning has got more advantages in improving performance than any other strategy. Therefore in order to ensure collaborative learning in Uganda, the government should increase spending in ICT instead of reducing it every year.

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