IMPROVING TEACHING AND LEARNING PROCESSES IN COMPUTING FOR MECHANICAL ENGINEERS: CASE OF DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING, KYAMBOGO UNIVERSITY

BY

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DISSERTATION SUBMITTED FOR THE AWARD OF DEGREE OF MASTERS OF VOCATIONAL PEDAGOGY OF KYAMBOGO UNIVERSITY

AUGUST 2017

DECLARATION

I, Kikoyo Ben, do hereby declare that this Research Dissertation is original and has not been published and/or submitted for any award in any other University before.

Signed:..... Date: 06/12/2017.....

Kikoyo Ben

DEDICATION

Every challenging work needs self-effort as well as guidance of elders especially those who are very close to our hearts. My humble effort I dedicate it to my family whose enormous support and prayers of day and night made me to get such success and honor, along with all hard working and respected supervisors.

APPROVAL

This research dissertation titled "Improving Teaching and Learning Processes in Computing for mechanical Engineers; a case of Department of Mechanical and Production Engineering, Kyambogo University", has been done under our supervision. It has been submitted to the Graduate School upon approval from the supervisors.

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ACKNOWLEDGEMENT

I wish to express my sincere appreciation to my supervisors Assoc. Prof. Kato Habib and Dr Kizito Mubiru, for their guidance and inspiration throughout the research. My deepest appreciation is also extended to the Coordinator NORHED Project Mr. Chris Sserwaniko, administrators, and facilitators for the education and scholarship extended to me to further my education in partnership with Kyambogo University as my workplace. Thank you so much. It's because of this sponsorship that I have been able to do this research

Thanks to Dr. Titus Watmon Bitek, Head of Department of Mechanical and Production Engineering, Kyambogo University for the recommendations.

Thank you all, may God bless you abundantly.

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LIST OF ACRONYMS

DMPE: Department of Mechanical Production Engineering

ICT: Information and commutation technology

PAR: Participatory action research

SCI: Student cantered instruction

KYU: Kyambogo University

MVP: Masters of vocational pedagogy

ABSTRACT

The purpose of this research was to investigate the existing teaching and learning systems, challenges in the delivery of training, identify and evaluate strategies aimed at improving delivery of training in Computing for Mechanical Engineers offered as a course unit in the programmes trained at the Department of Mechanical and Production Engineering, Kyambogo University. Work process analysis and the future workshop procedures were the methods used to investigate the teaching and learning processes involved in the delivery of training in Computing for Mechanical Engineers. The stakeholders in the study included students, lecturers, technicians and administrators in the Department of Mechanical and Production Engineering. In the future work shop phases, the investigations that involved the stakeholders revealed challenges that were affecting the delivery of training. The most felt challenges identified were need for relevancy in instruction and training to improve applicability of computing for mechanical engineers in industries, the inadequate time allocated to computing yet the content is wide, limited resources to aid the teaching for example ICT equipment in particular computers are inadequate compared to the large number of students. Strategies were established as alternative solutions to the identified challenges. From the established strategies, the most feasible strategies were agreed upon by stakeholders. The feasible strategies were implemented and evaluated, conclusions made and recommendations were derived basing on the evaluation findings. The findings indicated that the group discussions strategy was highly rated by students for improving the training delivery followed by additional practice time, demonstrations and ICT integration in teaching and learning processes. The lecturers rated demonstrations lowest while technicians rated ICT integration lowest. Therefore group discussion strategy should be taken advantage of inspite of demonstration and ICT facilities

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

The Department of Mechanical & Production Engineering (DMPE) is under the Faculty of Engineering, Kyambogo University. The Department offers Diploma courses in Mechanical Engineering, Automotive Engineering, Refrigeration Engineering and Bachelor's Degree courses in Mechanical Engineering, Industrial Engineering, Environmental Engineering and Automotive Engineering. Currently DMPE has a population of 1,500 students. The Department has existed since 2003 in the merger institutions (UPK, ITEK & UNISE) by the act of parliament and endeavors to give theory and practical experiences in the study programs to students. The Department has over the years developed strong industrial links for students' work placement, which leads to rewarding employment opportunities for the graduates as center for technology excellence in mechanical engineering education with well-built innovation and practical touch.

Computing for mechanical engineers is concerned with training students to gain adequate skills in the usage of engineering computer applications. Computers and laptops installed with necessary software are some of the requirements used to conduct the training. Students in mechanical engineering are required to acquire computing competences to equip them with vocational competences for self-reliance in the world of work. However graduates are unable to favorably create nor compete for employment because they were not adequately trained thus lacking suitable competences. Therefore there is need to improve training methods to enhance competence acquisition. The purpose of learning is to effect change in the learner (Mezirow, 2000). However during the course of execution of my duties I noticed that change in learners largely depends a lot on how the teacher executes his or her teaching and learning processes. When I tested the vocational didactical approach of teaching and learning such as learn by doing rather than passive learning (Dewey, 2001), I found that it gave the learner more chances to learn than the traditional methods of teaching.

The key stake holders in the Department are the students who receive the training, the head of department (HOD), department administrator, examination coordinator, instructors, secretary and technicians. The objectives of the Department are as follows;

i. To prepare future engineers who are creative and are able to design, manufacture, manage, operate or perform and accomplish tasks efficiently.

ii. To prepare multidisciplinary engineers to meet industrial demands now and in the future equipped with technological knowledge and precision engineering paradigm.

iii. To provide students with multidisciplinary capabilities to design products from concepts to manufacture by integrating cutting edge technology and mechanical equipment.

iv. To boost the department's international reputation as a Centre of excellence for student experience and employability through delivering education and conducting research that are relevant to the regional economic block /development.

v. To be the leading provider of employable graduates in the country through introducing the latest pedagogical concepts, novel learning and teaching methods, and practice-based research of relevance to the local and regional economic community of East Africa.

vi. To educate graduates who are ready to tackle the future, through programmes that are designed to encourage and nurture innovation and independent thinking

1.2 Situation analysis in DMPE

A situation analysis was carried out to determine areas for improvement in DMPE and in particular the area of teaching and learning processes in computing for mechanical engineers. Computing for mechanical engineers is a course comprising of solid-works designing, C++ programing and matrix laboratory (MAT-LAB) computer based applications. Students practice the three applications through the second semester in the second academic year. Computing equips students with knowledge and skills to effectively diagnose and solve engineering problems using

computers. Two approaches were used to carry out the situation analysis namely; that is work process analysis and future workshop.

1.2.1 Work process analysis

Work process analysis involved studying the programmes books that provide guiding information on how programmes shall be taught and assessed. According to the programme book, the mode of delivery is by lectures, tutorials, assignments, tests and practical work. The contact hour is equivalent to one lecture hour or two practical hours. The weighting in computing for mechanical engineers is shown in Table 1

Table 1: Weighting in computing for mechanical engineers

Unit	lecture hours	Practical hou	Contact hours	Credit units
CME	30	60	60	4

The courses are weighted in Credit Units (CU) where by one CU is equivalent to 15 contact hours or one contact hour a week for 15 weeks of teaching. In the weighting, two practical hours are equivalent to one contact hour while one lecture hour is equivalent to one contact hour. Therefore lectures and practicals have the same weighting.

1.2.2 Future workshop

The future workshop is a method that enables a group of people to develop new ideas or solutions when working, for instance, with social problems (Jungk, 1987). It is a method for social innovation, participation by the concerned and visionary future planning. The area of concern in this study was the teaching of computing for Mechanical Engineers which had three sections namely programming language in C++, matrix laboratory (MAT-LAB) and computer aided designing using Solidworks. The purpose of the future workshop in this study was to subject the area of concern, computing for mechanical engineers in this case to a more in-depth inquiry so as

to establish gaps or challenges and determine appropriate interventions for improvement. A future workshop was carried out with the stakeholders; that is students, lecturers and technicians (Fig 1)

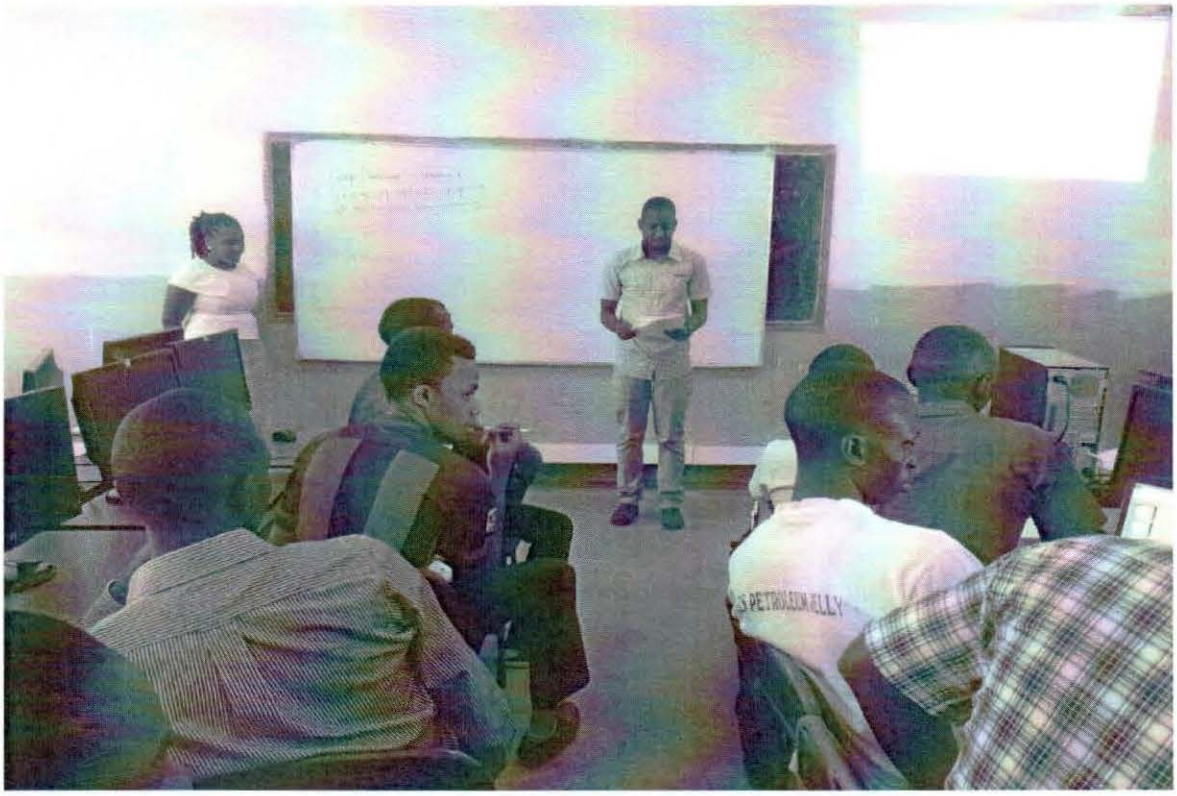


Figure 1: conducting future workshop with students to identify gaps in computing for Mechanical Engineers

In phase one (critical phase) of the future workshop, a general question of the problem was formulated. The question formulated was as follows; discussion of gaps or challenges faced in teaching and learning of computing for mechanical engineers, from which a visualized brain storming was carried out to identify gaps or challenges affecting the teaching and learning process in computing for mechanical engineers. Several gaps were identified and the similar gaps where grouped together in Figure 2 and Figure 3.

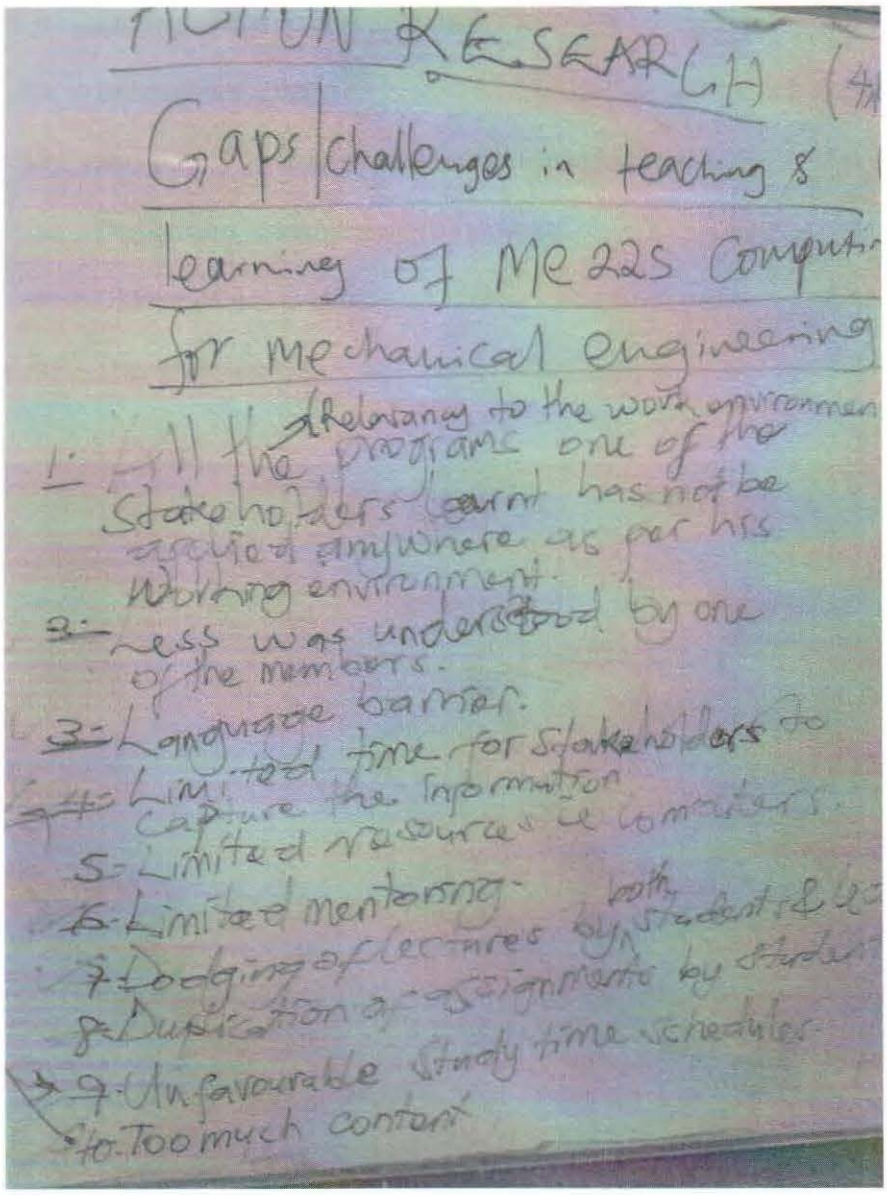


Figure 2 : Gaps identified during brainstorming

The gaps identified during brain storming as shown in Fig 2 are listed below;

i. Student stakeholders acknowledged that they had not applied computing for Mechanical Engineers anywhere as per their working environment

ii. Less was understood by some students

iii. Problem of language barrier from lecturers

iv. Limited time for students to exhaust the learning content

v. Limited computer resources in

vi. Limited mentoring

vii. Dodging of lectures by both students and lecturers

viii. Duplication of assignments by students

ix. Unfavourable study time schedules

x. Too much content

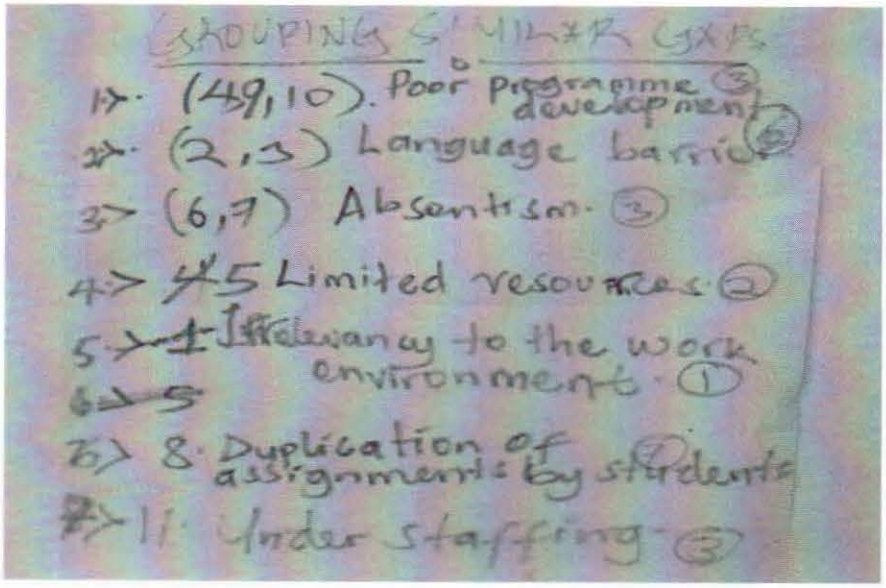


Figure 3: Grouping of the gaps

Similar gaps were grouped together as shown in Fig 3. The gaps identified after grouping are listed below;

i. Relevancy: Need for relevancy in instruction and training to improve applicability of Computing for Mechanical Engineers in industries

ii. Time allocation: Inadequate time is allocated to computing yet the content is wide.

iii. Teaching resources: Limited resources to aid the teaching for example ICT equipment in particular computers are inadequate compared to the large number of students and workshops are not fully equipped with tools and machines and teaching materials are usually inadequate

iv. Regularity of lecturers and students: Absenteeism by both lecturers and students where by lecturers do not attend to classes as scheduled which in turn demoralises students to attend classes promptly

v. Staffing: Under staffing and as a result there are very few lecturers on fulltime employment and most the lecturers are part-timer staff. This affects teaching and learning in that students are not given enough attention and mentorship

vi. Language barrier: where some of the teaching staff are Korea nationals who are not proficient in English language which affects their communication to students during teaching.

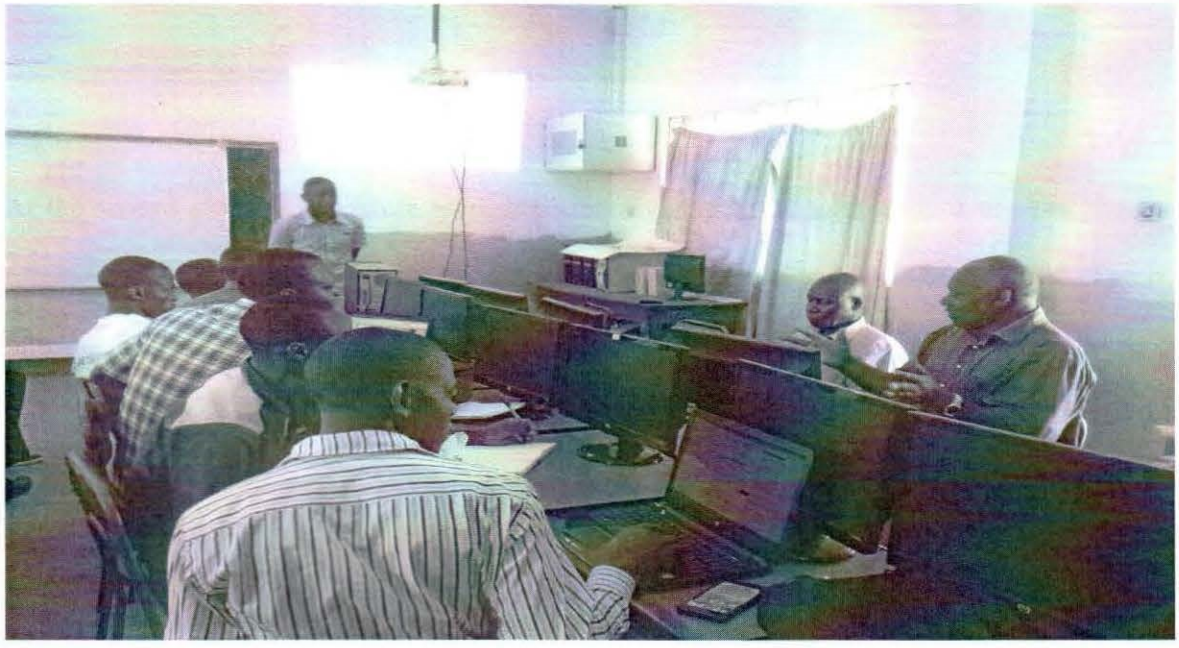


Figure 4: Future workshop to establish the most constraining gap

Among the gaps identified after grouping, the most constraining gap had to be established. In order to establish the most constraining gap, pair wise ranking of the identified gaps was carried out. With pair wise ranking, each gap was compared with all the gaps In pairs and whether each gap could be overcome in terms of collecting available resources. After the comparisons a gap with the highest rank was established as the most constraining gap. In this case irrelevant or

inapplicability of computing for mechanical engineers to the world of work was established as the most constraining gap.

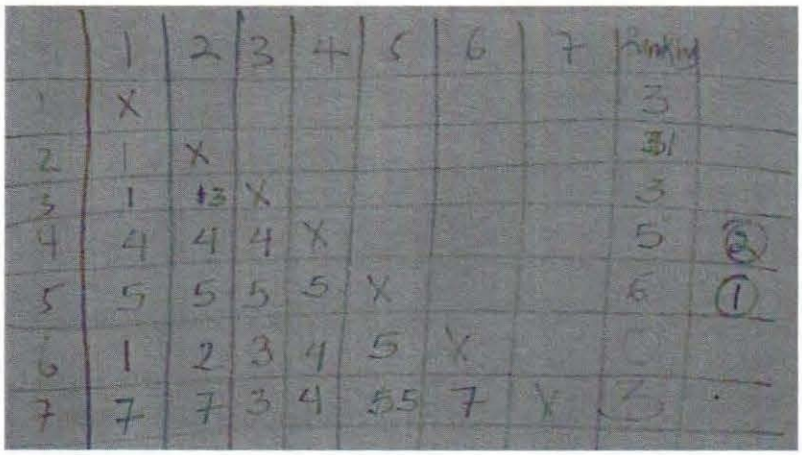


Figure 5: Pairwise ranking

At the second stage of the future workshop (fantasy stage), the interventions or strategies for turning irrelevant or inapplicability of computing for mechanical engineers to the world of work into positive strategies were explored. The strategies were identified in the future workshop through brain storming by the stakeholders that included students, lecturers and technicians.

The strategies for enabling training to be relevant to the work environment were identified as follows;

i. Collaboration with the world of work to establish the most relevant content to be taught and lectures by invited experts from the world of work
ii. Project based method of teaching and learning
iii. Tailoring each programme for its speciality.
iv. Linking computing to other course units
v. Requisitioning adequate teaching materials and establishing spacious teaching rooms
vi. Recruiting and continuous training of staff
vii. Allocate enough time for practicals and relating to real work environment.

viii. Emphasising group learning, and demonstrations.

ix. Integrating information and communication technologies in teaching and learning processes for example, availing video tutorials for repetitive demonstrations

Strategies including; Allocating enough time for practicals relating to real work environment, emphasizing group learning, and demonstrations, integrating information and communication technologies in teaching and learning processes were selected as the most feasible strategies because they could easily be implemented by the students, lecturers and students without involving top management to solicit for funds.

1.3 Statement of motivation

The researcher is an ICT technician whose major role is to conduct computing practical's for students as stipulated on the Departmental teaching timetable, provide ICT technical support to students, and staff members and maintenance of all ICT equipment in the Department. The researcher has served the Department of Mechanical and Production Engineering for four years and performs tasks diligently with the purpose of inculcating up to date competences and improving the training among students. Considering the objectives and concerns of the department my interest is improving the delivery of practical skills to foster innovations and students skills development in computing for mechanical engineers

The existing arrangement for teaching computing sessions includes practicals (section 1.2.1) which are stipulated to be conducted on ICT equipment in the computer laboratory. However, the ICT equipment are not sufficient and the time allocated is insufficient to adequately inculcate computing skills. As a result graduates fail to attain competences and cannot effectively compete for placements in the world of work

1.4 Statement of the problem

The work process analysis for computing (section 1.2.1) indicated allocations of lecture hours, practical hours and subsequently contact hours where one contact hour is equivalent to one lecture hour or two practical hours. Computing for mechanical engineers had a total of 30 lecture or contact hours, and 60 practical hours equivalent to 30 contact hours. Ideally teaching should have put more emphasis on practical work for computing and provide for training needs to be learner centered, so that the teaching and learning processes facilitate efficient skills acquisition. Therefore training would enable graduates to acquire suitable skills to effectively compete or create employment in line with the stated objectives of DMPE

1.5 Purpose of the study

To determine strategies for improving the delivery of training in Computing for Mechanical Engineers in the Department of Mechanical and Production Engineering at Kyambogo University

1.6 Objectives of the study

i. To investigate the existing teaching and learning processes in DMPE

ii. To identify the missing links in the delivery of training in Computing for Mechanical Engineers at DMPE at KYU

iii. To establish appropriate strategies aimed at improving teaching and learning processes in computing for mechanical engineers at DMPE at KYU

iv. To implement the identified strategies aimed at improving teaching and learning processes in DMPE at KYU

v. To evaluate implemented strategies aimed at improving teaching and learning processes in DMPE at KYU

1.7 Research questions

i. What are the existing teaching and learning systems in DMPE?

ii. What gaps are in the pedagogies employed in the teaching and learning processes of computing for mechanical engineers in the DMPE at KYU?

iii. What interventions can be adopted by staff and students as stake holders to address the gaps?

iv. What impact can the interventions make in addressing the gaps in the teaching and learning processes in computing for mechanical engineers at DMPE at KYU?

1.8 Justification of the study

In computing for mechanical engineers, students need to carry out practicals in the computer laboratory to effectively practice and acquire competences stated in the programmes of study and instruction manuals. Also, practicals are affected by inadequate time and ICT facilities available for students to practice and appreciate the importance of computing skills for engineers. Coupled with practicals, there is need for appropriated training approaches, hence the need for this study to assess training approaches that can be adopted to facilitate competence acquisition of the students

1.9 Significance of the study

The findings of the study will be of value to students, instructors, training institutions, the education ministry, world of work and the country at large with regard to knowledge creation, skills acquisition and transfer in the teaching and learning process.

1.10 Scope of the study

1.10.1 Geographical scope

The study was carried out in the DMPE at Kyambogo University located in Nakawa division, Kampala district. Kyambogo University is 8km from Kampala and 2km off the Kampala-Jinja highway. The university is accessible through Banda trading Centre and Kyambogo "T" junction. There is also an access route through Ntinda–Kiwatule Road. The Google location coordinates are 0.3520° N, 32.6301° E

1.10.2 Content scope

The study targeted computing for mechanical engineers at the Department of Mechanical and Production Engineering in Kyambogo University. The study investigated the appropriate strategies to improve the teaching and learning processes for skills acquisition in computing for engineers by engineering students.

1.10.3 Time scope

The study lasted for a period of six months from November 2016 to July 2017

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter discusses the existing literature on teaching and learning processes that aim at improving the quality of teaching and learning processes. The review will draw upon theoretical traditions, and researches to build a logical framework for the proposed study.

Instructors are not only expected be skilled in their areas of specialty but also to have knowledge about how learning takes place in learners. The aim is to identify and evaluate strategies for improving teaching and learning processes.

2.2 Teaching and Learning Processes

According to Brown, (2014) learning is acquiring knowledge and skills and having them readily available from memory so as to understand future problems and opportunities.

Similarly Susan et'al, (2010) defines learning as a process that leads to change, which occurs as a result of experience and increases the potential of improved performance and future learning. On the other hand, Teaching is an interactive process, primarily involving class room dialogue which takes place between teacher and pupil and occurs during a definable activity. Earlier theories of learning viewed learning as a passive process, and much of school learning has been based on this premise (Susanne, 2006). Teachers have been expected to do most of the talking, and students have been directed to listen. However more recent theories of learning view it as learner centered, active, and constructive process. Learners attempt to make sense of incoming information by interpreting it in terms of their prior knowledge, by questioning its meaning, and by exploring its uses. Such activities play a critical role in enabling learners to transform incoming information into usable knowledge. Students bring their own ideas or preconceptions to the learning process (Susanne, 2006). According to the constructivism theory, (Piaget) learning is considered as an active activity in which learners construct new knowledge based upon their prior

knowledge. Constructivism is learner-centered, assuming that learners learn better if they construct knowledge for themselves, rather than being told by an instructor. Therefore teaching and learning processes can be improved by emphasizing the constructivism theory.

2.3 Effective teaching

The quality of teaching is critical for the effectiveness of all education systems and learning in the classrooms, workshops, laboratories and other spaces in which education takes place. While outstanding teachers including lecturers, trainers, tutors, and coaches can engaged students, well-designed courses, facilities fit for training purpose, and a good level of resources are necessary if any kind of educational provision is to be excellent. The real answers to improving outcomes from vocational education lie in the 'classroom', and in understanding the many decisions 'teachers' take as they interact with students (Bill & Ellen, 2012). Specifically there's need to understand more precisely how best to engage particular kinds of learners to undertake the particular kind of learning which they have embarked on to achieve whatever vocational outcomes are desired

2.3.1 Student centered instruction

Learner centered instruction is when the planning, teaching and assessment revolve around the needs and abilities of the learner (Brown, 2008). This model is ideal for acquisition of long life practical skills and abilities.

Student-centered instruction (SCI) is an instructional approach in which students influence the content, activities, materials, and pace of learning. This learning model places the student (learner) in the center of the learning process. The instructor provides students with opportunities to learn independently and from one another and coaches in the skills they need to do effectively. The SCI approach includes such techniques as substituting active learning experiences for lectures, assigning open-ended problems and problems requiring critical or creative thinking that cannot be solved by following text examples, involving students in simulations and role plays, and using self-paced and/or cooperative (team-based) learning. Properly implemented SCI can lead to

increased motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes towards the subject being taught (Collins, 2003)

The student centered instruction approach is diametrically opposed, in its ethos, to the philosophy underlying the conventional method of learning. By its very nature, SCI allows students to shape their own learning paths and places upon them the responsibility to actively participate in making their educational process a meaningful one. By definition, the student centered learning experience is not a passive one, as it is based on the premise that 'student passivity does not support or enhance learning' and that it is precisely 'active learning' which helps students to learn independently (Machemer, 2007)

In spite of the variety of possible methods of implementation and application of the SCI approach, one can nonetheless identify some core aspects of SCI which include; innovative teaching, use of learning outcomes and the use of a system of transfer and accumulate on of credits. Much emphasis is directed towards innovative teaching, with its main focus, the manner in which students are best able to learn and which promotes teaching methods which lead them to do so. The requirement for innovative teaching underlies the rationale of continuous professional development for teachers, which together with enough elbow room to adapt teaching methods, can achieve the desired SCI approach (Trowler, 2005). Innovative teaching can take different forms; examples being team learning, and problem-based learning, as explored below:

Team Learning, also known as cooperative learning, is one of many ways used to get students to be responsible for their own learning (Felder, 1996). This enables them to interact with course-mates, sharing their ideas and supporting each other in the way they learn. Problem-Based Learning, is a method of teaching based on the premise that students learn more effectively by applying the knowledge they gain early in the course of their learning and not merely at exam time. Students are exposed to situations they would normally face outside the classroom and thus become more adaptable. Student Self-regulated Learning method ensures that students take their

own steps in order to learn, they also take care of their own monitoring, motivation and feedback process during and after learning' (Van Eekelen, 2005)

2.3.2 Experiential learning

According to Kolb, (1984) learning is the process whereby knowledge is created through the transformation of experience. Learning involves the acquisition of abstract concepts that can be applied flexibly in a range of situations. The impetus for the development of new concepts is provided by new experiences. Kolb's experiential learning theory works on two levels: a four stage cycle of learning and four separate learning styles much of which is concerned with the learner's internal cognitive processes.

Kolb's experiential learning theory is typically represented by a four stage learning cycle in which the learner 'touches all the bases as depicted in the cycle below;

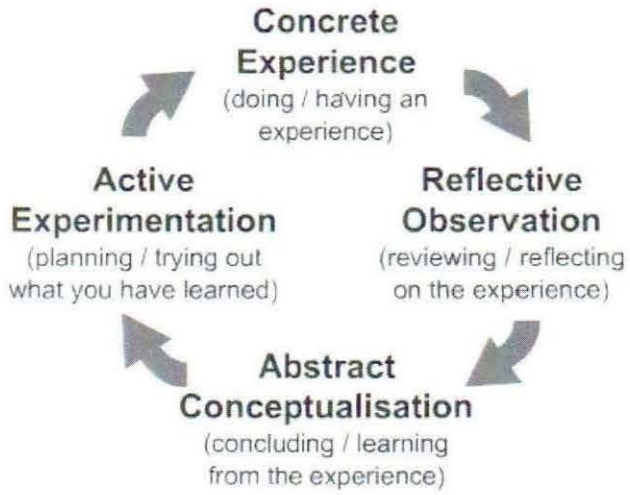


Figure 6: Kolb four stage learning cycle

At the beginning there is Concrete Experience where a new experience of a situation is encountered, or a reinterpretation of existing experience is experienced. Next there's reflective observation where there is a new experience of particular importance and any inconsistencies between experience and understanding are noted. Thirdly Abstract Conceptualization occurs where reflection gives rise to new idea, or a modification of an existing abstract concept.

Finally there is Active Experimentation where the learner applies the new ideas to the world around him or her to see what results. Therefore effective learning is seen when a person progresses through a cycle of four stages: that is (1) having a concrete experience followed by (2) observation of and reflection on that experience which leads to (3) the formation of abstract concepts (analysis) and generalizations (conclusions) which are then (4) used to test hypothesis in future situations, resulting in new experiences. The cycle is represented as follows;

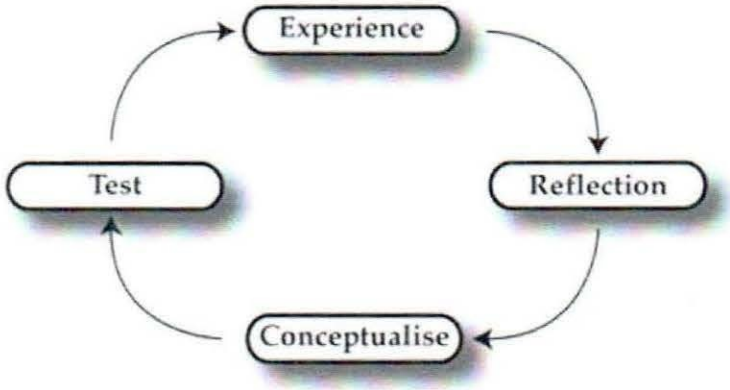


Figure 7: Effective learning cycle

kolb, (1974) views learning as an integrated process with each stage being mutually supportive of and feeding into the next. It is possible to enter the cycle at any stage and follow it through its logical sequence. However, effective learning only occurs when a learner is able to execute all four stages of the model. Therefore, no one stage of the cycle is an effective learning procedure on its own.

2.4 Learning Styles

Kolb, (1974) sets out four distinct learning styles, which are based on a four-stage learning cycle. Kolb explains that different people naturally prefer a certain single different learning style. Various factors influence a person's preferred style. For example, social environment, educational experiences, or the basic cognitive structure of the individual. Whatever influences the choice of style, the learning style preference itself is actually the product of two pairs of variables, or two

separate 'choices' that we make, which Kolb presented as lines of axis, each with 'conflicting' modes at either end: A typical presentation of Kolb's two continuums is that the east-west axis is called the Processing Continuum (how we approach a task), and the north-south axis is called the Perception Continuum (our emotional response, or how we think or feel about it).

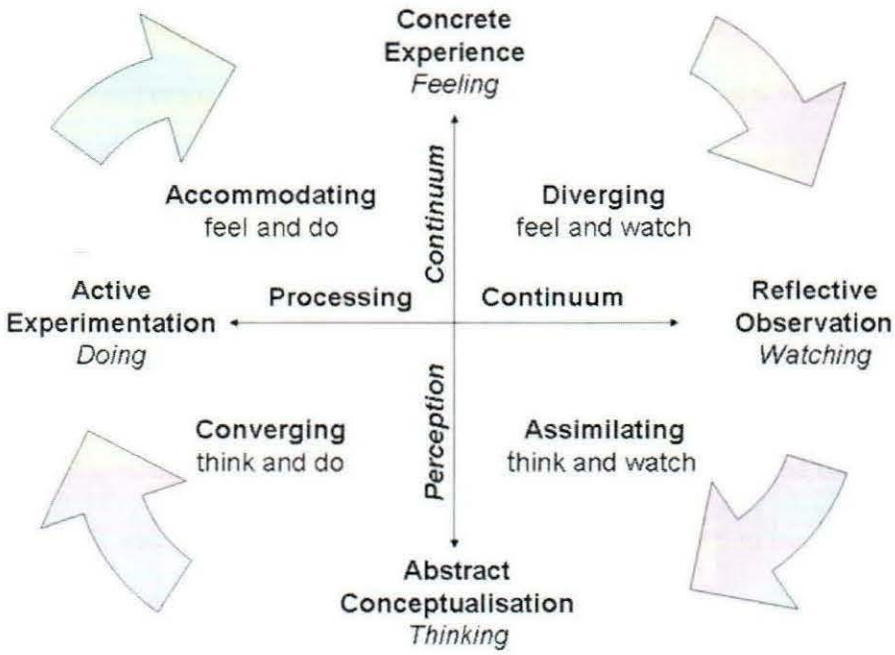


Figure 8: presentation of Kolb's two learning continuums

Kolb believed that one cannot perform both variables on a single axis at the same time i.e. think and feel). Ones learning style is a product of these two choice decisions.

It is often easier to see the construction of Kolb's learning styles in terms of a two-by-two matrix. Each learning style represents a combination of two preferred variables. The diagram also highlights Kolb's terminology for the four learning styles; diverging, assimilating, and converging, accommodating

2.4.1 Learning Styles Descriptions

In the case of diverging perspective one is able to look at aspects from different perspectives. They are sensitive. He/she is sensitive and prefer to watch rather than do, tending to gather information and use imagination to solve a problem. One is best at viewing concrete situations at several different viewpoints. Kolb called this style 'diverging' because learners perform better in situations that require ideas-generation, for example, brainstorming. Learners with a diverging learning style have broad cultural interests and prefer to gather information. They are interested in people, tend to be imaginative and emotional, and tend to be strong in the arts. Learners with the diverging style prefer to work in groups, to listen with an open mind and to receive personal feedback.

The Assimilating learning preference is for a concise, with logical approach. Ideas and concepts are more important than people. The learners require good clear explanation rather than practical opportunity. They excel at understanding wide-ranging information and organizing it in a clear logical format. Learners with an assimilating learning style are less focused on people and more interested in ideas and abstract concepts. Learners with this style are more attracted to logically sound theories than approaches based on practical value. This learning style is important for effectiveness in information and science careers. In formal learning situations, people with this style prefer readings, lectures, exploring analytical models, and having time to think things through.

Learners with a converging learning style can solve problems and will use their learning to find solutions to practical issues. They prefer technical tasks, and are less concerned with people and interpersonal aspects. Learners with a converging learning style are best at finding practical uses for ideas and theories. They can solve problems and make decisions by finding solutions to questions and problems. Learners with a converging learning style are more attracted to technical tasks and problems than social or interpersonal issues. A converging learning style enables

specialist and technology abilities. Learners with a converging style prefer to experiment with new ideas, to simulate, and to work with practical applications.

The Accommodating learning style is 'hands-on', and relies on intuition rather than logic. These learners use other people's analysis, and prefer to take a practical, experiential approach. They are attracted to new challenges and experiences, and to carrying out plans. They commonly act on 'gut' instinct rather than logical analysis. Learners with an accommodating learning style tend to rely on others for information than carry out their own analysis. This learning style is prevalent within the general population.

2.5 Summary

There is need for educators to ensure that activities are designed and carried out in ways that offer each learner the chance to engage in the manner that suits them best. Also, individuals can be helped to learn more effectively by the identification of their preferred learning styles and the strengthening of these through the application of the experiential learning cycle. Ideally, activities and materials should be developed in ways that draw on abilities from each stage of the experiential learning cycle and take the students through the whole process in sequence. To achieve student centered learning, there is need for continuous professional development for teachers, which together with enough elbow room to adapt desired teaching methods

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The purpose of this study was to investigate the existing teaching and learning systems, and together with the stake holders in the department identify the missing links in the delivery of training in computing for mechanical engineers at DMPE and establish appropriate strategies aimed at improving teaching and learning processes in computing for mechanical engineers at DMPE. The strategies were to be implement and evaluated. The evaluation was to improve teaching and learning processes in computing for mechanical engineers at DMPE.

3.2 Research Approaches

The approach used was Participatory Action Research (PAR). The methods used were work process analysis and future workshop.

3.2.1 Participatory Action Research

The study used PAR because it has a social and community orientation research which emphasizes participation and action (Buckles, 2013). Action research is a planned and collective approach to solving community and organizational problems. Action research is a systematic procedure that is flexible and can be adapted to address educational problems (Barb, 2015). It is a research in which the research contains an action agenda for reform that may change the practices of the participants, the institutions in which individuals work or live, and the researcher's life. Stakeholders were involved in all activities from planning to identify major gaps, and identifying possible strategies to address the gaps, implementation of the strategies, follow up and evaluation. Therefore, Participatory Action Research was used because it is collaborative, democratic and both the researcher and the participants are stakeholders in the study. Thus action research was suitable for addressing the issue of enhancing the teaching and learning processes in computing for mechanical engineers which needs the contribution from all the stakeholders.

3.2.2 Work process analysis

In this study the analysis was carried out to identify the teaching and learning processes involved in the conduct of the programs in DMPE and in this case, computing for mechanical engineering component. The findings of the analysis provided basis for the statement of the problem, the research objectives and questions

3.2.3 Future workshop

The future workshop (FW) is a technique that enables a group of people to develop new ideas or solutions to social problems (Jungk, 1987). The FW is a relevant method for action research because it involves the participants in the process of working out solutions according to the existing situation and can be transferred to situations of education and learning. A future workshop according to Jungk, (1987), consists of five phases:

i. The preparation phase: Here the themes, the invited participants, the methods, the rules and the time table of the workshop are settled by the organizers of the workshop and the facilitators. The room and local facilities for the workshop are settled.

ii. The critique phase: Here the problem is critically and thoroughly discussed and investigated. Brainstorming is the preferred creative technique followed up by a structuring and grouping of ideas in main sub-themes.

iii. The fantasy phase: Here the participants try to work a utopia, to draw an exaggerated picture of the future. Brainstorming and other creative techniques might be used. The social fantasies of the participants are developed in this phase.

iv. The implementation phase: Here the ideas found are checked and evaluated in what concerns their practicability. An action plan is elaborated.

v. The follow-up phase: Here the action plan is monitored; and eventually changes are implemented and if necessary, another future workshop is conducted.

The future workshop aims at improving the future through democratic participation in decision making as a positive change from existing situation and culture that seems oppressive or unsatisfactory. Future workshop involves basic values of dialogue, transparency, equity and democracy. In this study the future workshop was used to identify and prioritize the gaps in the teaching learning process of computing for mechanical engineering in DMPE. In the fantasy phase of the future workshop means of addressing the most felt gap were identified and prioritized. Implementation and evaluation of the most appropriate means was then carried out

3.3 Implementation of Action production plan

The action plan for this study is given in Table 2

Table 2: Action Plan

ACTION	PARTICIPANTS	LEAD PERSON	TIME FRAME
Establishing the state of computers and Discussion with HOD	Technicians Lead researcher	Mr. Ojangole Willy (Technician) Lead researcher	14th March to 16th March 2017
Establishing availability laboratory space and state	Lead researcher Lecturers HOD Technician	Lead researcher	20th March to 27th March 2017
Refurbishing the space (networking, installations, burglar proofing and painting)	Lead researcher Lecturers Technician students	Mr. Musoke Robert Lead researcher	3rd April to 17th April 2017
Pilot projects to evaluate the functionality of the lab	Lead researcher Lecturers Technicians Students	Lead researcher	24th April to 8th May 2017

3.4 Study location

The study was carried out at Kyambogo University, located in the urban setting of Kampala, Nakawa Division, 8km from Kampala and 2km off the Kampala-Jinja highway.

3.5 Study population

The study involved a sample of stake holders in the teaching and learning process who are mainly the students, administrators, lecturers and technicians in DMPE. The study population for this study is shown in Table 3

Table 3: Study population

Stakeholders to be interviewed	Purpose of interviewing
Students	To avail information on how they are taught and their learning
Administrators	To avail information on how the department is managed in regard to the conduct of teaching
Lecturers	To avail information on how they conduct teaching
Technicians	To avail information on how they conduct practicals with students

3.6 Sampling technique and sample size

3.6.1 Sampling technique

A purposive sampling technique was applied. Purposive sampling is a sampling technique in which the researcher relies on his or her own judgment when choosing members of population to participate in the study (Saunders, 2012). This sampling method involves deliberate selection of particular units of the universe for constituting a sample which represents the universe. The purposive technique was applied because the universe is small and has known similar characteristics. The characteristics include age, background, and gender.

3.6.2 Sample size

The Department has a population of 1,500 students pursuing different degree and diploma programmes on day and evening sessions. There are four degree programmes of which only second year students from these four programmes do study computing for mechanical engineers. The population for the second year students is 180 students. From the four degree programmes 27 students were selected to represent the population universe of 180 students. The students were selected according to performance records of the four degree programmes; two best performing from each programme, then two average performers and two poorly performing students from each programme. One lecturer represented each programme to make four lecturers in total. Three administrators represented the department administration. The Population sample is as shown in Table 4, below

Table 4: Population sample of participants involved in the research study

Category	Study population	Sample size	Selection technique
Administration	3	3	purposive
Lecturers	4	4	purposive
Technicians	2	2	purposive
Students	180	108	purposive
Total	189	129	

3.7. Data collection methods and tools

Data collection methods are techniques used to gather and measure information on targeted variables in an established systematic fashion, which then enables the researcher to answer the identified questions and evaluate the outcomes.

Table 5: Data collection methods

Data collection methods	Data collection tools
Interview	Interview guide,
Observation	Uses of the senses, and watch, scales. log books
Document reviews	Checklist; data compilation forms
Future workshop	Cameras and log books
Focus group discussions	Cameras, log books, items

3.7.1 Interview

In this study, in depth interviews were used. In depth interviews are personal and unstructured interviews, whose aim is to identify participant's emotions, feelings, and opinions regarding a particular research subject (Turner, 2010). In this study the subject of interview is the teaching and learning. The main advantage of personal interviews is that they involve personal and direct contact between interviewers and interviewees, as well as non-response rate. Unstructured interviews to be used will offer flexibility in terms of the flow of the interview

3.7.2 Observation

Observation is a technique that involves systematically selecting, watching and recording behavior and characteristics of living beings, objects or phenomena. Observation of human behavior was adopted in this study. Non-participant observation was used where the observer watches the situation, openly or concealed, but does not participate.

3.7.3 Document reviews

Document review is a way of collecting data by studying existing documents to analyze information about the organization regarding the particular area under investigation. Document review was used because it's a good source of background information which may not be directly observable.

3.7.4 Focus group discussions

In this study, Focus group discussions were used to collect information from the different categories of stakeholders in the department. Focus group discussions provide insights into what people think and provide a deeper understanding of the phenomena being studied. Focus group discussions are valuable research tools and can capture information that help to better tell the story on the study topic (Nichelle & Nagle, 2013).

3.8 Data analysis

Data analysis provides a process of inspecting, cleansing, transforming and modelling data with the goal of discovering useful information, suggesting conclusions, and supporting decision making (Adèr, 2008). The collected data was analyzed and presented according to the objectives. Data under each objective was presented in themes. Each theme data was interpreted and discussed under the respective objective

3.9 Ethical considerations

During data collection process, there is need to consider whether research procedures are likely to cause any physical or emotional harm. Therefore, obtaining informed consent before the data collection, ensuring the confidentiality of the data obtained, anonymity of respondents and learning enough about the culture of informants was vastly effected in a sense of academic purposes.

CHAPTER 4: IMPLEMENTATION AND EVALUATION

4.1 Introduction

The purpose of this study was to determine existing teaching and learning systems, gaps in the delivery of training, identify and evaluate strategies aimed at improving delivery of training.

Action research emphasizes that successful action is based on identifying alternative solutions, evaluating the alternatives, choosing the optimum solution and finally that change is achieved by taking collective action, implementing the solution and evaluating the results of the actions taken.

In the situation analysis, challenges and respective strategies for improving teaching and learning processes in computing for mechanical engineers were identified by use of work process analysis (section 1.2.1) and future workshop approach (section 1.2.2). In the reality phase of the future workshop implementable strategies were identified as follows; emphasizing didactical teaching methods including group work learning, demonstrations, allocating enough time for practice and demonstration that relate to the real work environment and Integrating information and communication technology (ICTs) in the learning processes for example, availing video tutorials for repetitive demonstrations. Therefore a stage was set for implementation and evaluation of the strategies.

4.2 Existing teaching and learning processes in DMPE

In the situation analysis that was carried out in the DMPE, it was found that there was a lot more theory covered and less of practicals on the course of instruction in computing for mechanical engineering (section 1.2.1).

4.3 Identifying the gaps

A future workshop was conducted (section 1.2.2) to identify gaps in the teaching and learning process and to determine the most appropriate intervention measures for improving the teaching learning process. In phase one of the future workshop gaps affecting the teaching and learning

process in computing for mechanical engineering were identified. Prioritization of the identified gaps was done and the most felt gap was found to be relevance of computing for mechanical engineering to the world of work

4.4 Strategies for improving teaching and learning processes

While in phase two of the future workshop the most felt gap in teaching and learning processes was found to be relevance of computing for mechanical engineering to the world of work, in phase three of the future workshop, the fantasy phase, the most appropriate intervention measures were identified as; Allocate enough time for practicals and relating to real work environment, Emphasizing group learning, and demonstrations, and integrating technology in teaching processes for example, availing video tutorials for repetitive demonstrations

. Implementation of the identified most appropriate strategies was carried out

4.5 Implementation of the identified strategies

4.5.1. Allocating enough time for practicals and relate to the real work environment.

For the existing teaching time table, theory and practicals were allocated different time fractions on different days for each programme taught. The theory sessions were allocated two hours and the practicals two hours a week for 15 weeks a semester. In a bid to allocate more time for practicals to improve the learning in computing for mechanical engineers, the one hour theory session was integrated into the practical session to make three hours for the practical session in a week to give more time for actual practice. Allocating more time for practicals was authorized by the Department administration and the changes were implemented in the teaching timetable as shown in Fig. 6 below.

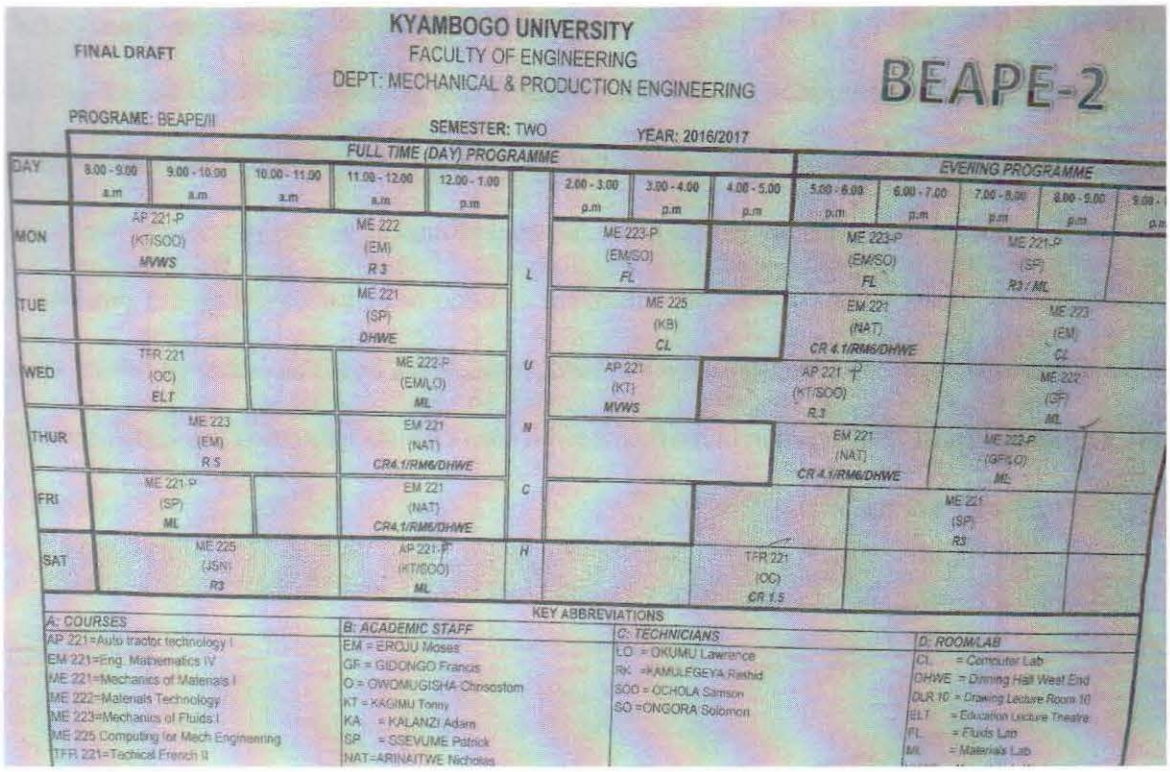


Figure 9: Adjusted timetable showing allocated time for practicals (ME 225)

In Figure 6, it can be seen that practicals for computing (ME 225) were allocated three hours for practice a week. Initially before the proposed strategies to improve teaching and learning in computing for mechanical engineers, practicals had only two hours for practice a week. Therefore one hour was added to allocate enough time and make three hours for practice in week. The time allocation for a semester is shown in Table 6

Table 6: Time allocation for practicals in a semester

	Time allocation in hours per semester		
Unit	Old	New	Increment
CME	30	45	15

4.5.2 Group discussions

Group learning is active learning that is deeper and lifelong. Group learning occurs in social contexts through interactions and communications with others (Vygotsky 1968). Discussions, collaborations and feedback maximizes the learner's ability to construct meaning. Therefore discussion groups were formed in order to maximize the learner's experience. The discussions were guided by technicians and the lecturers. Students were assigned tasks in groups. Students felt free to interact and communicate with each other which could improve their learning abilities. (Fig 7 and 8)

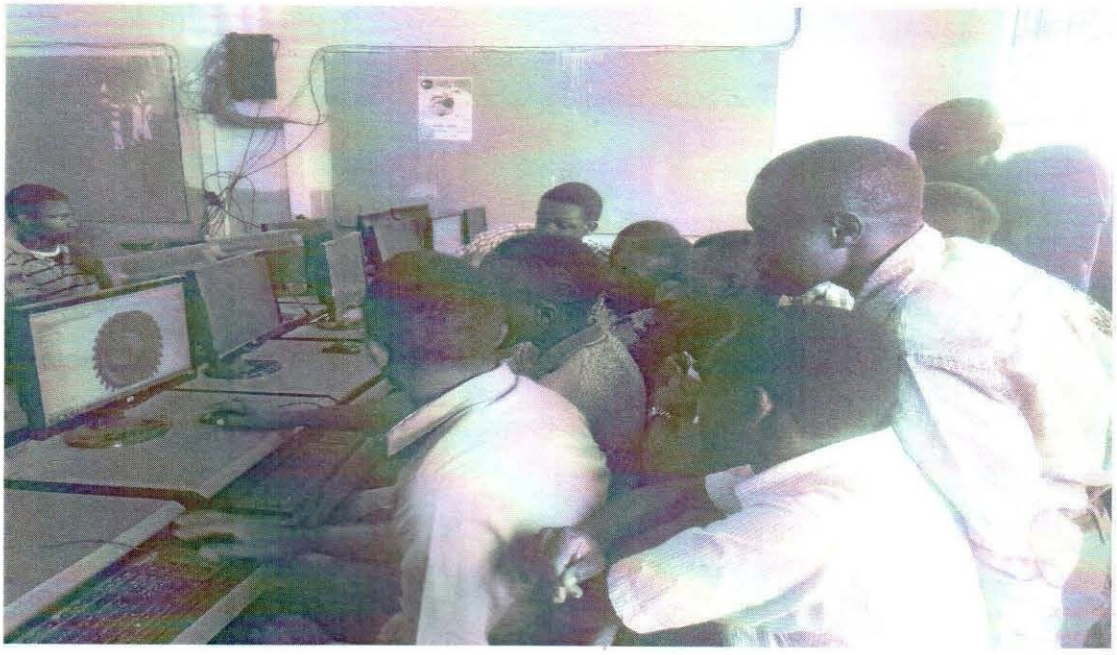


Figure 10: Learning in groups. Solidworks computer aided design



Figure 11: Learning in groups. Solidworks computer aided design

4.5.3 Demonstrations

Demonstration is the act of showing clearly how to carry out and act a technique or how something works. Demonstration is a method of presentation showing by proof using examples, concepts or experiments. Demonstration method aims at achieving psychomotor and cognitive objectives. In this study a demonstration on assembly modelling in Solidworks designing was carried out. The structure of demonstration followed was in three steps namely:

i. Introduction: in this step the objectives of demonstration were stated

ii. Development: students try to practice the demonstrated activity. If there is any query the lecturer satisfies them by further demonstrations and illustrations.

iii. Integration: the lecturer integrates all activities, one rehearsed , revised and evaluated

The demonstration method is based on the principle of learn by doing, perception and skills developed by imitation. With demonstration, complex concepts become easy to learn, learners develop interest and learning becomes permanent

4.5.4 Integrating information and communication technology (ICTs) in learning processes

The potential of ICTs is to innovate, accelerate, enrich, and deepen skills acquisition. ICTs further motivate and engage students. ICT-enhanced learning recognizes that there are many different learning pathways and many different articulations of knowledge. ICTs allow learners to explore and discover rather than merely listen and remember.

In this study, the integration of ICTs involved improving access to internet. The availability of computers and internet would immerse learners into the learning processes. The computer laboratory technician carried out maintenance tasks which included connecting all computers to internet, installing the projector, installing relevant software, and training learners how to use the internet, and to browse through reading material. (Fig 9)



Figure 12: Computer laboratory installed with projector, internet and computing software.

Recording videos for lessons taught was done to provide repetitive access to lesson tutorials. Videos offer repetition, multimedia aids and interactivity which would help to engage learners and reinforce information anytime and anywhere. Lecturers recorded lesson videos with the help of

computer laboratory technician who is responsible for distributing to learners the lessons through the computers in the computer laboratory.

4.6 Evaluation of the implemented strategies

The evaluation of implemented strategies involved analysis and reflection of completed activities during the implementation process. Evaluation involved participation from students, lecturers and technicians to collectively carry out assessment of implemented strategies as shown in figure 10. Therefore the researcher at this stage presents assessments of the implemented strategies.



Figure 13: Evaluation meeting

4.6.1 Additional practice time

Evaluation was carried out by means of a questionnaire (Appendix E), where Students, Lecturers, and Technicians views were captured. The average weighted rating (AWR) was obtained using the Likert Scale. The Likert scale is psychometric response scale primarily used in questionnaires to obtain participant's preferences or degree of agreement with a statement or set of statements

(Bertram, 2013). In the Likert scale, strongly agree would score 5; agree score 4; disagree score 3; strongly disagree score 2 and don't know score 1. The weighting was the number of respondents. The average weighted rating (AWR) for students, technician and lecturers was calculated as shown below.

$$student\ AWR = \frac{(5 \times 14) + (4 \times 15) + (3 \times 1) + (2 \times 0) + (1 \times 1)}{31} = 4.32$$

$$lecturer\ AWR = \frac{(5 \times 3) + (4 \times 1) + (3 \times 0) + (2 \times 0) + (1 \times 0)}{4} = 4.75$$

$$technicians\ AWR = \frac{(5 \times 3) + (4 \times 0) + (3 \times 0) + (2 \times 0) + (1 \times 0)}{3} = 5$$

The results from questionnaire are given in Table 7.

Table 7: Results from the questionnaires on extended practical time

Respondents	**Strongly agree**	**Agree**	**Disagree**	**Strongly disagree**	**Don't know**	**Number respondents**	**Average weighted rating**
Students: Benefited my learning	14	15	1	0	1	31	4.32
Lecturers: benefited student learning	3	1	0	0	0	4	4.75
Technicians: benefited student learning	3	0	0	0	0	3	5.0

The results in Table 7 show that most of the students (15 out of 31) agreed while (14 out of 31) strongly agreed that extended practical time benefited their learning. Three lecturers out of four strongly agree while one agreed that extended practical time benefited students learning. All the technicians strongly agreed that extended practical time benefited students learning. The increased

practical time was achieved by integrating theory lectures into practical sessions. This improved student engagement in learning processes in that theory concepts were practically aligned to real work. Students were able to visualize, extend the learning experience to acquire more knowledge and skills. Through the extended practical sessions, student were able to repeatedly exercise skills which led to reflection and deeper understanding of concepts. However extended practical hours were challenged by inadequate computers to accommodate the huge number of students per programme.

4.6.2 Adoption of group discussions

Student groups were created and became operational. Evaluation results from the questionnaires on group discussions are given in Table 8. The average weighted rating (AWR) was obtained by using the Likert scale as shown below

$$student\ AWR = \frac{(5 \times 12) + (4 \times 15) + (3 \times 3) + (2 \times 0) + (1 \times 1)}{31} = 4.58$$

$$lecturer\ AWR = \frac{(5 \times 3) + (4 \times 1) + (3 \times 0) + (2 \times 0) + (1 \times 0)}{4} = 4.75$$

$$technicians\ AWR = \frac{(5 \times 3) + (4 \times 0) + (3 \times 0) + (2 \times 0) + (1 \times 0)}{3} = 5$$

Table 8: Questionnaire results for group discussions

Respondents	Strongly agree	Agree	Disagree	Strongly disagree	Don't know	Number of respondents	Average weighted rating
Students: Benefited learning	12	15	3	0	1	31	4.58
Lecturers: benefited student learni	3	1	0	0	0	4	4.75
Technicians: benefited student learni	3	0	0	0	0	3	5.0

The results indicate that most of the students (15 out of 31) agreed and 12 out of the 31 strongly agreed that group discussions benefited their learning. However 3 students out of 31 disagreed while one did not know that group discussions benefited their learning. All the lecturers agreed with 3 out of the 4 strongly agreeing that group discussions benefited students learning. All the technicians (3) strongly agreed that group discussions benefited students learning.

4.6.3 Adoption of use of Demonstration

The evaluation results on the use of demonstrations are given in Table 9. The average weighted rating was obtained by using the Likert scale as shown below

$$student\ AWR = \frac{(5 \times 9) + (4 \times 15) + (3 \times 3) + (2 \times 2) + (1 \times 3)}{31} = 4.23$$

$$lecturer\ AWR = \frac{(5 \times 2) + (4 \times 2) + (3 \times 0) + (2 \times 0) + (1 \times 0)}{4} = 4.5$$

$$technicians\ AWR = \frac{(5 \times 3) + (4 \times 0) + (3 \times 0) + (2 \times 0) + (1 \times 0)}{3} = 5$$

Table 9: Questionnaire results for demonstrations

Respondents	Strongl agree	Agree	Disagree	Strongly disagree	Don't know	Number of respondents	Average weighted rating
Students: Benefited learning	9	15	3	2	3	31	4.23
Lecturers: benefited student learning	2	2	0	0	0	4	4.5
Technicians: benefited student learning	3	0	0	0	0	3	5.0

The results indicate that most of the students (15 out of 31) agreed while 9 strongly agreed that demonstrations benefited their learning. However 3 students out of 31 disagreed and 2 strongly disagreed while 3 students did not know whether demonstrations benefited their learning. For lectures, while 2 strongly agreed, also 2 agreed that demonstrations benefited students learning. However all the technicians indicated that demonstrations benefited students learning.

4.6.4 Integrating ICTs in teaching and learning

The questionnaire evaluation results on integration of ICTs in teaching and learning processes are given in Table 10. The average weighted rating was obtained by using the Likert scale as shown below.

$$student\ AWR = \frac{(5 \times 9) + (4 \times 17) + (3 \times 4) + (2 \times 0) + (1 \times 1)}{31} = 4.23$$

$$lecturer\ AWR = \frac{(5 \times 3) + (4 \times 1) + (3 \times 0) + (2 \times 0) + (1 \times 0)}{4} = 4.75$$

$$technicians\ AWR = \frac{(5 \times 1) + (4 \times 2) + (3 \times 0) + (2 \times 0) + (1 \times 0)}{3} = 4.33$$

Table 10: Questionnaire results for integrating ICTs in teaching and learning

Respondents	Strongly agree	Agree	Disagree	Strongly disagree	Don't know	Number of respondents	Average weighted rating
Students: Benefited my learning	9	17	4	0	1	31	4.23
Lecturers: benefited student learning	3	1	0	0	0	4	4.75
Technicians: benefited student learning	1	2	0	0	0	3	4.33

The results in Table 10 indicate that most students (17 out of 31) agreed while fewer students (9 out of 31) strongly agreed that integrating ICT in the teaching and learning process benefited their learning and 4 students disagreed while one didn't know. For lecturers, 3 out of 4 strongly agreed while one agreed that integrating ICT in the teaching and learning process benefited student's students learning. Only one technician strongly agreed while 2 agreed that integrating ICT in the teaching and learning process benefited students learning.

The adoption and usage of ICTs such as availability of computer laboratory, and free internet access increased student motivation towards learning by providing easy access to learning material. ICTs also facilitate situated contextual learning. This in turn engages learners into the learning processes to explore learning materials. The usage of video tutorials and simulation software would help students to relate learning experiences to work practices, getting picture of world of work and inspiration for practice. Though ICTs have the potential to innovate, accelerate, enrich, and deepen skills, to motivate and engage students, they have been challenged by users lacking adequate ICT skills and limited ICT resources. This could have contributed to the high doubt rating by

students for integrating ICTs in the teaching and learning process. Also there was some degree of doubt rating by the lecturers and technicians.

Indicative weighted average ratings were calculated for the implemented strategies for improving the teaching and learning process using the Likert scale where by strongly agree would score 5; agree score 4; disagree score 3; strongly disagree score 2 and don't know score 1. The weighting was the number of respondents that indicated the rating and finally the average ratings by each category of respondents to the strategies were calculated. The number of respondents were 31 students, 4 lecturers and 3 technicians. The results obtained are given in Table 11.

Table 11: Indicative ratings of the implemented strategies

	Strategies			
Respondents	Additional Time	Group Discussion	Demonstration	ICT Integration
Students	4.32	4.58	4.23	4.23
Lecturers	4.75	4.75	4.50	4.75
Technicians	5.00	5.00	5.00	4.33
Overall	4.69	4.78	4.58	4.44

The results in Table 11 show that students rated Group discussion highest followed by Additional time for practice. Students rated demonstrations and ICTs integration lowest. The lecturers rated Additional time for practice, Group discussion and ICTs integration highest and demonstration lowest. The technicians rated Additional time for practice, Group discussion and demonstration highest and ICTs integration lowest. Overall ratings show that group discussions were rated highest and ICTs integration lowest.

4.7 Discussion of the results

The indicative ratings of the implemented strategies show that students rated group discussions strategy highly compared to demonstration, and integration of ICT strategies. By learning in groups, students confessed that they were able to interact socially, share ideas, and jointly solve problems which all together enhanced their learning experience. Knowledgeable Individuals from groups were able to explain and demonstrate to group members through the interactions and communications leading to acquisition of knowledge of social skills. Similarly (Lave & Wenger, 1998) describes learning as a social participation and the motivation to become a more central participant can provide a powerful incentive for learning causing the desire to develop skills. Consequently Students effectively learn in groups as they encourage each other to ask questions, explain and justify their opinions, articulate their reasoning, and elaborate and reflect upon their knowledge (Soller, 2001). Therefore failure to adopt group discussions can limit student participation in teaching and learning processes. However students also noted that while group discussion is beneficial, it's challenged by individual disagreements and dominance from some of the group members. However this can be minimized by having group leaders and the leadership can be rotational.

The indicative ratings show that the demonstration strategy was rated lowest by lecturers. Teaching materials are required to carry out demonstrations. Lecturers acknowledged that they lacked teaching materials to carry out the demonstrations. This could have contributed to the lowest rating of the demonstrations by lecturers as well as the overall rating being the lowest.

The ICT integration strategy was rated lowest by technicians and its overall rating was lowest Though ICTs have the potential to innovate, accelerate, enrich, and deepen skills acquisition, motivate and engage students, they have been challenged by limited ICT resources and skills to exploit the potential of ICT integration in teaching and learning processes.

Formation and use of Group work and discussions therefore needs to be emphasized. The strategy of Group work and discussions should be prioritized to improve the delivery of training. While demonstration and ICTs integration are essential support systems

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The purpose of the study was to determine ways of improving the delivery of training in computing for mechanical engineers in the Department of Mechanical and Production Engineering at Kyambogo University. The specific objectives of the study were to investigate the existing teaching and learning systems in DMPE, identify the missing links in the delivery of training in Computing for Mechanical Engineers, establish appropriate strategies aimed at improving teaching and learning processes in computing for mechanical engineers and to implement and evaluate the strategies aimed at improving teaching and learning processes in computing for mechanical engineering. The method used in the study was situation analysis which involved work process analysis and the future workshop procedures. Evaluation of implemented strategies was done by questionnaires administered on students, lecturers, and technicians who participated in the study.

Findings from evaluation of the implemented strategies indicated that students rated group discussion highest followed by additional time for practice and rated demonstrations and ICTs integration lower in benefiting their learning. The lecturers rated additional time for practice, group discussion and ICTs integration highest and demonstration lowest in benefiting students learning. The technicians rated additional time for practice, Group discussion and demonstration highest and ICTs integration lowest in benefiting students learning

5.2 Conclusions

On the basis of the findings and evaluation of the implementations carried out, the following conclusions are made;

- Additional practice time is necessary for students to repetitively workout skills. This in turn facilitates students to reflect and deeply understand concepts. Additional practice time also helps to align theory concepts to the real work through carrying out practicals.
- Formation and use of group discussions profoundly contributes to improved student knowledge and skills acquisition and is preferred by students inspite of individual disagreements and dominance from some of the group members.
- Integration of ICTs into teaching and learning has the potential to innovate, accelerate, enrich, deepen skills acquisition, and motivate to engage students however its potential is bound to be challenged by inadequate computers in laboratories to accommodate large number of students.
- Integration of ICTs and group discussion can support demonstrations to students. For example video tutorials can aid demonstrations and group members can also demonstrate to others in a social context that can be understood by every one

5.3 Recommendations

On the basis of the conclusions, the following recommendations are made;

- Group work and discussions should be encouraged as students think it benefits their learning supported by ICT
- Equipping laboratories with adequate computers installed with internet connectivity to accommodate all students for a given programme as these are an aid to demonstrations.
- Lecturers and technicians can record demonstration videos and distribute them to students to repeatedly visualize and understand concepts. Thus enriching the learning processes
- Individual dominance and disagreements in group work and discussions can be overcome by having group leaders and the leadership can be rotational.
- Teaching and learning processes should be closely monitored by Heads of Department to enforce rules and regulations that are attached to teaching and learning.

- Suggested strategies to the gaps that were not implemented should be implemented and these include; Collaboration with the world of work to establish the most relevant content to be taught, Requisitioning adequate teaching materials and establishing spacious classrooms , Recruiting and continuous training of staff

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APPENDIX A: WORK PLAN

The action research began in November 2016 and will end in July 2017

Activity	Nov 2016	Dec 2016	Jan 2017	Feb 2017	march 2017	April 2017	May 2017	June 2017	July 2017
Seeking permission fro DMPE, Future work shop, Proposal writing and approval,									
Implementation of practical solutions									
Follow up and planning									
Evaluation, Data analy and drafting report writing									
Final review process and handing in final report									

APPENDIX B: KREJICE AND MORGAN (1970) FORMULA FOR DETERMINING POPULATION SAMPLE

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

"N" population size, "S" is sample size

Source: secondary source

APPENDIX E: QUESTIONAIRE

EFFECT OF ADDITIONAL PRACTICAL TIME, GROUP DISCUSSIONS, DEMONSTRATIONS, AND INTEGRATING ICTs IN TEACHING AND LEARNING PROCESS FOR COMPUTING FOR MECHANICAL ENGINEERS (CME)

Respondents:

Title: ☐ **student** ☐ **lecturer** ☐ **Technician**

Choose by ticking once for every strategy whether it improves student knowledge and skills acquisition in teaching and learning processes of computing for mechanical engineers

STRATEGY	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	DON'T KNOW
Benefited from Additional practical time (more learning activities)					
Benefited from Group discussions					
Benefited from Integrating ICTS into teaching and learning					
Benefited from Demonstrations					