IMPROVING STUDENTS' COMPETENCES IN ENGINEERING DRAWING IN THE DEPARTMENT OF CIVIL AND BUILDING ENGINEERING

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JUNE, 2019

DECLARATION

I, Kato Michael, hereby declare that this is my original piece of work and has never been presented to any institution of higher learning for the award of any degree.

Sign

……....

Kato Michael.

APPROVAL

This is to acknowledge that this thesis report entitled "IMPROVING STUDENTS' COMPETENCES IN ENGINEERING DRAWING IN THE DEPARTMENT OF CIVIL AND BUILDING ENGINEERING", is submitted with the approval of the undersigned research supervisors.

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DEDICATION

I dedicate this study to my family, whose love and support over the years, staked the efforts and levels of commitment that have been necessary to complete this study. Your contributions will remain memorable to me. May the almighty God bless you.

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LIST OF ACRONYMS

APEC	=	Asia-Pacific Economic Cooperation
DCBE	=	Department of Civil and Building Engineering
DIT	=	Directorate of Industrial Training
ED	=	Engineering Drawing
FW	=	Future Workshop
IDA	=	International Development Agency
MVP	=	Master in Vocational Pedagogy
NORHED	=	Norwegian Program for Capacity Development in Higher Education and Research for Development
UNESCO	=	United Nations Educational, Scientific and Cultural Organization
UGAPRIVI	=	The Uganda Association of Private Vocational Institutions
YMCA	=	Young Men Christian Association

ABSTRACT

The study is about improving students' competences in engineering drawing in the department of Civil and Building Engineering at Kyambogo University. The study was guided by the following research objectives; to explore possible strategies that can be used to improve students' competences in Engineering Drawing (ED) at the Department of Civil and Building Engineering (DCBE), to implement the identified strategies for improving students' competences in ED at DCBE and to evaluate the impact of the intervention strategies for improving the students' competences in ED at DCBE. To realise these objectives a descriptive research design based on a participatory approach was employed. The respondents were selected using purposive sampling techniques and the methods of data collection included; interviews, observation and focus group discussions among others. The findings unveiled a number of factors that could have led to observed low competence levels in Engineering drawing, Inadequate practice to perfect the relevant skills in ED, lack of orientation to the relevance of the topic taught, Lack of prior knowledge of the course unit of ED, Non-compliance with examination instructions, inadequate utilization of rubrics and lack of drawing equipment. Intervention strategies to solve the causes were suggested, implemented and evaluated, they included; Weekly hands on group task done, lecturers providing more hands-on tests, exposing students to different question approaches and Sharing and improving of rubrics used in assessing students work by lecturers and then with students. The results revealed that Inadequate competences are still a wide spread pitfall that contribute to poor performance in ED, it was strongly recommended that students should be drawing equipment to fully own practice and also have also be regularly assessment in ED so that inadequacies in students' competences can be easily identified and promptly rectified

CHAPTER ONE: INTRODUCTION

1.0 Overview

This chapter presents the background to the study with a focus on "Improving students' competences in engineering drawing in the Department of Civil and Building Engineering at Kyambogo University." The introductory chapter of this research report focuses on; background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, scope of the study and definition of operating terms.

1.1 Vocational training and vocational pedagogy as a field

The state of Vocational pedagogy and Vocational education has since the inception of the world been developing and its directions being influenced by socio-economic and socio pedagogical factors that have determined its contradictions and flaws.

The periodization of establishment and development of the vocational pedagogical education differs in various countries all over the world. According to Brush (2010), the most notable development is to the United States of America (U.S.A) vocational education which started in the early 20th century. Society was already industrializing before the Great Depression. Then agriculture was less lucrative, and children from rural areas were showing up to attend schools that were already overcrowded. Factories, on the other hand, needed labourers as did many in-demand trade professions. Many workplaces employed young people, when the United States passed its first child labour law in 1916, which was aimed at limiting child labour. It was no longer so widely accepted for young children to sit beside their parents and learn a trade hands on because many lobbyists deemed it unsafe and cruel. So, to help factories find skilled employees and to help schools deal with huge student bodies, U.S.A. high schools began to offer vocational education programs.

In Europe nearly all countries and for many centuries after the establishment of the guilds, the work of artisans and their vocational education and training were very similar. Guilds were associations in which, from the 12th century, people who worked in the same trade or craft joined together in a town or city (CEDEFOP, 2004). According to CEDEFOP (2004), a strict hierarchy held sway throughout Europe under the guild system: apprentice, journeyman, master. The title of master was the only written evidence of competence, while 'certificates of apprenticeship' confirmed completion of the first stage of training. Only after a trial period lasting several weeks were apprentices accepted into a guild. The period of apprenticeship ended with a specialised examination when the apprentice was 'discharged'. Each trade or craft had its own customs for this 'discharge' and for the former apprentice's acceptance into the community of journeymen. Journeymen's vocational qualifications were recognised in other countries. Generally, without family ties, they travelled from place to place, to augment and broaden their skills by learning from masters in other countries: an early form of occupational mobility in Europe. After journeymen had acquired sufficient experience, they would apply to a guild for admission as masters

In Africa, the spirit of independence that swept through the African continent in the early 60s heralded a new era that saw a phenomenal expansion in education and an increased demand for available goods and services. Improvement in health care, led to higher population growth which in turn, put pressure on the demand for education, food, health services, housing, transportation and other needs. As a consequence, there is hardly any African country that has not been affected by these new challenges. The impact and influences on education and training in general and on technical and vocational education and training in particular have been tremendous.

A decade after the independence error, the school programs were no longer relevant to the needs of new nations. They required, besides administrators and clerical officers, cadres

of qualified scientific and technological manpower to take over and develop the nation's productive capacities. Political independence without vocational skills, left the new African nation states still chronically dependent on developed nations and donor agencies. In an effort to overcome this situation most African countries reviewed their educational systems resulting in major changes and innovations (UNESCO, 1996).

According to Ministry of Education and Sports Portal Service Provider: UGAPRIVI (2018), The system of formal vocational skills training in Uganda dates way back in the colonial period, especially in the late 1940's when the World War II former camps were converted into skills training centers to re-train demobilized soldiers and younger children to acquire skills for survival.

In 1947, after world war II, legislation was enacted (1947 Ordinance) which was clearly intended to prevent the exploitation of children who were employed when they were underage and made provisions for contractual agreement of apprenticeship training setting down the rights of the younger employee (apprentice) and obligation of the employer. This led to the establishment of an apprenticeship legislation in 1949. During that time, the general practice of most organizations was to employ a youth as a helper or a cleaner under the name of "Spanner boy". In this way, the boy picked up smattering of skills without proper guidance.

According to UGAPRIVI (2018) in 1952, the Artisan Training Organization was established in Ministry of Labour, headed by the director to train Artisans in various trades. It was particularly put in place for the resettlement of World War II veterans. Later on, in 1953, the trade testing and guidance section was established to assess skills competencies of persons being trained. In order to accelerate vocational training in the country, Uganda established a Directorate of Industrial Training in the Ministry of Labour in 1974. Today the

Directorate of Industrial Training (DIT) operates five training centers. It is responsible for Industrial Training, apprenticeship training, trade testing and certification, skill upgrading and updating courses. Its aims and objectives are to develop, operate and promote an effective and efficient system of Industrial Training on a national and local basis for continued and sustained manpower development in Uganda. The five Government Vocational Training Centers are: Nakawa Vocational Training Institute, Lugogo Vocational Centre, Young Men Christian Association YMCA - Jinja, International Development Agency (IDA) - Jinja and Masulita Vocational Centre. Apart from these five established centers, a number of Vocational Schools run on private basis, exist in the country. Under the Directorate, candidates are required to take Trade Test II (Craftsman trade test) and then after 2 years, can sit for Trade Test I or Master Craftsman Trade Test.

1.2 Background to the study

The background to the study is organized in three sub-sections; personal background and experience, background to Engineering drawing and motivation to the study.

1.2.1 Personal background and experience

I am a graduate teacher with a Bachelor of Education degree in Technological Studies and a Diploma in Secondary Education with Technological Studies from Kyambogo University and also completed a degree in Civil Engineering from Ndejje University. Before taking up the Master's degree in Vocational Pedagogy at Kyambogo University under the NORHED programme, I was actively involved in the teaching of Technical Drawing at secondary school level and also worked with the Department of Civil and Building Engineering (DCBE) of Kyambogo University as a lecturer of Engineering Drawing. During the fourteen years of teaching I have served different institutions including Buloba High school, Masaka Secondary School, St. Peters Secondary School Nsambya and Kyambogo

University. Currently I am working with Kyambogo University as a part-time lecturer at DCBE and in addition I do architectural drawings of buildings on private work basis.

Throughout the period that I have served in teaching technical subjects, I have observed that it requires a multi-pronged teaching approach to properly equip the learners with the necessary skills and knowledge. This is owing to their varied back grounds, the necessary learning aids and individual attitudes of the learners that determine the direction and technique of teaching. This is very important in order to provide an environment that brings all the learners to move on the same page. Many learners who join technical subjects have a pre-conceived mind and target skills for work as the end result of their education career. Personal experience has shown that they have little patience with learning areas where they think they will have less attachment to the specific trade that led them in the field of study, even if it is the foundation of their destiny.

It is, therefore, imperative that various pedagogical approaches like use of project-based learning are employed in order to interest the learners in these fields of study or else elements like dodging lessons, not practicing drawing and the like will affect the learner's competence attainment.

1.2.2 Background to engineering drawing

Historically, the term 'engineering' stems from the word 'engineer' used in the 1300s for a person who operated a military engine or machine – such as a catapult, later, or a cannon. The word 'engine' in turn is derived from the Latin word 'ingenium' for ingenuity or cleverness and invention (UNESCO, 2010). UNESCO (2010) explains that, early interest in the development of engineering education took place in Germany in the mining industry, with the creation of a school of mining and metallurgy in Freiberg in 1702. According to UNESCO, the École Polytechnique, was the first technical university in Europe teaching the foundations of mathematics and science and was established in 1794 during the French

Revolution. The French model influenced the development of polytechnic engineering education institutions around the world. At the beginning of the nineteenth century, especially in Germany and Russia, similar schools of technology were opened and by the end of the nineteenth century, most of the now industrialized countries had established their own engineering education. In the twentieth century, the professionalization of engineering continued with the development of professional societies, journals, meetings, conferences, and the professional accreditation of examinations, qualifications and universities, facilitating education, the flow of information and continued professional development. These processes will continue with the development of international agreements relating to accreditation and the mutual recognition of engineering qualifications and professional competence, which include: the Washington Accord (1989); Sydney Accord (2001); Dublin Accord (2002), The Asia-Pacific Economic Cooperation (APEC) Engineer (199); Engineers Mobility Forum (2001) and the Engineering Technologist Mobility Forum (2003), and the 1999 Bologna Declaration relating to quality assurance and accreditation of bachelor and master programmes in Europe.

In Africa modern engineering education started in Egypt after the outcome of the French Expedition led by Napoleon Bonaparte which occupied Egypt from 1798 to 1801. Governing from 1805 to 1848, Mohamed Aly, the founder of Egypt's Royal Dynasty, sought to implement a ‘new order’ in the administration of the State he inherited from the Ottoman Empire by introducing a Western-style bureaucracy. French military engineers proved to be very important in Aly’s desire to modernize the State. French influence also came via Egyptian students sent to study at the Ecole Polytechnique in Paris. Returning from their first mission in 1826, these students formed the nucleus of the new Egyptian engineering community. Aly’s government established the first School of Engineering in 1816, located in Saladin's Citadel, as well as a regular school in (Bulak, Cairo). In 1858, two new engineering

schools were created under the government of Ismail (1848-1863) who, even more so than his grandfather Mohamed Aly, wanted to model Egyptian institutions after those in France. Located at the Delta Barrage, north of Cairo, the first of the new schools was dedicated to irrigation while the second, housed in the Citadel, specialized in architecture. They were replaced in 1866 by a single school that included both disciplines: The School of Irrigation and Architecture. Following the French model of the Ecole Polytechnique and Ecole des Mines, the school curricula privileged theoretical studies, especially mathematics. However, soon the Ecole Centrale des Arts et Manufactures proved a more adequate model since its curriculum was more geared toward industry. It was after Egypt that as a result of European colonization that Engineering education spread all over Africa.

According to the Faculty of Engineering Kyambogo University (2018), Engineering education in Uganda got its roots in 1921 at Kampala Technical College (KTC). To make a comprehensive unit of study in 1922, KTC added vocational subjects to the technical subjects. In 1928 KTC was transformed into Kampala Technical School (KTS) which was located on the slopes of Makerere hill. It was from KTS that in 1942 the Engineering School was formed at the current Makerere University playground which was later transferred to Nakawa.

In 1954 the Engineering School was transferred to Kyambogo as Kampala Technical Institute (KTI). In 1964 KTI was upgraded to the Uganda Technical College (UTC) Kyambogo and in 1984 UTC became part of the Faculty of Technology of Makerere University. In 1986, it was retracted from Faculty of Technology, Makerere University and upgraded to Uganda Polytechnic Kyambogo (UPK). The Faculty of Engineering was then formed in 2001 from the former Schools of Civil and Building, Mechanical and Production, Electrical and Electronic Engineering of the Uganda Polytechnic Kyambogo (UPK) and the former Department of Technological Studies of former Institute of Teacher Education

Kyambogo (ITEK) when the Government of the Republic of Uganda kick-started Kyambogo University by merging UPK,

ITEK and former Uganda National Institute of Special Education (UNISE). The faculty of engineering was rebirthed and composing of the Department of Civil & Building Engineering (DCBE), Department of Mechanical and Production Engineering (DMPE), and the Department of Electrical and Electronic Engineering.

1.3 Statement of motivation

The researcher's experience in the field of engineering drawing as a teacher positioned him to realise that success and progress in the mentioned discipline requires good knowledge of computer use. However, he also realised that fully utilising computer aided programs not only requires good knowledge of computer use but also adequate knowledge of computer use but also adequate knowledge of manual ED concepts. The researcher's observations on the challenges associated with the learners' ability to gain desired competences in the field of Ed and his exposure to MVP programme has also equipped the researcher with immeasurable knowledge and skills in action research have acted as spices for conducting this study.

1.4 Situation analysis

Consequent to the indications of vision 2040 that show the need for relevant Vocational education and focusing on education for work and green jobs and its target to shift from education certificates to skills and competences for the labour market, together with the stakeholders from DCBE we opted to contribute to this cause and as a result the researcher was tasked to carry out a situation analysis. It was then that the researcher together with the students, lecturers and other staff carried out a situation analysis with a purpose of critically studying the challenges that affect the skills acquisition at DCBE.

In this analysis together with the stakeholders, the researcher found out that; the lecture rooms were not enough, students did not give enough time for academic work, the assessment

feedback from lecturers was inadequate, the performance of students was poor in a number of course units that required skills employment, stakeholders noted that a lot of time is spent on strikes by both the students and the university staff and also found out that a number of students do not do the course works and assignment on their own. Resulting from this analysis the stakeholders agreed that to contribute to the improvement of the prevailing situation the focus would be put on improving the performance of Engineering Drawing (ED) because it is one of the core course units that requires the employment of skills and that the researcher is a lecturer of the same course unit at DCBE.

The problem of poor performance in ED was then subjected to a future workshop to critically analyze and come up with measures to solve the problem. A Future Workshop (FW) was planned and scheduled for 7th February, 2018 at 2:00pm, at NOMA House 1 in Kyambogo University. The Future Workshop was used as a research tool to identify causes and to lay possible strategies for improving students' performance in ED. During the future workshop, four phases were critically observed; preparation phase, critique phase, fantasy/utopia phase and reality phase. The preparation phase started by the researcher inviting the mentor, supervisors and stakeholders for the workshop, purchased the writing materials (Pens, papers, markers and manila papers) and refreshments, organized Noma 1(the room where the workshop was to be held). The researcher then briefed the participants about what a future workshop is, guided them on the rules and procedures to be followed in the course of the workshop before the critique phase began. The guiding principles for this future work shop were that; the participants were to generate ideas through brain storming, there were to be no criticisms of each other's ideas, short responses and a combination of ideas were to be permitted and that every one's ideas were to be respected.

The Critique phase was the actual start of the workshop where the participants critically and thoroughly investigated the cause for failing engineering drawing examinations at DCBE.

The photograph in fig. 1 shows participants and the mentor in the plenary session at the future work shop.

Figure 1: Participants and the mentor in the plenary session at the future workshop.
Source: Primary data, (2018)

During this session, brainstorming was used as a tool for idea generation from which participants pointed out the causes for failing engineering drawing. Many crucial points were generated. However, due to the large number of issues raised, the participants agreed to cluster the issues into categories of:

Inadequate practice to perfect the relevant skills in ED, where participants said that learners only do practice when the examination time table is pinned while others hinted that some students lacked interest in the course unit. Some added that they lacked connectivity (lacked mental imagery). This clearly indicated that students do not have adequate practice. The second clustered cause of failing engineering drawing was lack of orientation to the relevance of the topic taught. According to learners, at times they are not aware of the contribution of some particular topics in field of work. This does not motivate them to pay attention to it.

Lack of prior knowledge of the course unit of engineering drawing was another identified cause that led to failing engineering drawing examination. This was mainly attributed to learners who did not do Technical drawing at Secondary school level or other tertiary institutions prior to joining Kyambogo University for the Engineering course.

Non-compliance with examination instructions was also identified as a major reason for failing engineering drawing examination. According to one lecturer (name withheld), there is poor question interpretation. Students answer questions that are not asked on paper. He cited an example where the question requires students to draw in first angle orthographic projection and instead, the students present the work in third angle orthographic projection. On another occasion, he added, some students were asked to demonstrate the use of some concepts accurately instead they just forged. While some students agreed that it is really difficult to complete the work in time and so we do it without the required instruments in order to work within the scheduled time. Other suggested reasons for this include; lack of neatness and poor time management according to examination instructions.

Students' on the other hand mentioned the inadequate utilization of rubrics by lecturers and therefore lacked ideas on how the examinations are marked. The students alleged that some lecturers do not follow any standard when marking their drawings. The last points were clustered in the point of lack of drawing equipment by students for practice and use in exams.

In the fantasy phase (also known as utopia) participants worked out an imagination and drew exaggerated pictures of the future possibilities of the problems identified in the critique phase. In this process together as participants we put the ideas that were collected in an "idea store", regardless of their practicability. Then the problems were imagined to be fixable and we turned all the negative ideas into positive ones. Stakeholders imagined that every situation was possible and resources were available to address them in this Utopia phase of

the future workshop. The points turned from negative to positive were; Adequate practice to perfect the relevant skills, Get orientation to the relevance of the topic to be taught, Have prior knowledge of TD to enable the students easily catch up, Compliance with examination instructions, Adequate utilization of rubrics by both students and lecturers, and Students have personal drawing equipment. However, since this was not an ideal situation, the participants (together with the researcher) were compelled to move to the reality phase of the future workshop where a more realistic situation would be attained.

In the reality phase the ideas participants agreed to set objectives of how to address each of the points that had been turned into positive ones and also suggested the duration which they could take to be addressed as shown in table 1.

Table 1: Summary of the agreed points and set objectives identified as either long term or short term.

Points	**Set objectives**	**Person responsible**	**Period**
1. Adequate practice to acquire relevant skills	Weekly hands on group task done 6hrs a week	- Students and lecturer	short term
	Provision of more time on the departmental time table	-Department load allocation committee	long term
	Lecturers to provide more hands-on tests after every 2 weeks.	-lecturer	short term
2. Provide orientation on the relevance of the course unit to the students at the start of the course	Give basics of engineering drawing to all first-year students taking engineering	- head of department - lecturers - dean of faculty	long term
3. compliancy with examination instructions	Emphasis on the importance of examination instruction to the candidates	- lecturer	long term
	Exposing students to different question approaches during the course of lecturing.	-lecturer	short term
4. Adequate utilization of rubrics by both students and lecturers.	Formulation and explanation of rubric plates by lecturer to the students.	-lecturer	short term
5. Students should have personal drawing equipment.	Making it compulsory to students to have equipment during lectures	-head of department and lecturer	long

Source: field data (2018)

At this point the participants unanimously agreed to take all the short-term objectives for action implementation as a means to improve students' performance in their final ED exams. Table 2 shows the action plan with the agreed action points, the processes to achieve them, the duration within which they would be expected to be addressed and the personalities responsible for each action point.

Table 2: Action plan

Action point	**Action process**	**Time**	**Person responsible**
Weekly hands on group task done 6hrs a week	• Lecturer identifies tasks and gives them to the students • Students form groups and leaders ensure that every one participates • The group leader submits the done tasks to the lecturer	6 hours a week (Every group identifies appropriate time)	• Students • Lecturers • Group leaders
lecturers to provide more hands-on tests	• Set the tests • Allocate time for the test • Doing the test • Supervising, Collecting, Marking, recording and returning scripts	After every 2 weeks.	• Lecturer • Lecturer & students • Lecture
Exposing students to different question approaches during the course of lecturing.	• State a question and elaborate on it. • Gives an opportunity for the students to share their views before he elaborates	During the lecture	• Lecturer & students
Formulation and explanation of rubric plates by lecturer to the students.	• Lecturers meet and agree on scoring format • Come up with assessment plate • Attending sessions for sharing assessment plates • Practicing what is being told.	2 weeks from the time of the FW When given tasks and when revising the tasks with the students	• Lecturer • Lecturer • Students • Students

Source: Field data (2018)

Owing to the fact that the students were being taught what their program requires and the suggested strategies, the stakeholders saw that the strategies were contributing to competence improvement and so decided that 'improving students' competences in the

DCBE' was needed in order to stake the students' performance in ED and consequently contribute to skills and competences for the labour market

1.5 Statement of the problem

For EDs to be well read, they should be accurate, clear, consistency, well dimensioned, have good line work and have well interpretable symbols. In training students, efforts have been made to equip them with the aforementioned skills. However, students were seen not to fully apply these competences in their examinations. This was attributed to disablements as noted in the FW with the stakeholders. Therefore, addressing these issues was imperative in order to improve students' competences in ED at the DCBE in Kyambogo University.

1.6 Purpose of the study

The purpose of this study was to improve students' competences in Engineering drawing at DCBE.

1.7 Specific objectives of the Study

The objectives to this study were;

i) To explore possible strategies that can be used to improve students' competences in ED at DCBE.
ii) To implement the identified strategies for improving students' competences in ED at DCBE.
iii) To evaluate the impact of the intervention strategies for improving the students' competences in ED at DCBE.

1.8 Research questions

The research questions to this study were;

i) What are the possible strategies that can be used to improve students' competences in ED at DCBE?
ii) How can the identified strategies be implemented to improve students' competences in ED at DCBE?

iii) How can the intervention strategies be evaluated to show the extent of students' competence improvement in ED at DCBE?

1.9 Significance of the Study

The findings of this study redounded to the benefit of the society considering that ED plays an important role in the engineering fields. The greater importance for societal-engineering demands justifies the need for a more effective life teaching approaches. Thus the scholars and departments that apply the approach derived from this study will be able to make better competent engineers. For the researcher the study was not only useful to improving his competences in conducting an action research but also enabled him improve in the teaching and learning process of ED and to the students as stake it improved their competence acquisition in ED at DCBE.

1.10 Limitations

Although the study was fully completed, there were some unavoidable limitations. First because the study was conducted during the semester when the students and lecturers were busy, getting time for carrying out the implementation activities was based on the available free time on the timetable which was also affected by course works and other extra activities on the side of the students. Also, the experiences from the research showed that not all stake holders' attitudes were good, some of the students carried out the experimentation activities for the sake of it while others were compelled to carry out the implementation activities. These could have undermined the quality of the findings.

1.11 Scope of the study

1.11.1 Geographical scope.

The study was conducted at DCBE, in Kyambogo University which is located in Nakawa division approximately 10 kilometers from Kampala the capital City of Uganda. DCBE was

chosen because the researcher is a lecturer within the department and would ably interact with the stakeholders in the same department.

1.11.2 Content scope.

The content scope of this study was based on the research objectives of this study and these were;

i. To explore possible strategies that can be used to improve students' competences in ED at DCBE. Under the is objective, the researcher explored the different strategies put in place by various scholars to ensure good performance in ED.

ii. To implement the identified strategies for improving students' competences in ED at DCBE. Under this objective, the researcher investigated various strategies for implementing the identified strategies.

iii. To evaluate the impact of the intervention strategies implemented for improving the students' competences in ED at DCBE. Under this objective, the researcher examined various evaluation strategies and their impact on improving students' competences in ED at DCBE.

1.11.3 Time frame.

This study was conducted from April to November 2018

1.12 Definition of operating terms

Action research: Lesha, (2014) refers to action research as a model of professional development that promotes collaborative inquiry, reflection, and dialogue. "Within the action research process, educators study student learning related to their own teaching. Lingard, (2015) on the other hand looks at action research studies in a more elaborative way; in his opinion, action research, (also referred to as community-based research, participatory action research, or collaborative inquiry), is not done on or with participants; research is designed, carried out, and integrated by the participants in partnership with the researchers. Based in

emancipatory social theory and designed to democratize the research process, action research is an iterative process in which researchers and practitioners act together in the context of an identified problem to discover and effect positive change within a mutually acceptable ethical framework.

Teaching: refers to a deliberate course of action that involves planning, implementation, assessment and evaluation of instructional activities and experiences to ensure learning outcomes.

Learning: Rossum and Hamer (2010) connote that Learning is seen as using a way of thinking (a skill) to arrive at an informed view.

Engineering Drawing: Chedi (2015) alludes to Igbnomwanhia and Alui the assertion that Engineering Drawing is a technical drawing used to represent and communicate thoughts and designs with sufficient precision to others.

Pedagogy: as distinct from 'curriculum' refers to the processes of teaching, in particular interaction with learners, but also planning and designing learning situations (Lucas, Spencer, & Claxton, 2012).

Competences: are clusters of related abilities, commitments, knowledge, and skills that enable a person or an (organization) to act effectively in a job

Action research: AR is the superordinate term for a set of approaches to research which, at the same time, systematically investigate a given social situation and promote democratic change and collaborative participation (Anne Burns, 2015).

CHAPTER TWO: LITERATURE REVIEW

2.0 Overview

This chapter presents the theoretical and conceptual framework, works of other researchers about participatory Action research and improving students' performance in engineering drawing examinations. The analysis on improving students' performance will be based on the study objectives of identifying factors affecting the performance of engineering drawing examinations, possible strategies to be used in improving the performance in engineering drawing, ways of implementing the identified strategies to improve performance in engineering drawing examinations and ways of evaluating the impact of intervention strategies used to improve the performance in engineering drawing.

2.1 Theoretical Frame work

A teacher plays an active role in the teaching and learning process with more emphasis put on the learner for whom the learning is intended. Felder and Brent (2003) point out that the only way a skill is learnt is through practice. It involves trying out something, seeing how well or poorly it works, reflecting on how to do it directly, and try it again to see whether it works better.

The experiential learning theory (ELT) on which this research is to leaned as defined by Armstrong (2008) in relation to Kolb's experimental learning theory states that learning involves the acquisition of abstract concepts that can be applied flexibly in a range of situations providing a holistic model of learning process. This study views Kolb's model as relevant since it aims at capturing the nature of learning through action. Hence, the theoretical frame work chosen for this study is relevant because the study is based on the reflective practice which relates with experiential learning used to enhance performance in engineering drawing.

Kolb's learning theory argues that we learn from our experiences of life, even on an everyday basis and also treat reflection as an integral part of such learning.

According to Kolb (1984), the process of learning follows a pattern or cycle consisting of four stages, one of which is referred to as 'reflective observation'. In the context of ED, it will be looked at as regular practice which involves actions that help people pay attention to and learn from experiences. Examples of which included; observing the present level of performance, noting accomplishments, analyzing strengths and areas for improvements, analyzing and developing identity, and improving levels of knowledge (Elger, 2007). Kolb's experiential learning theory stages are illustrated and summarised in figure 2.

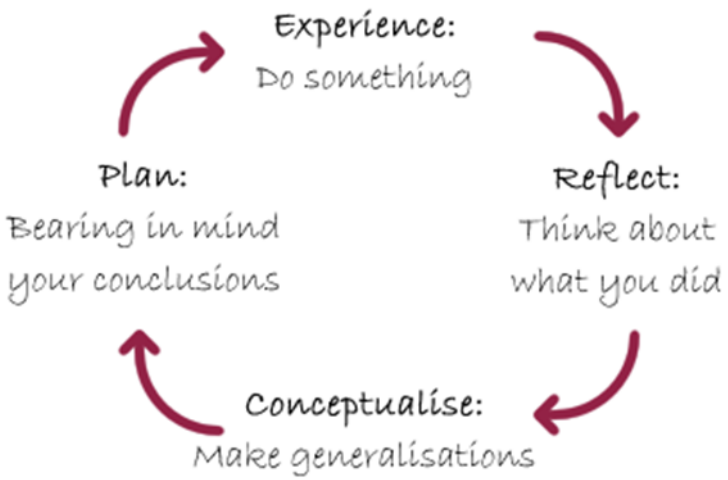

Figure 2: Illustrated stages of Kolb's learning Theory

In Kolb's first stage he states that Life is full of experiences we can learn from. Whether at home or at work or out and about, there are countless opportunities for us to 'kick-start' the learning cycle.

In his second stage he looks at reflective observation as that that involves thinking about what we have done and experienced. Some people are naturally good at this. Others train themselves to be more deliberate about reviewing their experiences and recording them.

When we pass from thinking about our experiences to interpreting them we enter into the realm of what Kolb termed 'conceptualization'. To conceptualize is to generate a hypothesis about the meaning of our experiences

In the last stage, the active experimentation stage of the learning cycle we effectively 'test' the hypotheses we have adopted. Our new experiences will either support or challenge these hypotheses.

To learn from our experiences, it is not sufficient just to have them. This will only take us into stage 1 of Kolb's cycle. Rather, any experience has the potential to yield learning, if we reflect on our experiences, go through them again we should be able to conceptualise them. It is on this process that this study was anchored, arguing that through regular practice of tests, group tasks and understanding question approached plus rubrics for assessment then reflections on previous assignments would compel students to conceptualise the competences required for ED.

2.2 Theoretical Framework visualised

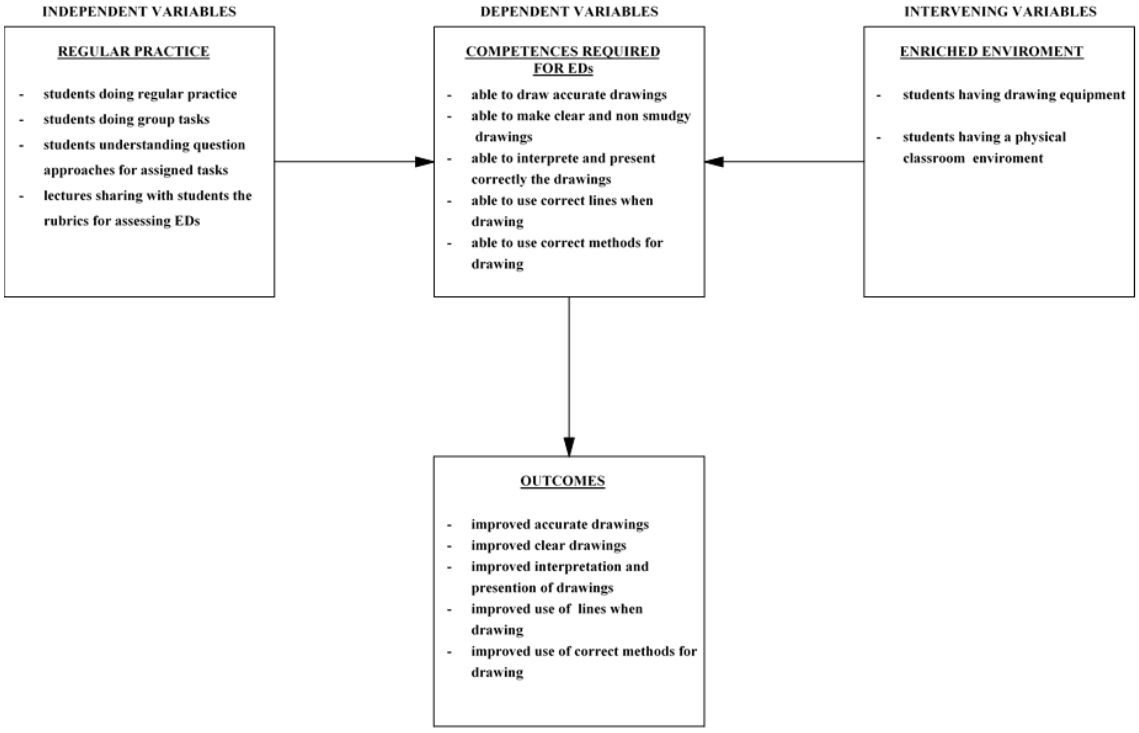

Figure 3: Theoretical framework visualized.

According to Armstrong (2008), while some factors that influence improving performance are immutable, other factors can be influenced by the performer or by other factors. The factors looked at in this conceptual frame work are those that can be varied to enhance the competence of the students in ED and these included:

Regular practice, which involves actions that help students pay attention to and learn from experiences. In which participants do regular tests and assignments, students doing group tasks every week, lecturers sharing with students on how to approach questions on every task given to them and students knowing the required rubrics for assessment of their work. This assists students to know their present level of performance, noting accomplishments, analyzing strengths and areas for improvements, analyzing and developing identity, improving skills and levels of knowledge.

Immersion in an enriched environment, which involves checking the physical classroom environment, active learning with required tools and equipment, actions that engage students' emotions (both positive and negative) where the students are given challenging goals, allowing failure as a natural part of attaining high performance, and providing conditions in which the students feel an appropriate degree of safety. These factors act as motivators for the students to ably practice and consequently improve their competences. For this study this factor was attained in choosing the participants who felt motivated to move with researcher through the entire research process.

2.3 Participatory action research

The study was based on the theoretical underpinnings of working together as a group in laying strategies for solving common concerns, (Wenger, 1998). The Action Research approach (community–based) used in this study was demonstrably supported by this underpinning.

A community of practice being one which grows naturally because of the members' common interest in a particular area or one created deliberately with a goal of gaining knowledge related to a specific filed, a community-based Action research on the other hand encourages collaboration between study participants and the researcher in all phases of the study. According to Hendrick (2006, as cited in Chiou-hui, 2010), said collaborative action research is a system of action research in which multiple researchers from school settings work together to study educational problems.

Similarly, Schon (1983), suggests that in a reflective practice, continual interpretation, investigation and reflective conversation with stakeholders about the problem while employing the information gained from past experiences to inform and guide new actions for learning. He adds that this process of experimentation, reflection and action combined, is cyclically conducted as the problem is continuously framed and reframed and as solutions to complex or ambiguous problems are systematically sought. The goal of this type of research is to utilize the expertise of the collaboration and to foster sustained dialogue among educational stakeholders in different settings. In addition, Wenger explains that it is through the process of sharing information and experiences with the group that members learn from each other and have an opportunity to develop personally and professionally.

In this study, stakeholders were involved in all phases from planning, holding the future workshop and identifying the problems, suggesting possible solutions, implementing the follow up and evaluating of the impact of the identified strategies. This is supported by Meyer (2000), who maintains that in action research, practitioners identify any existing problem, seek and implement practical solutions and systematically monitor and reflect on the process and outcome of the change. This therefore, implies that the participants and the researcher are co-researchers throughout the entire research process and that participants and the researcher join together in improving democratic and social changes within the

institution. It was against this background that a participatory action research design was used in this study.

2.4 Strategies for improving students' competences in ED

Competence attainment and use have become key areas in the world of work today. The education institutions have therefore bent on linking work requirements and training goals. Competence attainment in ED is an area of concern in today's Engineering core course results. The main strategy for checking on competence attainment is to first identify the challenges students encounter in competence attainment before we could see them improved. Students have a variety of challenges in ED with predominant ones being having difficulties with the ability to; see images in 3-dimension, understand projection view methodologies, produce drawings of professional quality, and the ability to read and interpret EDs (Kosse, 2005; Akasah and Alias, 2010; Rio et al., 2006; Jayasree, 2003). Dirasio (2013), argued that varied factors lead to the challenges students encounter in acquiring ED competences. He identified the teaching approach, instructional and educational items, acquisition of the fundamental knowledge of the subject in secondary education, learning atmosphere and time allocated for the subject as key factors that affect the performance in ED. On the other hand, Radheshyam and Gajghat (2017), postulated that there are so many independent factors which affect the students' competence acquisition in ED. According to them, these factors include pre-schooling background, family background, personal characteristics, college environment and learning habits etc. These factors may be broadly classified into academic and non-academic factors.

Vygotsky (1978), in his theory of Vygotsky's Zone of Proximal Development, asserts that external stimulation (non-academic factors) highly influence the child's cognitive development and as a consequence affect their levels of competence acquisition. He mentions the lack of external stimulation as cultural deprivation. In terms of cultural and

environmental influences on intelligence, Vygotsky refers to children who did not develop the necessary cognitive skills as 'culturally deprived.' He looked at a culturally deprived child as one without access to culturally intact situations in which the mediator/cultural agent/caregiver played a vital role.

Vygotsky claims that individuals' attainment of higher mental functions was rooted in the use of physical tools (for example, sticks, lego blocks and symbols. He emphasizes that both physical and symbolic tools were invented in culture and that children come to master such tools during the process of socialization. I am aware that in Uganda most females do not get exposed to technical subjects at an early age largely owing to culturally-assigned gender roles.

In terms of Vygotsky's theory, they would be conceptualized as culturally deprived in these subjects. This tells how much the family and personal backgrounds affect the performance of students in ED besides the academic environment. Vygotksy also asserts that higher mental functions are integrally tied to social interactions.

The importance of social interactions was also illustrated in what he termed the "zone of proximal development" (ZPD). This would be the zone between the level of problem solving an individual can do in isolation and the level of problem solving an individual can do in social situations involving other more knowledgeable individuals. This type of zone would be found among students studying together in study groups, in which they have the opportunity to work with more knowledgeable peers. In my experience as a lecturer at DCBE, Vygotksy's theory of proximal development is in tandem with the causes of inadequate competence acquisition, where learners gain more learning experiences when they work in peer groups.

As Radheshyam and Gajghat (2017) postulated that also academic factors also affect students' competence acquisition in Engineering drawing. Faser and Killen (cited in

Radheshyam et al ,2017) in their research, investigated the different perceptions of students and lecturers on factors that affect examination performance and according to their findings, lecturers perceived student's failure in examinations as being caused by inadequate or poor examination preparation, lack of self-discipline and lack of self-motivation ranked 1st, 2nd and 3rd, respectively. They posted that students wait for the time- table to be displayed before they can start reading. Consequently, they do cram rather than understand. Yet on the contrary, students suggested that boring presentations by lecturers, unclear criteria and lecturers' expectations of assignments coupled with lack of self-motivation were given 1st, 2nd and 3rd, rankings, respectively. I concur with the findings by Faser and Killen in so far as I have witnessed bright students of ED perform well below their abilities owing to poor preparation and lack of self-motivation.

In a recent research by Muhdin (2016), he pointed out University entrance examination score, family financial situation, sleeping time and study habits to be significant factors which affect students' academic performance. I also agree that sleeping time and study habit affect students' performance because they engage more in social life thus sleeping late and not focusing on practicing the taught skills. Unstable family financial situations also affect students, whereby they have to be engaged in fending for themselves instead of studying and or practicing the taught skills. This comes with a lot of worries especially where the student is worried about impending deadlines of paying school fees. This is evident with students of Engineering at DCBE were many contribute to their school fees.

Also, an instrument developed by Rita Kizito et al (2016), to identify and examine factors affecting student academic performance showed that workload was found as the factor which has the greatest impact on student's academic performance. I can attest that when students are given a lot of assignments they get overwhelmed and end up either doing

it just for the sake of handing in within the stipulated time or failing to hand in the work altogether.

Based on the findings of Kapil and Sridhar (2014), that freshman Engineering students face various difficulties in learning Engineering drawing course, is a well-known fact. Akasah and Alias (2010) also share a similar view that one of the major difficulties ED students face is that of transformations between two- dimensional (2D) projections and three-dimensional (3D) views of objects. They explain that conventional instruction methods require students to practice sketching and drawing for longer durations but this does not guarantee the elimination of these difficulties entirely. Yet this is the most appropriate method employed at DCBE.

According to Cincou (2013), in modern instruction methods instructors make use of software tools such as computer-aided design (CAD), multimedia tutors and web-based instructions as a supplementary visual aid in learning but these techniques are spread over weeks. Although these techniques are useful in improving ED skills, certain difficulties such as interpretation of EDs required for 2D and 3D transformations still remain as observed with students at DCBE.

Sorby (2009), suggests that the possible reasons for this are students' poor spatial ability or the instruction method. Mental rotation ability is a major component of spatial abilities and found to be important in learning and solving problems of ED, especially in orthographic projections. Research study according to Potter and Van der Merwe (2000), submitted that students vary in spatial ability and that students with low scores on tests of three-dimensional spatial perception are at risk as regards passing the first year ED.

Saima and Qadir (2011), from their findings concluded that; (i) at university level most of the psychological, physical, socioeconomic and educational factors affect students' performance in examination (ii) the in-pattern of question papers in the examination affects

student's performance (iii) unfair means in examination affect their performance (iv) lack of proper guidance affect students' competence acquisition.

I am in agreement with the findings of Saima and Quarter because the physical factors, socioeconomic factors, the way the examination is prepared and the guidance given to the students truly impact on their psychology and hence determine their performance in examinations.

The results of students are the highest concern of engineering education system. It is from various course units that the results are computed. The performance of engineering drawing has become an area of concern in today's engineering course results. Students have a variety of challenges in engineering drawing with predominant ones being difficulties to see an image in 3-dimension, understanding of projection view methodology, producing drawings of professional quality, and reading and interpreting engineering drawings (Kosse, 2005; Akasah and Alias, 2010; Rio et al., 2006; Jayasree, 2003). Dirasio (2013), argued that varied factors lead to the challenges students encounter in engineering drawing.

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Academic factors also affect students and were observed by a number of scholars. Faser and Killen (cited in Radheshyam et al , 2017 p.105) in their research, investigated the different perceptions of students and lecturers on factors that affect examination performance

and according to their findings, lecturers perceived student's failure in examinations as being caused by inadequate or poor examination preparation, lack of self-discipline and lack of self-motivation ranked 1st, 2nd and 3rd, respectively. They posted that students wait for the time- table to be displayed before they can start reading. Consequently, they do cram rather than understand. Yet on the contrary, students suggested that boring presentations by lecturers, unclear criteria and lecturers' expectations of assignments coupled with lack of self-motivation were given 1st, 2nd and 3rd, rankings, respectively. I concur with the findings by Faser and Killen in so far as I have witnessed bright students of engineering drawing perform well below their abilities owing to poor examination preparation and lack of self-motivation.

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I am in agreement with the findings of Saima and Quarter because the physical factors, socio-economic factors, the way the examination is prepared and the guidance given to the students truly impact on their psychology and hence determine their performance in examinations.

2.5 Possible strategies to be used to improve students' competences in ED

Previous studies proved that students' university results can be improved by predicting the influencing factors which affect their academic performance at university level. It is through understanding these effects that possible strategies can be set to improve the students' performance as corroborated by McKenzie (2005), who asserts that exploration and utilization of a diversity knowledge and perception in an individual makes new sense of its opportunities so as to be able to design innovative actions that enhance the robustness of an organization's relationship.

A Research study by Samsudin, Rafi & Hanif (2011), reveals that a student with low mental ability can improve his mental ability by using mental rotation. Mental rotation is the time required to recognise that two dimensional drawings portray objects of the same three-dimensional shape (Shepard & Metzler, 1971). According to Samsudin et al (2011), eight weeks of mental rotation training improves mental rotation ability and students with high scores in mental rotation (MR) perform better than students with low MR scores in a multi-view orthographic drawing task. Kadam, Sahasrabudhe, and Iyer (2012), "In our previous work we established that 3-hour MR training using Blender improves MR skills of first year undergraduate engineering students". We then continued to investigate the effectiveness of the MR training on improvement of engineering drawing problem solving skills. In this paper, we present the findings of our study on the impact of a 3-hour Blender-MR training on students' problem-solving skills in engineering drawing. Results revealed that our treatment for improving engineering drawing problem solving skills through three-hour Blender-MR

training was effective." The qualitative analysis revealed that training helped alleviate the difficulties that students typically face while solving engineering drawing problems.

With a similar view Van der Merwe and Potter (2000) reported that students with low scores on tests of three-dimensional spatial perception can be trained to use mental imagery but may require extended exposure to exercises involving modelling and sketching which link three dimensional models to different views used in Multiview sketching and drawing. Linked with mental rotation are the findings of Dewey (1997), who analyzed and pointed out that to learn from experience is to make a backward and forward connection between what we do to things and what we enjoy or suffer from things in consequence. In his analogy he supports Van der Merwe's requirement for extended exposure of exercises as well as mental rotation. He laments that in linking learning with backward and forward connections, doing becomes a trial experiment with the world to find out what it is like whereas its undoing becomes instruction, that is, discovery of the connection of things. Based on the great Roman leader Julius Caesar's proverb that "Experience is the teacher of all Things'' I perceive experience as a practical situation an individual has gone through in life.

Other independent thoughts like Steenkamp, Baard and Frick (2009), indicated that good class attendance, adequate examination preparation, sufficient time management and availability of English tuition were the main factors responsible for good performance whereas the study conducted by Sarath, Gail and Hudson (2006), suggested that ability variables like motivation and study time significantly influence academic performance. My experience also shows that good examination preparation and adequate study are crucial factors in motivating students to perform better in examinations. Marburger (2006), also suggested that an enforced mandatory attendance policy significantly reduces absenteeism and consequently improves examination performance. My stay at Noma has given me an

experience which proves Marburger's assertion that when the enforced mandatory attendance policy is used absenteeism is minimized.

CHAPTER THREE: METHODOLOGY

3.0 Overview

This chapter will highlight the research design, study population, sampling method, data collection methods, tools and instruments used in the action research study.

3.1 Research design

A descriptive research design based on participatory approach using qualitative method will be used (Dick, 2001).

3.1.1 Participatory Action Research design (PAR).

The study will employ a participatory action research approach because it is considered democratic, equitable, liberating, and life-enhancing qualitative inquiry that remains distinct from other qualitative methodologies Using participatory action, qualitative features of an individual's feelings, views, and patterns are revealed without control or manipulation from the researcher. The participant is active in making informed decisions throughout all aspects of the research process for the primary purpose of imparting social change (MacDonald, 2012). It will therefore allow the stakeholders to freely diagnose the problems affecting the engineering department through the situation analysis and develop practical solutions to address them quickly and efficiently. It will offer a complete description and analysis of a research subject without limiting the scope of the research and nature of participants' responses. The key participants will be assigned responsibilities and dates of completion.

3.1.2 Qualitative approach

This study will employ the qualitative research design because it is a means for exploring the behavior, perspectives, experiences and feelings of people and emphasizes the understanding of these elements. The rationale for using a qualitative approach in this research will be to explore and describe the opinion of stake holders on the performance of students in engineering drawing examinations. The study will involve three main phases of

first carrying out a situation analysis to define the problem and articulate implementation strategies, participatory implementation of the identified strategies and evaluating the outcomes of the implementation.

Descriptive studies are usually the best methods for collecting information that will demonstrate relationships and describe the world as it exists. These types of studies are often done before an experiment to know what specific things to manipulate and include in an experiment.

3.2 Area of the Study

The area of study was DCBE targeting mainly the administrators, lecturers and the students. DCBE was selected because it is one of the engineering courses that use ED in everyday life.

3.3 Study Population

With special reference to this study, the target population will comprise of 32 participants in the following categories: 25 students, five lecturers, the secretary and administrative assistant.

3.3.1 Sample Size and Selection

The sample size representative of the stakeholders in this study were 32 participants. It was determined based on the Krejcie and Morgan's sample size calculation which is the same as using the Krejcie and Morgan's sample size determination table.

Table 3: Composition of study Participants (Population, Sample Size and Sampling Technique)

Category of participants	Target population	Sample size	Sampling technique
2nd year Students at Civil Engineering Department	30	25	Purposive
Lecturers	05	05	Purposive
Administrative assistants	02	02	Purposive
Total	**35**	**32**	

Source: Krejcie and Morgan (1970) table of sample size determination

Selection was done according to the willingness of individuals and category of people to provide the required information for the study. Five lecturers were purposively selected because they are lecturers of engineering drawing (an area which is under study) and would help in the implementation of the agreed strategies for the improvement of the Engineering drawing at the Department of Civil and Building Engineering. The 25 students were purposively selected because they were second year students who had studied the ED course unit, had identical challenges and were expected to give their experiences so as to improve the situation and the administrative assistant and secretary were purposively selected because they were influential in the examination recording process and would promote the implementation of the recommendation of the study. This sample size enabled the researcher to collect valid information relating to the study and follow up the implementation processes with key participants. The demographic details of the stakeholders were tabulated as shown in table 4.

Table 4: Demographic details of the stake holders

PARTICIPANT	GENDER	PHASE IN WHICH INVOLVED	ROLE PLAYED	PARTICIPANT	GENDER	PHASE IN WHICH INVOLVED	ROLE PLAYED
1	male	all	student	17	male	all	Student
2	male	all	student	18	male	all	Student
3	female	all	student	19	female	all	Student
4	male	all	student	20	male	all	Student
5	male	all	student	21	male	all	Student
6	male	all	student	22	male	all	Student
7	male	all	student	23	male	all	Student
8	female	all	student	24	female	all	Student
9	male	all	student	25	female	all	Student
10	male	all	student	26	male	all	Student
11	male	all	student	27	male	all	Lecturer
12	male	all	student	28	male	all	Lecturer
13	male	all	student	29	male	all	Lecturer
14	male	all	student	30	male	situation analysis	Lecturer
15	male	all	student	31	female	all	secretary
16	male	all	student	32	female	situation analysis	admin. Assistant

Source: Primary data (2018)

3.3.2 Sampling Techniques.

The researcher used purposive sampling for selecting key participants for the case of this research. The students, lecturers the administrative assistant and secretary who are the key informants will be purposively selected using purposive sampling technique to aid the researcher in ensuring that the required information is gathered from the right respondents.

This would also enable the researcher to collect relevant information relating to the performance of engineering drawing examinations at DCBE in Kyambogo University.

3.3.3 Sample Size.

A sample is a segment of the population with the same characteristics as the population on whom the study is conducted (Burns and Grove; 2003). The study had a sample size of 32 respondents for both interview and Focus Group Discussion (FDG) methods and will involve 25 students, five lecturers, the administrative assistant and the secretary at DCBE.

3.4 Methods of Data Collection

The researcher intends to employ interviews, focus group discussion (FGD) and observation methods while collecting data for the study. The purpose of the research methods will be to explore the views, experiences, beliefs and interests of individuals on specific matters at DCBE.

3.4.1 Interview

Interviews will enable the participants to describe their situation hence offering the researcher access to participants' ideas, feelings, and remembrances in their own words, rather than the words of the researcher (Key, 1997). Unstructured interviews will be used to collect data from the stakeholders on challenges encountered during the implementation process of the identified strategies intended to improve students' performance in engineering drawing examinations at the department of civil and building engineering of Kyambogo University.

The researcher will use unstructured interviews because of their nature of flexibility and open-endedness that allows the researcher to rephrase questions to different interviewees to suit the immediate context of presentation. This will allow the researcher and the participants to share and learn from each other throughout the interviewing process in a

participatory manner. Kumar (2005) defines interviewing as a person-to-person interaction between two or more people with a specific purpose.

3.4.2 Focus Group Discussion

Focus group discussion (FGD) is a qualitative method of data collection where members of the group are encouraged to express views pertaining the issues being studied. It is usually facilitated by a moderator and sometimes assisted by someone scribing the minutes. FGD is one way of gathering a group of people with common background or experience to discuss a common idea or ideas. Freitas, Oliverira & Popjoy (1998) refer to focus group as a type of in-depth interview accomplished in a group, whose meetings present characteristics defined with respect to the proposal, size, composition, and interview procedures.

The FGDs were used during situational analysis process and were used during data collection and validation. This method helped the researcher to understand participant's responsibilities, benefits, challenges and to plan for improvement.

3.4.3 Participant observation.

This method was used in recording all those phenomena which are visible to the human eye. It entailed making critical analysis of events, seeing and hearing. The researcher as a participant and moderator in this collaborative research lived with the key participants in a community of practice, listened and took notes of the events that took place at the institution during the study. The method was instrumental in gathering detailed and accurate first-hand data and above all, it helped in triangulating the information acquired from the interviews with the information got from focus group discussions.

3.5 Tools of data collection

3.5.1 Interview Guide.

The researcher formulated an interview guide based on the study objectives to gather information from the participants because they provided subject areas within which the

interviewer was free to explore, probe and ask questions. This approach was opted for because it permitted the establishment of confidence and co-operation between the researcher and respondents, which made it easier for the interviewer to get vital information.

3.5.2 Future workshop

The future workshop (FW) as a tool helped the research participants in generating information and laying strategies for possible solutions regarding the performance of ED. The tool supported participants in identifying and refining the problem of poor performance in ED, developed visions and ideas, and made an action plan. This tool consists of five phases; preparation, critical, fantasy, reality and implementation.

Preparation phase: During this phase, the researcher prepared the venue to be used, the materials and tools and put in a place a conducive environment for the discussion to take place. This was done in advance before the meeting to have everything set for the smooth running of the meeting. This phase also included informing participants on what they were expected to do, read the rules of the discussion and informed them the theme under discussion.

Critical Phase: In this phase, which is mostly referred to as the beginning or opening of the workshop, challenges or problems in relation to the workshop theme, were highlighted by participants, (Skoglind-Öhman, 2015, p. 121). A problem list based on the participants' submissions was developed and displayed for everyone to see. The discussion here and throughout the workshop was democratic, concrete and objective as participants drew from their experiences about the subject matter under study.

Fantasy phase: In this phase, participants were encouraged to; (while forgetting all the financial, personnel, technical and organizational restrictions), give their ideal situations, dream of what they would have loved to have in place. This generated quite a number of ideas which aimed at improving the situation.

Reality phase: In this phase, the ideas brought forth by participants in the fantasy phase were concretized to form an action plan. This is supported by Lauttamäki, (2014) who holds that the aim of this phase is to go through all fantasies trying to find the hindering factors. Critiques and visions were connected into concrete action plans. In this phase participants documented clear missions with information about the "who", "what", "when" and "how" of reaching the goal, e.g., which action plans was to be adopted and what resources were needed for various actions.

Implementation phase: The final phase in the FW is implementation phase. Sometimes referred to as the action phase, here we emphasised drawing a plan to follow the implementation of activities agreed upon in the reality phase. During the workshop, a timetable was designed highlighting the activities, responsible person, timeframe, process to be followed.

3.5.2 Log book

The researcher will record the views of each discussion held by the participants within the focus group discussion in the log book. This will contain all activities, indicating experiences including dates the resolutions to be made by the participants and work plans. After each informal observation, the researcher will record his observations in his log book. This data collection technique is highly corroborated (Maykut and Morehouse, 1994). Maykut and Morehouse stated, "The keen observations and important conversations one has in the field cannot be fully utilized in a rigorous analysis of the data unless they are written down".

3.5.3 Cameras

These were used to collect the evidence of the research through taking photographs and videos. They were vital during all focus group discussions especially when participants were

stressing their views. For academic purposes, smartphones cameras were also used to gather and document information during field research activities (Pelckmans, 2009).

3.6 Data Analysis

Data from the interviewees and focus group discussions for this study will be coded, analyzed manually by first identifying major themes and sub-themes based on the study objectives and questions. The schematized data frequencies (Creswell, 2003) that was got from interview findings were coded, edited, arranged and analyzed. The data obtained was manually tabulated with frequencies which were used in decision making, comprehensive interpretations and other related inferences. From the qualitative data obtained, the emerging ideas, opinions and beliefs were critically analyzed and synthesized with what other writers had said in the literature review in order to make them more comprehensive. This was done in order to fill the literature gaps (Lipton, 2014).

3.7 Validity and Reliability of Data

Reliability refers to the stability of findings whereas the validity represents the truthfulness of the findings (Altheide & Johnson, 1994) as cited in (Mohajan, 2017). To achieve this, triangulation techniques, that included employing various research methods and tools, were used in order to gain further qualification of data obtained. The rationale for triangulation was to cross check and cross-breed information gathered from different categories of respondents. In some cases, some of the respondents were interviewed more than once, for example through individual interview and again through focus group discussion for purposes of validating and elaborating the information they had given earlier. This helped to ensure validity and reliability of the findings.

3.8 Ethical Considerations

To address the ethical issues, the researcher presented an introductory letter from the faculty of Vocational Studies, department of Art and Industrial Design of Kyambogo University to the respondents so as to avoid bias and give focus of the study. Principles of ethics were purely taken into consideration in the course of the research. Respondents retain the independence of their minds and free decision-making process.

The researcher also ensured that the information got from participants was kept very confidential to avoid the stakeholders being in danger of being victimized of any ideas contributed during the study. Free discussion and every one's idea was considered to encourage maximum participation by the stakeholders without any form of distress. Anonymity was maintained through the use of stakeholders or respondents to conceal the identity of participants. This is because the information provided by respondents was in no way to reveal their identity.

Recording responses and photography during the interviews and focus group discussions was done under the permission of the participants to avoid fear and suspicions.

CHAPTER FOUR : ACTION IMPLEMENTATION, RESULTS AND EVALUATION

4.0 Introduction

This chapter presents findings from implemented strategies that were developed collectively by all stakeholders during the future workshop. The study sought to improve competences of students in ED at DCBE. A number of strategies were suggested, implemented and evaluated as presented in this chapter. The presented and discussed findings are based on the study objectives three and four that the researcher, together with stakeholders, set out to accomplish.

4.1 Implementation of the identified strategies aimed at improving students' competences in ED

4.1.1 Weekly hands on group task done 6hrs a week.

During the stake holders' meeting in future workshop, it was agreed that students be given weekly hands on tasks which were to be done at least for a duration of six hours within a week. The Lecturer would identify tasks and give them to the students who would form groups and their leaders would ensure that every one participates. The group leaders would then submit the completed tasks to the lecturer. The lecturer set the tasks an example of which is shown in fig.5 and the students formed the groups and identified group leaders amongst themselves. The method for selecting members in the groups was left to students to identify the members they would cooperate with best. This was then followed by the lecturer giving the tasks to the students through the class coordinator and group leaders, it was then that the students gathered in times that best suited their groups discussed and did the tasks as shown in fig. 4 . To have the tasks meet their intended goal, the stakeholders agreed that after discussing, each student was supposed to do his own work and show how he/she had understood and benefited from the discussion.

Figure 4: One of the groups discussing a group task

Source: Field data *(*DCBE, 2018)

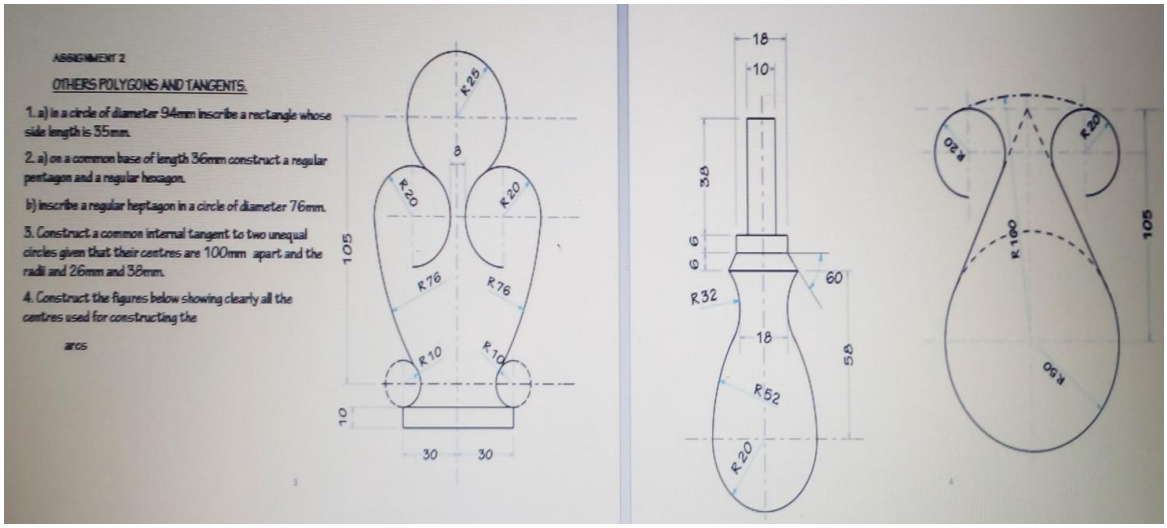


Figure 5: Copy of template for first group task

Source: Primary data

However, not all group leaders were effective in submitting their fellow colleagues' assignments in time and some of the members were constantly being covered up by their colleagues as they kept absenting from the group discussions. The students later agreed that the coordinator would assist pick the done assignments from the group leaders and submit

them to the lecturer. Together we agreed to encourage all members join the discussions because we were all to benefit. On giving a feed back to the students, a member from each group was asked to share with the other participants the experiences they went through in finding a solution for the area they attempted best within the given task.

The reasons for the group assignments were to involve the participants in a co-operative inquiry which is a practice method for groups working through a structured cycle of action and reflection, through which group members move towards improving and developing new ways of acting. (Moon, 2004). To strengthen this cause, we agreed that marking of group tasks was to be done by randomly selecting one person's piece of work to act as a bench mark for the others and hence the group would be assessed based on that work. This was done to encourage group members assist each other and present good work together. While carrying out this strategy the researcher observed that students who participated in group discussions were more reliably informed and could ably demonstrate what they did as shown in fig. 6 where one of the students explains to the others some concepts attained in the group discussion.

Figure 6: A student sharing the experience obtained from the discussions held with colleagues.

Source: Primary data (DCBE 2018)

Reflecting on how the group tasks were done, revealed that the students were very active and seemed to benefit from the first discussions but later their attendance became less regular. Some could only come to copy from colleagues and submit the work. The results of this implementation strategy revealed that despite the variations in students, group instructional tasks can improve students' competences as reflected in table 5. This is supported by Awolowo (2011) whose study found that the use of group instructional strategy enhances the learning of students and thereby improve their performance than the whole class teaching method. However, the strategy is unlikely to benefit the irregular attenders.

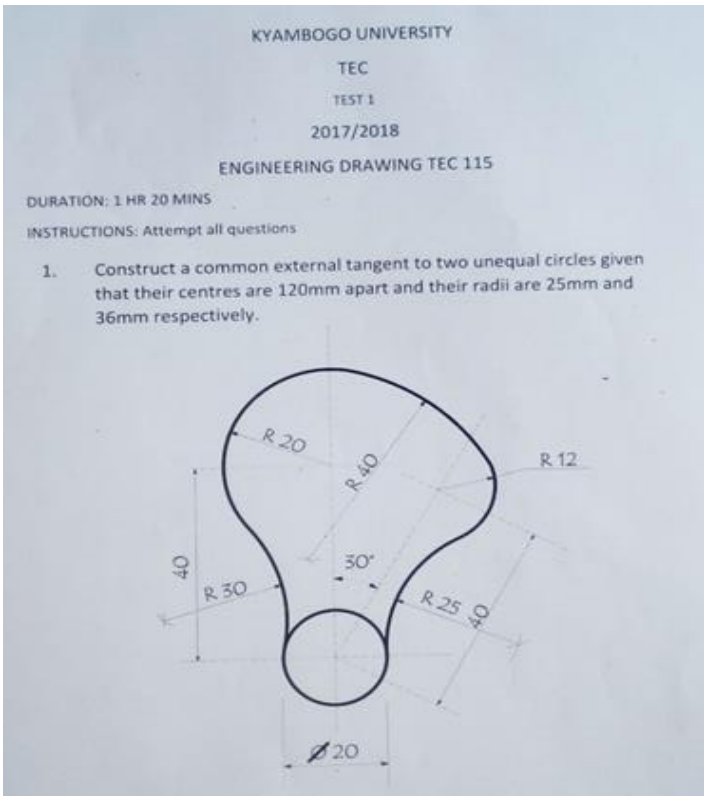
Table 5: Students' ED marks for group tasks

ASSESSMENT FOR GROUP ASSIGNMENTS				
GROUPS	PARTICIPANTS CODE	MARKS		
		TASK 1 / 50	TASK 2 / 50	TASK 3 / 50
A	19	36	40	47
	1			
	4			
	9			
	11			
B	2	38	32	42
	3			
	25			
	17			
	14			
C	24	26	35	45
	18			
	6			
	5			
	12			
D	13	26	37	47
	20			
	26			
	7			
	16			
E	19	26	46	50
	15			
	10			
	8			
	23			

Source: primary data

4.1.2 Lecturers to provide more hands-on tests

The second strategy suggested by stakeholders, aimed at improving students' competence acquisition in ED, was providing more tests to the learners. During the future workshop, it was brought out that students do one test for each course unit and mostly done at the end of the semester and hence get less time to reflect on how it was marked and how they could use it for improving their competences. In the context of this study the researcher, a lecturer at DCBE, set the tests as shown in the template for test 1 in fig 7.


KYAMBOGO UNIVERSITY

TEC

TEST 1

2017/2018

ENGINEERING DRAWING TEC 115

DURATION: 1 HR 20 MINS

INSTRUCTIONS: Attempt all questions

1. Construct a common external tangent to two unequal circles given that their centres are 120mm apart and their radii are 25mm and 36mm respectively.

Figure 7: Copy of template for test 1 that was given

Source: Primary data

The lecturer agreed with the students when the tests were to be done, tests were done under his supervision, papers collected, marked, marks recorded and scripts were returned. Prior to doing the test the lecturer agreed with the students when the test would be done and

also agreed to do it in the drawing room for which the researcher met and booked the room from the custodian in time. Fig. 8 shows students in one of the tests that were done.

Figure 8: Students doing a test

Source: Primary data DCBE, 2018

In our implementation we managed to do three tests. In the first test the results showed that almost half of the class had smudgy drawings with many erasures, most of the learners properly employed the correct line types but accuracy and correct methodology were their biggest challenges. In the second and third test there was a tremendous improvement in drawings; proper line types were evident on the students' papers, work was clear and accurate for the biggest number of the learners although the methodologies in some learning areas were not followed.

The researchers' observation during and after conducting the strategy of regular testing showed that as regular testing assisted the students in enhancing their competences on one side it also helped the lecturer to identify learning gaps of individual students and think of intervention strategies that would assist in filling the observed gaps. From my observation this is what actually helped students improve their competence in ED as indicated on bar

chart in fig. 9.

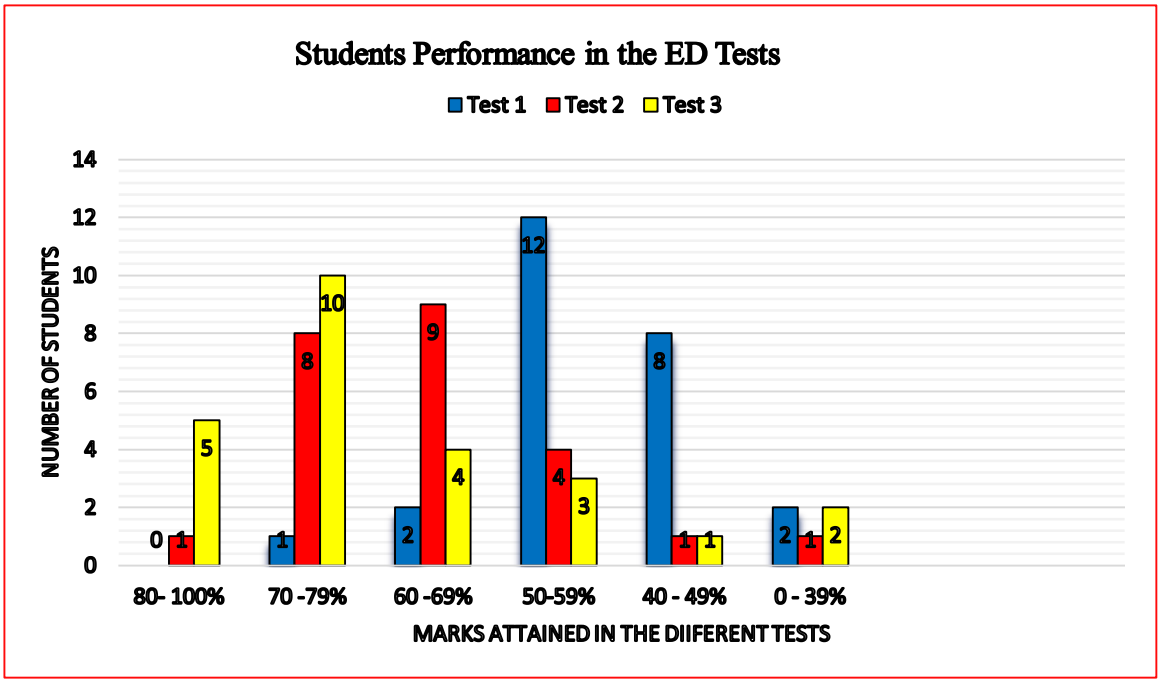


Figure 9: Students performance in the ED tests

Source; primary data.

From the bar chart it is clearly shown that test 1 had the least number of students who attained 60% to 100% marks, having been the first test. With exposure from the tests, correction done and further practice done through question approaches the marks are seen to have tremendously improved as shown in test 2 and test 3 where the percentages reflect reduced mediocracy and improved percentages between 60% and 100%.

Also, when students understand that the purpose of the test is for their own improvement they prepare and do the test well. Thus, successful use of tests requires that students believe that the test will contribute to their improvement. This is supported by Wolf, (2018) who asserts that testing assists students in building important skills and knowledge through regular tests and provide an experience of test taking that will help them throughout their lives. Table 6 shows the students results from the tests done.

Table 6: Students' ED results for the tests

SN	PARTICIPANTS CODE	TEST 1 /100	TEST 2 /100	TEST 3 /100
1	19	72	82	80
2	1	44	67	68
3	4	40	76	71
4	9	44	72	89
5	11	54	56	67
6	2	53	72	71
7	3	50	71	82
8	25	54	66	66
9	17	61	70	74
10	14	34	61	56
11	24	43	76	78
12	18	56	72	
13	6	56	65	75
14	5	54	73	81
15	12	51	65	43
16	13	51	56	67
17	20	47	54	72
18	26	48	61	76
19	7	46	54	54
20	16	53	46	56
21	19		36	
22	15	60	65	
23	10	54	54	76
24	8	56	64	76
25	23	49	61	76

(Source: Primary data)

4.1.3 Exposing students to different question approaches during the course of lecturing

Another agreed strategy by the stakeholders was that students were to be exposed to different question approaches during the course of lecturing. This was to be done by the lecturer stating questions, elaborating and demonstrating on how they would be attempted. During our first meeting to prepare for implementation strategies we agreed with the students that the questions could be given in form of assignments and it would be during correction that the lecturer would discuss the question approach. But when shared with lectures, they differed and suggested that giving the guidance on question approach before the assignments could be given would be more beneficial to the students. The continued discussion with the

lecturers brought us to an agreement that the approaches be shared both before and after assignments had been given. It is then that the researcher held sessions with the students on engaging in question approach. In this process the students gathered in civil room 1.4 as shown in fig.10, the lecturer read questions for the students and through mixed tactics that included interpreting, sketching and drawing with instruments, demonstrated how the solutions would be obtained. After every assignment we would meet with the students and discuss where they had fallen short of the agreed question approaches. This was done in a joint session as well as with individual groups when students had points of contention in their group as seen in plate 6.

Figure 10: Students attentive as the researcher explains how to approach particular concepts in drawing

Source: Primary data (DCBE 2018).

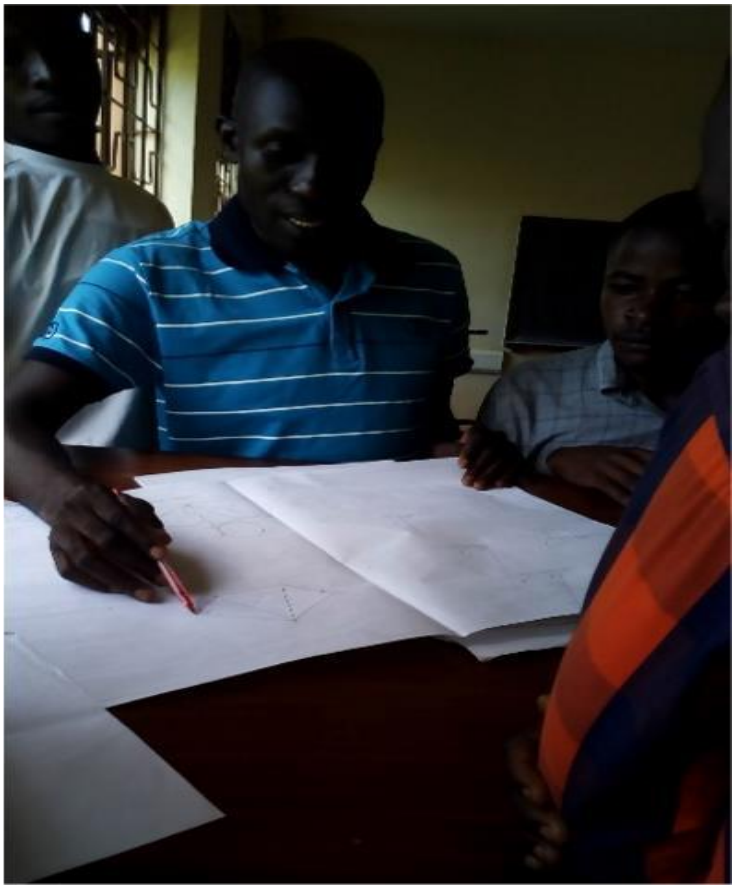


Figure 11: Researcher explains to learners how they would have approached particular concepts

Source: Primary data (DCBE, 2018).

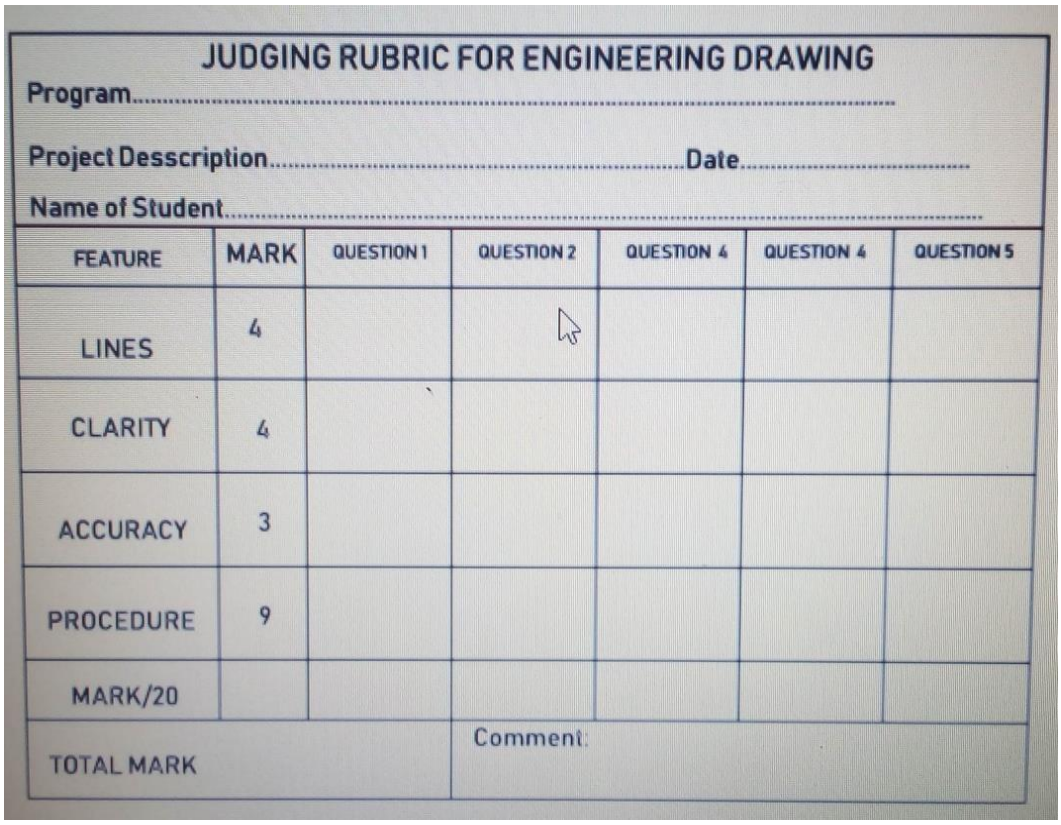
During the process various questions were discussed and from this experience it was observed that students demonstrated a keen interest in understanding how to apply various concepts when faced with various tasks. Although a good number of the students produced quality work with the assignments owing to measures explained as we discussed question approaches prior to the assignments being given, the majority benefited more when sharing these approaches after the assignments and tests were marked and returned. Reflecting on this strategy showed that when students were explained to how the questions could be approached, they simply reproduced the facts and ideas with little recourse to seeing relations or connections between ideas. But after the assignments were done and the approaches to questions done in correcting mistakes they seemed to substantially gain, this was proven when the same mistakes were not repeated in the subsequent assignments.

4.1.4 Sharing and improving of rubrics used in assessing students work by lecturers and then with students.

According to the stakeholders in the future workshop, one of the reasons why students were unable to perform well in their examinations and assignments was because they did not know how the lecturers mark their work. Participant 2 said they do make drawings expecting to get good marks but they are always disappointed with the displayed results. From this experience the stake holders agreed that the rubrics used in assessing students work would be shared and improved by lecturers and then shared with the students to know the areas of score as these would constitute the competence areas for improvement on the side of the students.

To attain this, the researcher discussed with the lecturers to obtain ideas of how to improve the existing rubric plate (fig.12) and to make adjustments that will assist the rubric plate be tailored to be shared with the students' competence attainment. Participant 26 suggested that we needed to include the criteria for awarding the individual features existing in the rubric plate and participant 27 suggested to incorporate a section to show an area for improvement. It is then that he came up with a draft of the rubric plate to begin the process of discussing the rubrics for assessing E.Ds. This was done because he had set the tests on which the guides and rubrics to be shared were to be tested. The researcher shared these ideas. This was done on a one to one basis because it was not possible convening the lecturers together at a particular time. Participant 27 had an opinion of sticking to the existing format where if each question demands to have an independent approach then we align independent assessment targets, but participant 28 suggested that targeting learning outcomes and areas that could bring out students' competences clearly were to be key items to be included in the rubric plate. However, all the lecturers agreed that leaners should be able to use proper line types, gain the ability to produce a clear drawing, be able to come up with accurate work and

have the ability to use the proper methods for coming up with the required drawings as key areas to be put in the rubric as seen in fig. 12.



JUDGING RUBRIC FOR ENGINEERING DRAWING

Program.....

Project Desscription.....Date.....

Name of Student.....

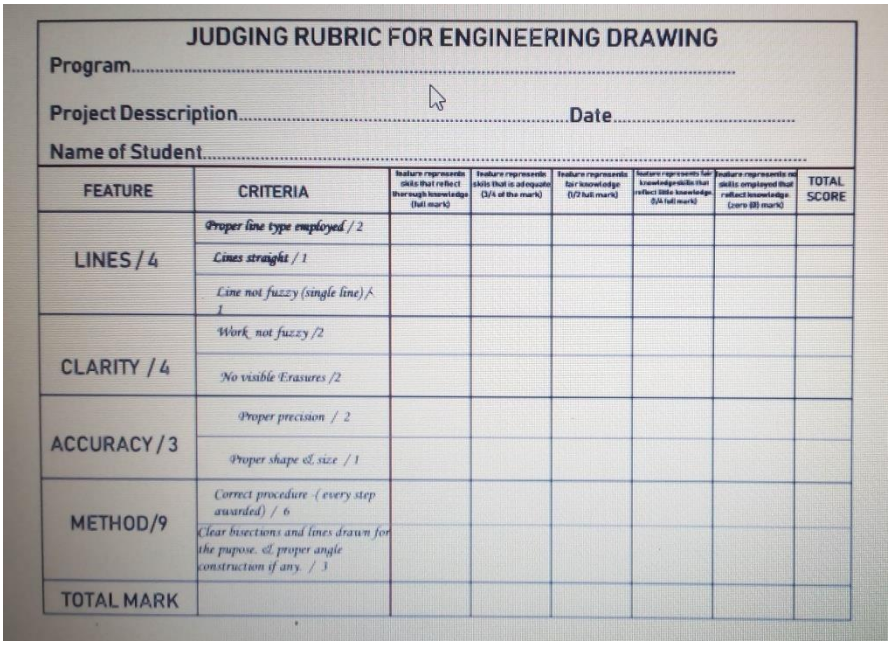
FEATURE	MARK	QUESTION 1	QUESTION 2	QUESTION 4	QUESTION 4	QUESTION 5
LINES	4					
CLARITY	4					
ACCURACY	3					
PROCEDURE	9					
MARK/20						
TOTAL MARK			Comment:			

Figure 12: Original rubric plate

Source: Primary data.

The researcher then went ahead and made a fair copy of the rubric plate (fig.13) which was again shared by the lecturers who all agreed that it was fit for use but it was to be unfriendly to the user and required to be simplified.

Participant 26 pointed out that the word “judging” on the rubric plate was also not fit for use and suggested that it could be changed to “assessment”. Fig. 15 shows the researcher together with one of the lecturers sharing on improving the rubric plate. The researcher then made another rubric plate (fig.13) which was agreed on by the lecturers before it was taken to be shared with the students.



JUDGING RUBRIC FOR ENGINEERING DRAWING

Program.....

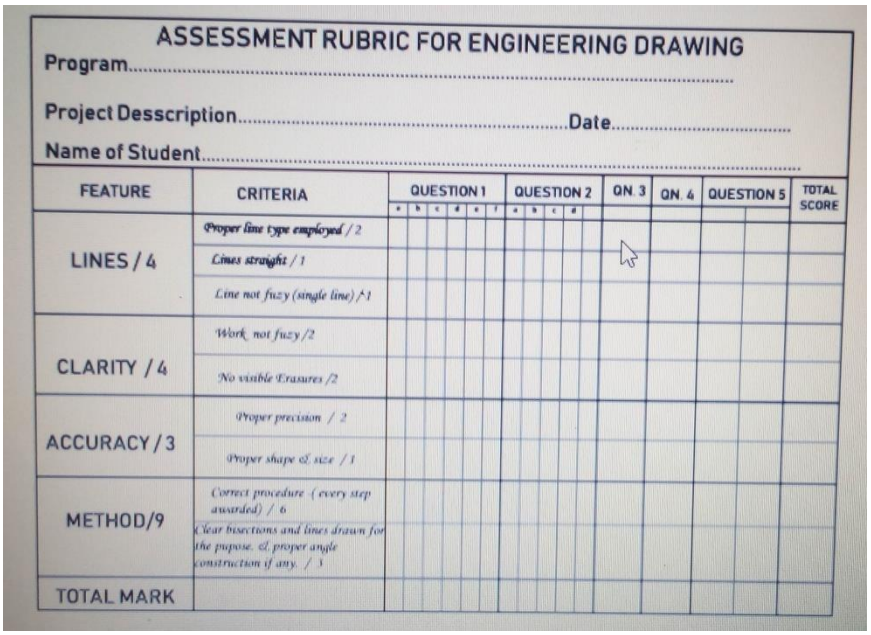
Project Desscription.....Date.....

Name of Student.....

FEATURE	CRITERIA	Feature represents skills that reflect thorough knowledge (full mark)	Feature represents skills that is adequate (3/4 of the mark)	Feature represents fair knowledge (1/2 full mark)	Feature represents fair knowledge skills that reflect little knowledge. (1/4 full mark)	Feature represents no skills employed that reflect knowledge (zero (0) mark)	TOTAL SCORE
LINES / 4	Proper line type employed / 2						
	Lines straight / 1						
	Line not fuzzy (single line) / 1						
CLARITY / 4	Work not fuzzy /2						
	No visible Erasures /2						
ACCURACY / 3	Proper precision / 2						
	Proper shape & size / 1						
METHOD/9	Correct procedure (every step awarded) / 6						
	Clear bisections and lines drawn for the pupose. & proper angle construction if any. / 3						
TOTAL MARK							

Figure 13: Fair copy of the rubric plate

Source: Primary data.



ASSESSMENT RUBRIC FOR ENGINEERING DRAWING

Program.....

Project Desscription.....Date.....

Name of Student.....

FEATURE	CRITERIA	QUESTION 1						QUESTION 2						QN. 3	QN. 4	QUESTION 5		TOTAL SCORE
		a	b	c	d	e	f	a	b	c	d							
LINES / 4	Proper line type employed / 2																	
	Lines straight / 1																	
	Line not fuzzy (single line) / 1																	
CLARITY / 4	Work not fuzzy /2																	
	No visible Erasures /2																	
ACCURACY / 3	Proper precision / 2																	
	Proper shape & size / 1																	
METHOD/9	Correct procedure (every step awarded) / 6																	
	Clear bisections and lines drawn for the pupose. & proper angle construction if any. / 3																	
TOTAL MARK																		

Figure 14: Fair copy of the rubric plate

Source: Primary data.

The researcher then engaged the students in sharing the rubric plate. The researcher invited the students in a plenary and explained to them how the rubric was to be used in assessing their work. Fig. 16, shows the researcher explaining to the students how the rubric

plate will work in relation to the guide. This process was followed by testing the rubric on one of the assignments where the students appreciated its use.

Figure 15: One of the lecturers and the researcher sharing on how to improve a rubric plate

Source: Primary data.

Figure 16: The researcher sharing sections of the rubric plate with students.

Source: Primary data.

The reasons for sharing the rubric was to make a clear assessment criterion based on expected performance standards and learning outcomes. The researcher observed that besides evaluating student's performance against set standards, the rubric plate improved consistency and objectivity in marking. It was also realized that when shared with students, the rubric plate gave them awareness of all expectations related to the assessment task and helped them evaluate their own work. This is in line with Arter and McTighe (2001) who assert that rubric plates improve assessment quality and Angelo, (2002) who emphasizes that, rubrics can be a vital component of an effective outcomes assessment system, contributing to program improvement and university accreditation.

4.2 Evaluation of the intervention strategies implemented aimed at improving students' competences in ED.

During the evaluation of the impact of intervention strategies, interviews, observations and reflection were made on the implemented interventions that were agreed upon with the key participants. The evaluation was conducted by interviewing participants and holding an evaluation meeting. The evaluation meeting was held at NOMA house 1 on the 10th of October, 2018. Fig. 17 and fig.18 show participants in an evaluation meeting.

Figure 17: The researcher and the participants in an evaluation meeting

Source: Primary data (NOMA, 2018)

Figure 18: Participants in an evaluation meeting

Source: Primary data (NOMA, 2018)

Interviewing was done to the staff members because it was not possible for them to join others in the evaluation meeting while the evaluation meeting was conducted with students because the strategy targeted improving their competences and there was a need to hear their voices as they attest the experience they went through the strategies. This evaluation meeting was structured on themes of what went well, what did not go well and the way forward. Under what went well the researcher targeted getting information on how the strategies benefited the stake holders, while under what did not go well he targeted identifying the gaps that the strategies left un attended to and the way forward was to suggest how these gaps were to be filled for the strategies to fully serve their intended goals.

The evaluation is presented as per the implemented strategies of; providing weekly hands on group tasks done 6hrs a week, lecturers to provide more hands-on tests, exposing students to different question approaches during the course of lecturing and sharing and improving of rubrics in assessing students work by lecturers and then with students.

4.2.1 Weekly hands on group tasks done 6hrs a week

The evaluation on group tasks was done in an evaluation meeting together with stakeholders-students, and it is described under the themes of what worked well, what did not work well and way forward.

The students here endorsed the strategy and suggested it had made a meaningful difference in the way they viewed their own practice. Virtually when giving their opinions on what went well with group tasks within the session, students were supportive of having group tasks and said they got new methods of approaching various questions.

The tasks helped them create unity among group members, they also compelled them to do more research about particular tasks, got more ways of approaching questions, the tasks too helped them to know where to put more emphasis when drawing and also built their confidence in approaching questions. For the students, the major advantage of the group tasks was that it made them committed to research. One participant stated, *"The methods for approaching some questions were more than one and one can only get several methods through research" (participant 2)*

Within the session of what didn't go well, issues of absenteeism during the discussions, limited time to do the tasks given, finding the appropriate time for the group members to convene for the discussion, finding hardship in coordinating group members, not having enough drawing tables and some members being reluctant in sharing ideas on questions that were given emerged. The issue of making a choice about the many methods brought about during the discussions brought about a debate. While some participants appreciated the opportunity of getting a variety of methods for attempting one question others were stack to their original ideas and it brought problems in deciding which method was to be presented for submission "In our discussions many methods could come up and it was difficult to decide which method to take" (participant 4). Although participants raised the points that incomplete the value of group tasks, they didn't negate the benefits they obtained from these group tasks. Their challenges relied on personal conflicts and inadequate resources for proper handling of discussions. This maintained that group discussions were of benefit to them.

In the way forward, the participants suggested that lecturers would explain technical terms at the beginning of every teaching session, non-active students to be given specific individual tasks and also counsel the members. One participant suggested that each individual would be given a question to research on and also discuss for the group. They also suggested time tabling the tasks to counter the problem of limited time for discussion and also consult the lecturer to assist in choosing an appropriate method where they stale in deciding the method to consider for a particular question.

Since the participants agreed that the group tasks where of benefit to them and the limitations they had were solvable as stated in the way forward the strategy of the group tasks was a positive step in towards improving the students' competences in ED.

4.2.2 Lecturers to provide more hands – on tests.

Evaluation on hands on tests was done in an evaluation meeting together with stakeholders-students. According to the participants in this meeting, hands on tests played a significant role in improving their competences in drawing. Their comments revealed a nuanced view. On what went well participant one expressed that the tests helped them to learn how to utilize time in exams, in his words he mentioned, "*With me, I gained more speed drawing because of constantly practicing for the tests*". Participants also mentioned that tests helped them to have self-assessment in that they managed to realize their strength and weakness as they got experience in drawing and saw their mistakes corrected and revised constantly. This was ably attested by participant 6 who in his words holds that, "*for me as a student, regular tests helped me recognize my strength and weaknesses and later made me to have purposeful revision and practice".*

On the other hand of what didn't go well participants reported that there was little time provided for them to do the test and they were not given enough time to prepare for the tests and also added that the tests were not time tabled. This reflected a communication gap

that would have occurred since some students got the information about when to do the tests early enough while others did not.

In the way forward, they fronted that the tests should be communicated in time. They also mentioned that students should have regular practice and choose appropriate methods for attempting the chosen questions in order for them be able to answer the questions within the stipulated time. Participant 2 commented that *"if the students' apportioned time for each question attempted then the issue of being given little time in the tests would not arise. He added that all exams are given same period and therefore could affect the general exam time table."*

4.2.3 Exposing students to different question approaches during the course of lecturing.

In this strategy the participants explained that they were helped to structure the solution for particular questions, this resulted from the several discussions on how to attempt questions. The participants appreciated that after having several sessions discussing how to attempt and approach questions they were able to get new skills and basics in ED. Participant 2 narrates *''I found that after attending several sessions of sharing question approaches I was able to apply the knowledge and skills that I had gained in answering questions that I had failed previously.''* On another occasion participant 6 revealed that, "*in the process of discussing how questions should be approached, many new ideas were revealed that built on the body of knowledge they had"*. This revealed that despite the prompts used to elicit change in the way learners approach questions being varied across various questions, valuable experience was gained in the sessions held to share with students on question interpretations. This is supported by Dewey (1997) when he asserts that a skill can effectively be acquired through a hands-on approach.

4.2.4 Sharing and improving of rubrics in assessing students work by lecturers and then with students

According to the participants in the evaluation meeting, sharing the rubric plate with them played a significant role in improving areas of attention in examinations and tests, and their comments revealed that, they learnt where to put emphasis in ED. Most participants indicated that sharing the rubric plate changed their view of attempting questions as participant 14 explains *"without being told about the rubrics even our discussions would not be important"* they added that this rubric assisted them to get knowledge of how to evaluate their own work. To most of the students the rubric was to able shed, a clear picture of the required skills for examination presentation. The participants also thought that the rubric eliminates marking by impression. On the other side the participants saw a major challenge of the rubric plate being that it could not accommodate all features that in their opinion who deserve being awarded marks. Participant 10, identified a title block which consumes a lot of time in examinations and tests. When carrying out the evaluation with stake holders – lecturers, the interviews were structured to evaluate the impact of the rubric plate on students' competence attainment.

Table 7: Interview guide used to obtain the evaluation account of lecturers

Sn.	Questions
1.	To what extent has the improved rubric plate created a change in the assessment of engineering drawing at DCBE?
2.	What new ideas has the improved rubric plate brought to the assessment of engineering?
3.	What short fall did you identify with the improved rubric plate?

Source; primary data

The lecturers were three in number and these were the ones who participated in the study throughout. These lecturers were coded participant 26, participant 27 and participant 28. They saw the rubric plate very beneficial to the ED assessment process. In an interview with participant 27 answering the question, *"To what extent he thought the improved rubric*

plate would create a change in the assessment of ED at DCBE" – appreciatively said, *"Besides evaluating student's performance against the expected learning outcomes the rubric plate will truly promote consistency in marking*." They said the rubric plate played a significant role in providing a feedback to their students because it was able to identify the students' areas of weakness and strength, but their comments revealed that it would be more beneficial to the students than the lecturers.

Participant 26 specified that, "*although the changes in the rubric plate were decent but the marking process would be lengthened, it picks up the specific skills that are wanted and accounts for individual accomplishments but it took a lot of my time."* According to the views of the lecturers it confirms that the strategy of improving the rubric plate has the ability to contribute to student 'competence improvement provided the lecturers adopt and use the rubric plate.

In this evaluation rubrics were not only seen to formulate standards for levels of accomplishment and use in guiding and improving performance of students but also, they also made the standards and learning outcomes clear and explicit to students.

CHAPTER FIVE: DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter discusses the outcomes emerging from the series of interventions that targeted improving the competences of students in Engineering drawing at DCBE as they were presented in chapter four of this report. This discussion of the results basically depended on the interpretation and description of the processes based on the researcher's experience, observation and reflection upon the situation as it unfolded in the process of research and also on the perceptions and views from the participants of this research. In this discussion, the researcher incorporated related views, theories and concepts from various scholars where it was deemed necessary to back up the analysis of results.

After discussing and analyzing the results, the researcher also put down conclusions based on his learning and understanding acquired through the research process and the recommendations which would reveal the way forward for this research study.

5.1 Discussion

The study sought to tackle the study objectives, each handled independently in a chronological order.

5.1.1 To explore possible strategies that can be used to improve students' competences in ED at DCBE

Basing on the information collected from the stakeholders, a variety of strategies were identified to provide a means for improving students' competences. In the future workshop participants suggested both long and short-term measures but owing to the period of time for implementation and the means that were available, the stakeholders agreed to tackle the short-term strategies. It was the weekly hands-on group task that were to be done for 6hrs a week, lecturers providing more hands-on tests after every 2 weeks, exposing students to different question approaches and improving and sharing of rubric plates by lecturer to the

students that were selected for implementation. This decision is supported by Inouye (1993) who states that functional measures are strong solutions and they contribute substantially to solving major challenges.

The weekly hands on group tasks and more hands-on tests that were to be done after every 2 weeks were intended to provide adequate practice to assist students acquire relevant skills in ED. This is because exposing students to different question approaches would assist the students comply with examination instructions. For Adequate utilization of rubrics by both students and lecturers, the rubric plate was to be improved and shared by lecturers and later with the students.

Those that were thought to be long term and were stored for future reference were; giving basics of ED to all first-year students taking engineering. This was not considered because it would require a curriculum review which would take a long time. Another strategy not considered was that of making it compulsory for students to have drawing equipment during lecturers. It was argued that this would have monetary implications for which stake holders were uncertain of who the money would be levied on for effective achievement of the strategy.

5.1.2 Implementing the identified strategies for improving students' competence acquisition in ED at DCBE.

The implementation process was discussed as per the strategies set to improve the competences of students in ED at DCBE. The weekly group tasks revealed that students can improve their competences through this intervention. This was reflected in the change of their work habits, and the majority committing to the assignments given. However, this strategy requires a keen follow up of every student if all learners are to benefit. This is because students do this in the absence of the lecturer and some do not even attend but their names

appear on the group register. It therefore requires means that will compel all students to attend.

The option of question approach suggested to improve students' competences in ED was broad. This was because almost every learning area has its own challenges and hence have various interests that examiners would like to test. The areas tackled were consequently those that were broadly seen from existing question papers and those that students raised from their experiences which implies that not all approaches could be shared with the learners. Never the less, the areas that the researcher shared with the students showed; that students were very interactive and did not repeat the mistakes in the subsequent assignments. It was also realized that students gain more from this strategy after feed backs from the given assignments. This implied that for the strategy to work well one would teach basing on questions which as a consequence would lead students to cram work rather than learn to be creative and innovative.

The tests on the other hand gave valuable experience to the students, they not only coerced them to practice but also assisted them to reason, manipulate situations in the test item to provide suitable solutions. The latter also gave them experience of working within the scheduled test time.

5.1.3 Evaluating the impact of the intervention strategies for improving the students' competence acquisition in ED at DCBE

The evaluation process showed that the strategies employed contributed to the improvement of students' competences in ED. The views obtained from the evaluation process indicated that it would be good for similar concepts to complement each other because as one is being explained the other is also understood. Therefore, competence attainment requires a multi tasked tactic in the context of this research it will be good to be given approaches as well as handling group tasks. This is supported by Ruder (2017), in his

tale, “our understanding of tasks, their similarity, relationship, hierarchy, and benefit is limited because we cannot multi task”. It is therefore required that for proper competence attainment in ED, the agreed-on tasks should be done concurrently where possible. In our implementation the strategy of discussing the question approach and sharing about the rubric plate that were done concurrently yielded better. Students keenly followed and results from the tests obtained later also showed improved competence attainment.

It was also found out that employing strategies of group tasks, multiple tests, and improving rubric plates and shared them would only contribute to enhancing the competences. This observation resulted from the short falls that were raised from the evaluation meeting. Basing on the stakeholders’ arguments, gaining from the implemented strategies required students who are ready to learn new approaches to concepts with varying tasks. The majority of the students in the implementation believed that through these interventions they were ultimately to master what had seemed to be difficult to them. These students developed self-efficacy in accomplishing the given task, they had the belief and confidence that they can succeed. But as brought out in the evaluation meeting, some leaners were not only uncooperative but also unwilling to join others in sharing academic tasks. This proves that to mitigate this irony of competence attainment one needs to employ other intervention strategies that will motivate all students to participate in doing set tasks.

Our evaluation meeting also disclosed that feedback on all grounds is imperative for ideal competence attainment. Through feedback from the lecturer seen when the test marks and papers were returned and a feedback on the side of students to the lecturers as they submitted their assignments assisted in knowing the extent to which both parties perceive each other. The strategies employed position the study on formative assessment that is specifically within a model of self-regulated learning. Formative assessment refers to

assessment that is specifically intended to generate feedback on performance to improve and accelerate learning (Sadler, 1998).

5.2 Conclusion

Inadequate competences are a wide spread pitfall that students of engineering continually face. This has been attributed principally to the uniqueness and strength of individual skills in ED that call for varied approaches. These competences were seen to have big implications to the requirements needed in the world of work and affect students' performance particularly at DCBE. The attempt to contain this challenge saw the researcher through strategies of regular group tasks, regular testing, discussing and sharing various question approaches. The results of which showed that these approaches are able to improve the competences in ED.

5.3 Area for further study

The researcher recommends that all strategies put to improve students' competences should be complimented with regular feedback. From the various strategies implemented, different forms of feedback on similar concepts where given to the students and each was seen to compliment the other. Of a similar opinion are (Chang & Daly 2012) who assert that the use of several different sources of information will also add credibility to the feedback that is being given whether it is positive or negative. From this study it was also realised that self-regulated motivation among the students could be brought about when students are aware that without tests and course works done they would perform more poorly. They attended more regularly when told that the tests were to contribute to their final examinations.

Also recommended for further study is to find out whether mandatory enforced attendance in all strategies placed to compel the students to regularly attend lectures would ably contribute to competence enhancement among students. Unlike high school, from this study it was revealed that at university classroom attendance is not mandatory. As young

adults, university students are typically given more freedom to make their own choices. They choose whether to attend class, turn in homework, or even show up for the final exam. From a learning perspective, the issue becomes one of time allocation, as the students choose between competing academic and non-academic uses of their time (Marburger, 2006). It was observed from this study that ED requires students' physical attendance to be able to move from abstract to concrete conceptualization, manipulating of materials, mental rehearsal of physical space and of practical design solutions (Kabouridis, 2010). This may require facilitators to resort to didactic interventions that go beyond simply presenting the theoretical concepts of the systems of representation.

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APPENDICES

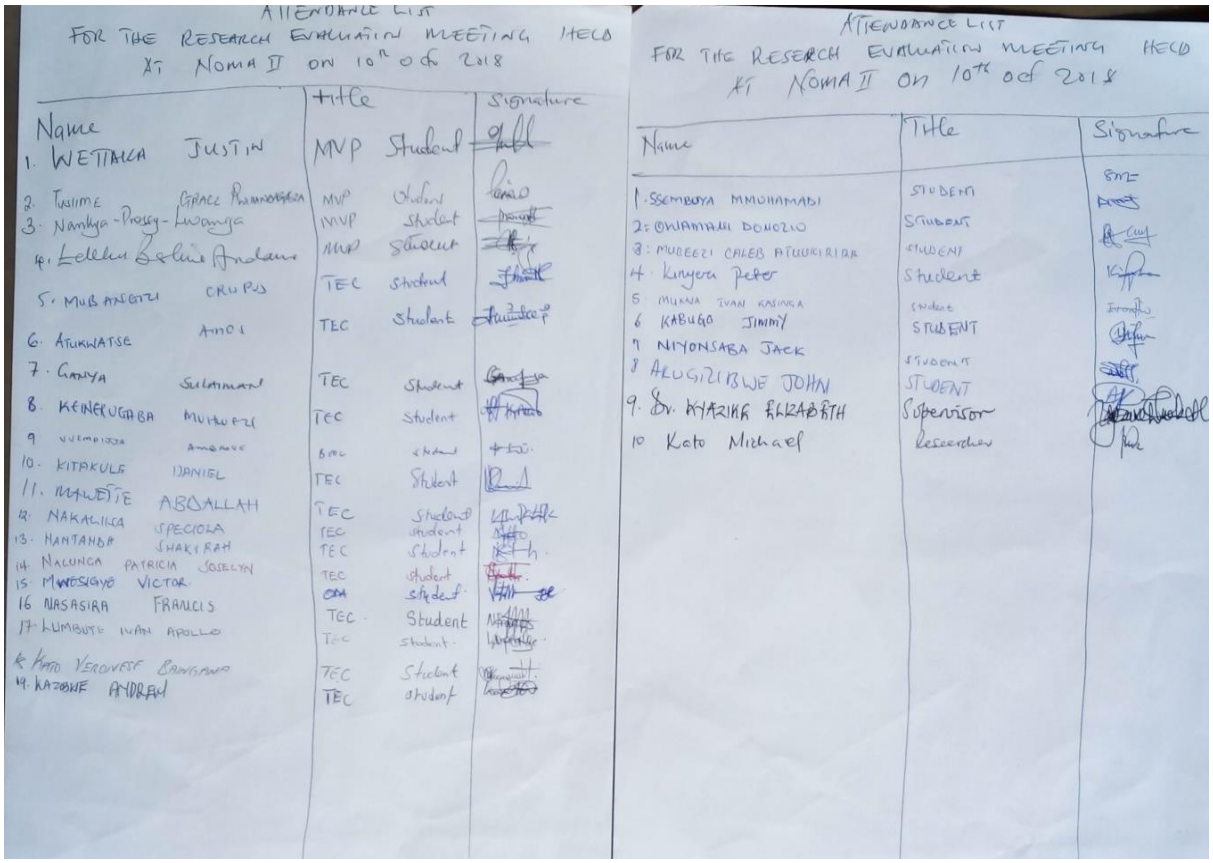
Appendix A: Implementation plan

Action point	**Action process**	**Time frame**	**Person responsible**
Weekly hands on group task done 6hrs a week	• Lecturer identifies tasks and gives them to the students • Students form groups and leaders ensure that every one participates • The group leader submits the done tasks to the lecturer	March – April then August - September 6 hours a week (Every group identifies appropriate time)	• Students • Lecturers • Group leaders
Lecturers to provide more hands-on tests	• Set the tests • Allocate time for the test • Doing the test • Supervising, Collecting, Marking, recording and returning scripts	After every 2 weeks. (March-April) & (August -September)	• Lecturer • Lecturer & students • Lecture
Exposing students to different question approaches during the course of lecturing.	• State a question and elaborate on it. • Gives an opportunity for the students to share their views before he elaborates	During the lecture (March-May) & (August -September)	• Lecturer & students
Formulation and explanation of rubric plates by lecturer to the students.	• Lecturers meet and agree on scoring format • Come up with assessment plate • Attending sessions for sharing assessment plates • Practicing what is being told.	(March - April)	• Lecturer • Lecturer • Students • Students

Appendix B: Budget Estimates

Particulars	**Units**	**Price**	**Total**
Research budget incomes			
i) Research grant			700,000/=
ii) Personal saving			950,000/=
Total income			**1,650,000/=**
Research Budget expenditure			
i) Stationary collection			300,000/=
ii) Communication costs			150,000/=
iii) Transport costs			450,000/=
iv) Meals & refreshments			300,000/=
v) Classified materials			350,000/=
vi) Miscellaneous			100,000/=
Total expenditure			**1,650,000/=**

Appendix C: Evaluation meeting attendance list



ATTENDANCE LIST
FOR THE RESEARCH EVALUATION MEETING HELD AT NOMA II ON 10th Oct 2018

Name	Title	Signature
1. WETTALCA JUSTIN	MVP Student	
2. Twisime Grace Rwamongera	MVP Student	
3. Namiya-Prossy-Luwanga	MVP Student	
4. Lelelu Belinda Andama	MVP Student	
5. MUBANGIZI CRISPUS	TEC Student	
6. ATUKWATSE AMOS	TEC Student	
7. GANYA Sulaiman	TEC Student	
8. KENERUGABA MUHAFU	TEC Student	
9. NYEMBIZA AMANYE	BMC Student	
10. KITAKULE DANIEL	TEC Student	
11. MALUETTE ABDALLAH	TEC Student	
12. NAKACWECA SPECIOLA	TEC Student	
13. NANTANDA SHAKIRAH	TEC Student	
14. NALUNGA PATRICIA JOSELYN	TEC Student	
15. MWESIGYE VICTOR	OM Student	
16 NASASIRA FRANCIS	TEC Student	
17. LUMBUTE IVAN APOLLO	TEC Student	
18. KATO VERONICE BANGAMO	TEC Student	
19. KAZIONE ANDREW	TEC Student	

ATTENDANCE LIST
FOR THE RESEARCH EVALUATION MEETING HELD AT NOMA II ON 10th Oct 2018

Name	THle	Signature
1. SSEMBOYA MUHAMADI	STUDENT	
2. OWIAMANI DONOZIO	STUDENT	
3. MUBEEZI CALEB ATUHAIRIRA	STUDENT	
4. Kinyera Peter	Student	
5. MUKWA IVAN KASINGA	Student	
6 KABUGA JIMMY	STUDENT	
7 NIYONSABA JACK	STUDENT	
8 AKUGIZIBWE JOHN	STUDENT	
9. Dr. KYAZIKA ELIZABETH	Supervisor	
10 Kato Michael	Researcher	

Appendix D: Templates of tests given

KYAMBOGO UNIVERSITY

Civil and building engineering

TEC

TEST 2

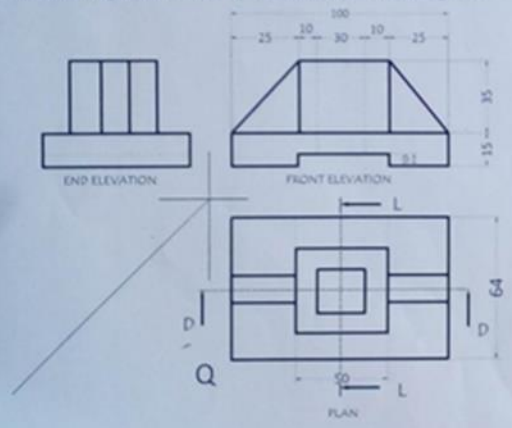
2018/2019

ENGINEERING DRAWING TEC 115

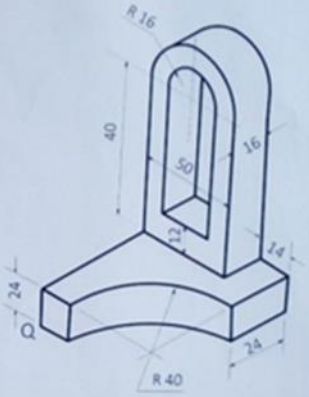
DURATION: 1 HR

INSTRUCTIONS: Attempt all questions

1. Draw the figure below in orthographic projection and show:
a) A sectional front elevation D-D
b) A sectional end elevation L-L
c) Draw the figure in isometric projection with corner Q in the foreground.



2. Draw the figure below in third angle orthographic projection. Take F as the front elevation, E as the end elevation and T as the top view.



END.

KYAMBOGO UNIVERSITY

Civil and building engineering

TEC

TEST 2

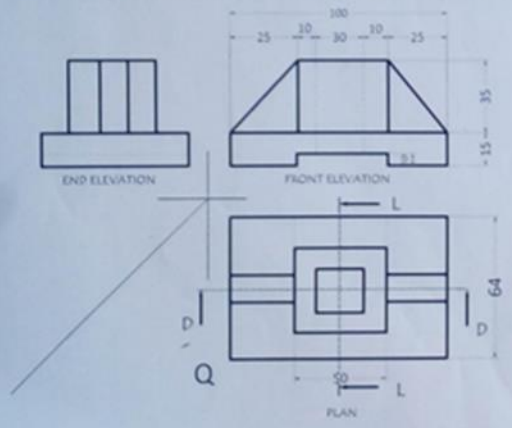
2018/2019

ENGINEERING DRAWING TEC 115

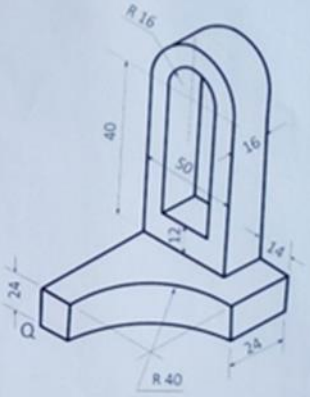
DURATION: 1 HR

INSTRUCTIONS: Attempt all questions

1. Draw the figure below in orthographic projection and show:
a) A sectional front elevation D-D
b) A sectional end elevation L-L
c) Draw the figure in isometric projection with corner Q in the foreground.



2. Draw the figure below in third angle orthographic projection. Take F as the front elevation, E as the end elevation and T as the top view.



END.

Appendix E: Group tasks

Assignment 1

ANGLES, TRIANGLES AND QUADRILATERALS

1. a) Construct the following angles

90°	60°
67½°	157 ½°
100°	115°

2. a) construct the fig.2

b) inscribe a circle to triangle EFG

c) escribe a circle to triangle GDE on face DE

d) circumscribe a circle to triangle ABG

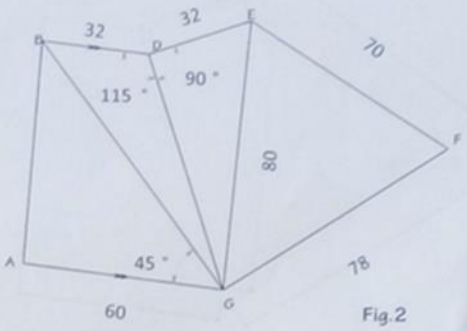


Fig.2

1

3. The perimeter of a triangle ABC is shown in fig.3 is 215mm and the sides AB, BC and CA are in a ratio of 3:2:3. Construct the fig.

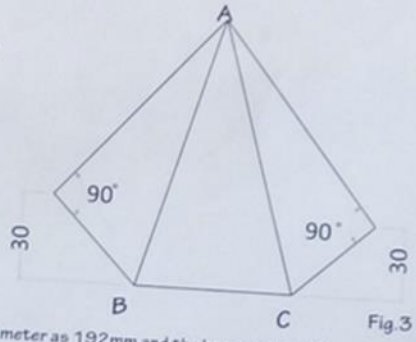


Fig.3

4. a) construct a triangle PQR given its perimeter as 192mm and the base angles 45° and 60°.

b) measure and state the sides of the triangle

5. a) construct a square whose diagonal length is 100mm.

b) inscribe an octagon in the drawn square

2