IMPROVING PLUMBING PRACTICAL SKILLS USING PROBLEM BASED LEARNING FOR CIVIL ENGINEERING STUDENTS AT NATIONAL INSTRUCTORS' COLLEGE, ABILONINO, UGANDA

KABUNGA SSENDI PETER

18/U/GMVP/ 19613/PD

A RESEARCH DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING IN FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER DEGREE IN VOCATIONAL PEDAGOGY OF KYAMBOGO UNIVERSITY

NOVEMBER, 2022

DECLARATION

I, Kabunga Ssendi Peter, hereby declare that the content of this thesis is my original piece of work and has never been presented for any award for a degree in any institution of higher learning. Any other extra information used in this report by other scholars has been acknowledged.

Sign.....

Kabunga Ssendi Peter

Date.....

APPROVAL

This is to acknowledge that this research project titled "**Improving plumbing practical skills using problem based learning for Civil Engineering students at National Instructors' college, Abilonino, Uganda"** is an original work for Kabunga Ssendi Peter (18/U/GMVP/ 19613/PD). It has been under our supervision and is now ready for submission with our approval

Sign: ..... Date: .....

JUSTINE NABAGGALA (PHD).

(Principal Supervisor)

Sign: ..... Date: .....

Dr Muhwezi Lawrence (PHD)

(Second Supervisor)

DEDICATION

I dedicate this dissertation to my employer, National Instructors College-Abilonino and supervisors, my family for their tireless efforts they have exhibited toward the completion of this research.

ACKNOWLEDGEMENT

This dissertation has been a collaborative endeavor of a number of people whose effort cannot go unrecognized. I am greatly idebted to all the persons whose contributions have been very vital in this piece of work. It has been apleasure working with each one of you and I am proud of what we have accomplished together.

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Despite the contributions of all the above mentioned personalities I remain entirely responsible for all the views and outcomes in this dissertation.

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LIST OF ACRONYMS/ABBREVIATIONS

ACPIC	Abilonino Community Polytechnic Instructors' College
ATL	Active Teaching and Learning
BVTS	Bachelors' degree in Vocational and Technological studies
CPIC	Community Polytechnic Instructors' College
DITTE	Diploma in Instructor and Technical Teacher Education
FGD	Focus Group Discussion
FT	Future Workshop
IT	Industrial Training
NICA	National Instructors' College, Abilonino
MOES	Ministry of Education and Sports
PBL	Problem Based and Learning
P.G	Performance Guide
TIET	Teacher Instructor Education Training
TVET	Technical and Vocational Education and Training
UPE	Universal Primary Education
WPA	Work Process/Production Analysis

DEFINITIONS OF THE KEY TERMS AND CONCEPTS

Improving: This is an approach of making something better in order to enhance in value or quality. Hence this makes it more useful for human use

Problem Based Learning (PBL): This is refers to the instructional methods / approaches used in active teaching and learning process. In this approach, learners are actively involved during the instructional process. This approach if used effectively allows students to grasp the concepts they studied with the daily activities and thus this has enhanced their knowledge and understanding. Hence, it is a student-centered approach.

Acquisition: This is the process of gaining possession of something.

Plumber: This is a technical person who installs water systems, sanitary appliances', drainage systems, heating systems, repair pipe work and carries out maintenance work for the installed systems.

Plumbing skills: these are talents or expertise, that allows a plumber to carry out plumbing jobs. E.g. installation of: sanitary appliances,cold water systems, laying drainage systems to name but a few.

Industrial based content: This refers to the total sum of knowledge and skills, which are desired in the world of work. In addition, also it refers to the competence-based curriculum intending to equip people with knowledge and skills.

ABSTRACT

This study was carried out in Kole District at (NICA) National Instructors College – Abilonino in the Department of Civil Engineering with an intention of improving practical skills using Problem Based Learning (PBL)- method. It was guided by four objectives: to identify challenges in plumbing practical skills, establish possible strategies to address the challenges, implement and evaluate the possible strategies. A participatory Action Research Model was us ed for the study. The inquiry used a descriptive study design taking a qualitative approach based on a sample of 22 participants comprised of the instructors, students, college administrators, employers and former students. The researcher used purposive sampling for selecting key participants for the case of this research. Situation analysis, Future workshop and focused group meetings provided descriptive data which were recorded and interpreted,basing on the PBL-method and Performance Guide (PG) technique. The main findings from the situation/work process analysis showed that graduates were having *"*inadequate practical skills" which could affect them not to perform well during the practical tasks. One of the major important reasons which was noted during the future workshop was due to ineffective methods of delivery by instructors. Possible strategies to address the challenge were achieved through brainstorming and discussion from the future workshop. All participarts agreed and recommended the use of PBL-method and PG technique to improve the performance of practical skills for civil engineering students at NIC-Abilonino. The study concluded that lack of practical skills was the main challenge for Civil Engineering students. Under this study, PBL-method and PG technique were used and proved to be effective and efficient tools which responded to the major challenge and the entire objectives of the study. The feedback that students received through organised practical work enabled them to improve plumbing practical skills and enhanced skills acquisition.

CHAPTER ONE

INTRODUCTION

1.0 Over view

This chapter focused on all the aspects in Vocational Training and Vocational Pedagogy, background of the study, personal background, situational analysis, motivation statement, problem statement, study purpose, objectives, research questions, scope of the study, justification of the study, significance of the study. The world over a number of countries have been undergoing rapid transformation in areas of technological innovations and intensified competition in the world of work for the last two decades (Mouzakitis, 2010). These changes have created new demands for more adaptable, multi-skilled and creative labour. To meet these demands, vocational training becomes necessary as it is identified as an essential field that attempts to prepare young people for work. Furthermore, vocational training develops craftsmanship, life-long learning, practical experience and practical problem-solving through hands-on training.

On the other hand, vocational pedagogy as a field is required by any vocational teacher to adjust the teaching approaches to meet the needs of learners and to match the context in which they find themselves. Much of the learning is acquired through interactions with materials and tools while reflecting on the theoretical knowledge. Vocational pedagogy as a field of knowledge focuses on teaching and learning oriented towards trades, occupations and professions. It stresses the relationship between teaching/learning/training on one hand, and work and the labour market on the other (Mjelde, 2008). According to Mjelde, (1995, p. 125), vocational pedagogy focuses on learning by doing, in relation to trades, occupations and professions; it stresses a dynamic relationship between the work of hand, the mind and the body that plays host to these activities. She further contends that the concept is broad and covers the pedagogical activities of teaching, learning and developmental work directed towards vocational/professional and technical disciplines, whether these are conducted in schools or through apprenticeship system in working life.

According to Yates (2007) pedagogy as the study and practice of teaching and learning, involves a conscious use of particular instructional methods such as constructivism which focuses on the active role of learners in constructing new knowledge and understanding based on what they already know and believe. Mjelde (1995, p. 132; 2006a, p.79) asserts that the

advantage of vocational education has been a pedagogy based on learning inductively from practice (workshop learning) towards theory and back, reflectively, again to practice. Teaching and learning of home economics, a field in vocational training, requires specific pedagogical methods that emphasise hands-on experiences.

To approximate teaching and learning of home-economics in relation to working life, there is need to improvise instructional materials. Here the understanding comes through action and personal experience and that theory is learnt in close relationship with practice. This is supported by Mjelde (2006a, p. 21) who contends that the core of vocational pedagogy is the relationship between workshop learning and learning from the classroom on one hand and learning in practical situations in working life on the other.

Globally, Vocational training is considered to be the most suitable solution to youth unemployment. In German, Vocational education program is a dual system such that students learn in the classroom and also learn by doing. Typically, the trainees attend vocational school for one or two days per week and they study the theory and practice of their occupation, economics, social studies, foreign languages and other general subjects. Then they further do a working apprenticeship in their chosen field (Olumide, 2015). In South Africa, qualifications whether academic or Vocational are seen as advantage in labour market (UNESCO, 2011).

Youth unemployment, particularly among those without training or qualifications is a threat in many countries. Vocational Education (VE) refers to all forms and levels of the educational process involving preparation for occupational fields and effective participation in the world of work, lifelong learning and a preparation for responsible citizenship according to Halton, 2012.

In Uganda, attitudes towards vocational education have changed over the years. Students too, influenced by their parents, teachers and the labor market situation, have become more positive towards technical education (Egau, 2002). I concur with the above author and through experience, I have observed that the our society is gradually realizing the value of VET in regards to employable skills. More students are being admitted in technical institutions to be trained in various areas of specialization for skills acquisition. This is reflected in new vision of (May 10th2018) where it was reported that there was a marginal increase in the number of candidates from 4,331 in 2015 to 4,629 in 2016. The number of registered examination centres also rose from 102 in 2016 to 113 in 2017 indicating 10.8% increase.

Vocational training standards relating to the qualifications of instructors who are supposed to transfer skills to the trainees in technical institutes have also been stipulated by the Education Service Commission. The training for instructors has been improved by reviewing the curriculum to match with the needs of the employers in the world of work. “Nsalasaata David former commisioner rehabilation services was reported to having said that the Minister of State for Finance, Planning and Economic Development wanted Ugandans particularly parents and young generation to embrace technical and Vocational education” because it is a gateway to job creation, curb unemployment and forge a sustainable economic development for Uganda . agree with the minister because it is through technical education that the majority of unemployed respondents in Uganda can get skills and access jobs in order to improve on their standard of living and contributes to gross domestic product of the country.

1.1 Vocational Pedagogy (VP) as a field of study

Vocational Pedagogy is defined as a field of knowledge and skills appropriated towards all trades of professions. The central aspect of vocational pedagogy is an understanding of the relationship between learning in school life and learning in work life (Mjelde 2006, Kyakulumbye, 2008). The central aspect of vocational pedagogy is also an understanding of human learning and of the integration of “hand, mind and heart” in any learning situation.

Vocational Pedagogy refers to a science, art and craft of teaching that prepares people for certain kinds of working lives (Crawford, 2010). This is emphasised by the decisions that are undertaken by teachers and learners. In addition, it is a sustained process whereby somebody acquires new forms of conduct, knowledge, practice and criteria from somebody who is an appropriate provider and evaluator (Bernstein 2000 cited in Harry 2001). Baing on Bernstein’s description of pedagogy, he defined it to refers to the act of enhancement of the skills and knowledge required for a particular job or trade such as plumbing, building, carpentry, welding to equip an individual with real skills, as opposed to theoretical knowledge.

Vocational Education and Training

Indigenous technical and vcational education in Uganda before 1877 “Technical and Vocational and training” was used as comprehensive terms referring to those aspects of the education process involving, in addition to general Education.the study of technologies and related sciences and the aquisition of practical skills, atitudes, understanding and knowledge relating to occupation in virious sectors of economic and social life.the missionaries and

colonial master who championed the course of westrrn education were concerned mainly with training globally starting with Nigeria to make their missionary and colonial assignments easier.in this wise the purpose of western education was to train clerk and interpreters to make them read and write in order to serve the missionary and colonial interest.

Vocational training can be in different forms, depending on needs,resources and circumstances. For example, formal training/education, none-formal training, and apprenticeship training. Mjelde, (2006) observed that there are three players in VET namely; school, workplace and employee. It is in my opionion that in the learning process, new strategies are developed and are improved to fulfill the gaps . this is based on the fact that learning is a continous cycle of processes that originate from one generation to another and also from experience we have attained and what is intended to do currently according to Dewey, (1997).

In this case, Vocational Pedagogy is an approach in which an expert, Instructor, Lecturer or Experienced trainer in a particular occupation/ trade is able to transfer knowledge and skills to a learner (Lucas, Claxton & Webster, 2010, p.3). In my view, this will lead to practical competences among the learners hence getting prepared to join the world of work. While transferring knowledge and skill, this approach needs to select appropriate methods like Problem Based Learning (PBL) and techniques, which should emphasize Active Teaching and Learning (ATL).

Vocational Pedagogy therefore is a field of knowledge oriented towards trades, occupations and professions (Mjelde 2006). It involves training, learning and work. VP is aimed towards learning for attainment of competences for executing standard work. VP embraces learner-centred approach to teaching and learning whereby learning and doing move hand in hand.

The main aspect of VP is to understand the teaching and learning process and the integration of hands, mind and heart in the learning situations. Learning in this case, aimed to equip a person with specific skills required in the world of work. Mjelde (2006) observed that there are three players in VET namely; School, Workplace and Employee. These parties work together in developing expertise in required work force. Putting into consideration my personal experience in technical education, there is need for a curriculum that reflects key competences and skills required at the workplace/industry. By so doing Vocational Pedagogy becomes relevant to the trainee, employee and world of work.

Vocational pedagogy is a field of knowledge oriented towards trades, occupations and professions . The central aspect of vocational pedagogy is an understanding of human learning and the integration of hands, mind and heart in the learning situation (Mjelde, 2008). According to Hodley (2015), vocational pedagogy is a science of education which deals with the strategies of teaching and learning. In my own view, vocational pedagogy is a wide field of knowledge which encompasses various areas of specialization such as building construction, carpentry and joinery, welding, catering among others and it focuses on practical tasks which involves learning by doing.

The effectiveness of all education systems depends critically on the quality of teaching and learning in the classrooms, workshops, laboratories and other spaces in which education takes place. It is observed that vocational pedagogy unlike general education employs learning strategies that are focused on hands on training. In this case, it is important that a blend of methods are used so that learners acquire the intended skills from a particular area of study. According to Harkin (2012), there is no single teaching strategy which can satisfy all learning situations.

There is a strong consensus that effective teaching methods for vocational learning are based on realistic work problems and scenarios, led by teachers and trainers who have recent and relevant vocational experience. In my view, we learn through different ways such as through inquiry, imitation, practice, reflection, critical thinking and observation. So if most of these ways are used during teaching and learning, the rate of skills acquisition will always be high.

According to Kyambogo University (2009), one of the specific objectives of MVP programme is to develop competences within learners. When learners are guided well during training, the required competences are developed and they become useful technicians in the world of work.

In order to get a clear meaningful of vocational pedagogy approaches, there is need to reflect on the Vocational Didactic model. According to Tobiassen, (2002) vocational didactic model shows the interdependency of the elements, which make up learning and evaluation of the vocational pedagogies.

Vocational didactics consists of six different sub-topics namely; learning experiences, resources, objectives, content, learning process and evaluation. In my expertise, this model matches with the scheme of work, which is the total sum of all the activities required to

facilitate teaching and learning processes. Preparation of the scheme of work which includes identifying the items for learning with other stalkholders; analyzing them into suitable units for instruction; sequencing units in a logical order,and lastly but not least, identifying the suitable methods together with the appropriate learning aids and making self evaluation.

1.2 Study Background

The study background is comprised of the personal background, historical perspective of National Instructors College, Abilonino and instructional concerns at the College.

1.2.1 Personal background

The researcher is a Technologist, Technician and an Educator with a practicing record spanning across a period of 20 years in the field of TVET Institutions emerging as a successful record of work. He is a graduate with a Bachelors' degree in Vocational and Technological Studies with Education (BVTS with Educ.). Currently, the researcher is a lecturer, plumber and a trainer in the field of TVET education and skills, at Civil Engineering Department at National Instructors College (NIC) – Abilonino. The researcher served as a Deputy Principal, and Head of Plumbing department at St.Joseph's Technical Institute Kisubi. He has taught various groups of people at craft certificate and diploma level, formal and non-formal, and trainers of trainers. In addition, he participates in the supervision of students in both school practice and industrial training.

During MVP course, I received assistance and direction from the facilitators through mentoring. This helped me to acquire more skills such as working through team work and discussion of challenging tasks that are relevant for practice in the field of work. I also learnt a lot from research expeditions which were conducted in groups from selected workplaces after which the findings were documented and presented for assessment.

1.2.2 National instructors' College- Abilonino

National Instructors' College, Abilonino (NICA) started as one of the eleven Community Polytechnic Instructors' Colleges (CPIC's) in 2001/2002 and it was known as Abilonino Community Polytechnic Instructors' College (ACPIC). The College was started with an emphasis to solve unemployment problems through provision of employable skills and job creation to Ugandans especially the Universal Primary Education (UPE) leavers'. However in 2004, the ten (10) CPIC's in Uganda were closed and only Abilonino CPIC remained with the purpose of training instructors for community polytechnics, Technical and Vocational Education and Training (TVET) institutions.

NIC-Abilonino is under the Teacher Instructor Education Training (TIET) Department in the Ministry of Education and Sports (MOES). The obligations of TIET to NICA include; instructor education & training that is, responsive of the needs of the education sector, improving and strengthening the quality of the staff for instructor education by ensuring that instructors are available in adequate numbers and are of the right character and quality.

NIC-Abilonino offers, diploma courses in Instructor and Technical Teacher Education (DITTE) awarded by Kyambogo University as the affiliated institution . The programme consists of several courses which include; Civil Engineering (Block laying and Concrete Practice, Plumbing, Carpentry and Joinery), Welding and Fabrication/Fitter mechanics, Motor Vehicle Mechanics, Agriculture, Electrical Installation, Shoe Making and Leather goods and Tailoring and Fashion Design. The college admits graduates from TVET institutions with a minimum qualification of Craft Part II (Advanced Level), National Certificate in Technical courses and Ordinary Diploma in relevant professional courses such Diploma in Civil Engineering,electrical ,mechanical and water to mention but a few. The trainees from national certificate and advanced level are trained for two years, while trainees who hold diplomas in technical fields are trained only for one year and all follow full time and semester programme.

1.3 Situation analysis

Situation analysis refers to as the process of assessing a complex situation within its wider context. The purpose of situation analysis first, is to provide a broad basis of understanding what is on ground. Secondly, it also provides a common reference point for the rest of the planning process, and it provides the background for the selection of priority areas of concern for planning. Therefore, the researcher carried out a situational analysis at NIC,Abilonino in civil engineering department to identify the most pressing challenges and concerns in teaching and learning methods employing work process analysis. A future workshop was later conducted to establish a research problem to be addressed within the given research project lifespan and the possible interventions strategies to create a positive change.

According to Calhoun (1994), the first phase of action research is to select an area of focus. Therefore, in order for the researcher to get a topic, he had primarily to identify the concerns or issues at National Instructors College, Abilonino. The researcher together with the stakeholders held a Focus Group Discussion (FGD) to identify concerns in the college. The FGD consisted of seven (07) students and three (03) lecturers from the Department of Civil Engineering and three (03) members of the College Administration. Before identifying the

concerns, the researcher presented a work process analysis to DITTE student of Civil Engineering showing activities right from admission to graduation. The work process analysis brought out issues of concerns for the participants to discuss as presented in Table 1.

Table 1 : Work process analysis of a DITTE Student of Civil Engineering

S/N	Activity	Lecturer Competence	Student Competence
1	Admission	N/A	Apply for DITTE program
2	Training Theory and practical skills in Civil Engineering	-Teach Theory concepts of Civil Engineering -Teach practical skills lessons of Civil Engineering	-Learn theory concepts of Civil Engineering -Apply the theoretical concepts of Civil Engineering -Demonstrate practical skills of Civil Engineering -Perform practical skills of Civil Engineering
3	Teaching Skills Training	Train Learners the Teaching Skills	-Apply the teaching skills to learners of lower level
4	Assessment	-Assess Theoretical concepts of Civil Engineering -Assess Practical skills of Civil Engineering	-Do the assessment for both Theory and Practical
5	Examinations	Invigilate Examinations	-Do Examinations
6	School Practice	-Supervise Students in School Practice	Teach other learners during School Practice
7	Industrial Training	Supervise Students in Industrial Training	Perform practical work of Civil Engineering in the world of work
8	Graduation	Attend graduation	Graduate

Having taken the Civil Engineering participants through the work process analysis, the researcher posed the following question:

“You have under gone through some of the activities a DITTE student goes through right from admission to graduation, which activities therefore were not going on well that need improvement?”

The researcher divided all the participants into three equal groups. Through brainstorming and discussion, each group noted areas, which needed improvement on a manila paper, after which \each group made presentation.

The following areas of improvement / challenges were identified per group:

Group I

- Inadequate training materials
- Poor time management by lecturers
- Inadequate practical skills
- Inadequate continuous assessment
- Failure to conduct study trips
- Delay of results by Kyambogo University
- Unclear school program

Group II

- Inadequate teaching and learning resources
- Unclear curriculum
- Poor time management by students
- Inadequate practical skills in the workshop
- Inadequate study tours
- Lecturer lack competences in practical skills
- Lecture rooms not accessible all the time
- Unclear roles of some staff members

Group III

- Inadequate teaching and learning resources
- Low syllabus coverage in some course units
- Inadequate practical skills
- Inadequate selection criteria during admissions
- Inadequate safety precautions
- Irregular exposure to workshop tools and equipment
- Poor communication between administrators and students

- From the above discussion together with the stakeholders the following areas of improvements / challenges under teaching and learning process were identified;
- Inadequate training materials
- Inadequate practical skills
- Poor time management
- Inadequate study tours
- Irregular exposure to workshiop tools and equipment
- Inadequate safety precautions
- Inadequate continuous assessment
- The stakeholders ranked the above mentioned areas of improvement / gaps using pair wise matrix ranking tool.

Basing on the identified challenges from the three groups the stake holders agreed on the following challenges to be addressed in the future workshop.

- Inadequate training materials
- Irregular exposure to workshop tools and equipment
- Inadequate safety precautions
- Inadequate practical skills
- Inadequate study tours
- Inadequcate continuous assessment
- Poor time management

1.3.1 Future Workshop

Future workshop, this is a method/technique, which was developed, by Jungk, Luiz and Muller in 1980's. This method equips partcipants to formulate new ideas by identifying the most critical issue, identifying a research topic and generating solutions to the challenges/concerns in a collaborative effort towards existing problems. A future workshop emphasizes critical learning, democracy, teamwork and empowerment (Lauttamaki, 2014).

According to Jungk and Müller (1987), the future workshop consists of five phases which include;

The preparation phase*:* Here the researcher makes prior preparation, participants are invited using invitation letters, program showing different activities prepared, the room and local facilities for the workshop are settled by the organizers.

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

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

The implementation phase: An action plan is elaborated and done. Here the ideas found are implemented, checked and evaluated.

The follow-up phase: Here the action plan is monitored; eventually changes are performed and if needed new future workshop can be planned.

In this study the future workshop as a tool and an approach of research was used because it enables a group of people to develop new ideas or solutions of social or educational problems or conflicts and it is a well-structured method, fosters self organization, awareness, fantasy and action competence (Jungk & Müller, 1987). The researcher used the future workshop because it has almost similar phases and intentions with how action research is conducted (Calhoun, 1994).

The preparation phase which seeks for an area of focus while critique & fantasy involves data collection, organizing the data and analyzing, and implementation/reality phase is similar to interpreting data and taking action.

Having identified that the teaching and learning of plumbing practical skills was insufficient for civil engineering students at National Instructors College, Abilonino as per the findings from the situational analysis, a Future Workshop (FW) was organized to find out in details the causes of inadequate practical skills in plumbing. According to Jungk,(1987), Future Workshop is a tool used for problem identification in a given setting. In line with the research proje ct, the future workshop was planned and carried out at National Instructors College, Abilonino as shown in figure 2. During the future workshop, five phases were observed; preparation phase, critique phase, fantasy/utopia phase, reality phase and implementation and evaluation.

1.3.2 Future Workshop phases

a) Preparation phase

During the preparation phase, the researcher came up with a programme that was to be followed during the future workshop. The participants were invited using invitation letters and through phone calls to the workshop. The researcher prepared the room and local facilities for the workshop. Refreshments and writing materials like; pens, markers, papers and manila papers were provided to the participants being offered by the administration.

b) ***The critique phase***

During the critique phase, the stakeholders brainstormed and identified causes for inadequate teaching and learning of practical skills in plumbing for DITTE students in Civil Engineering at National Instructors College, Abilonino. These causes were brainstormed during group-focused discussions and stakeholder's future workshop. The causes were grouped according to the short term, medium term and long term as shown in Table 3.

Table 2: Causes of inadequate teaching and learning of practical skills in plumbing for civil students DITTE

Short Term	**Medium Term**	**Long Term**
Inadequate preparation by instructors to teach	Inadequate skills in preparation of design and cost estimates	Poor fees payment
Limited time allocated for practical periods	Poor relationship between instructors and learners	High enrollment
Inadequate training materials	Lack of exposure for teachers handling practical skills	Poor quality of pupils admitted
Inadequate skills in use of some tools and equipments in plumbing	Lack of exposure for learners to handle practical work	High cost of training materials
Poor attitude of learners towards practicals	Inadequate equipments and materials	Lack of refresher courses for instructors
Lack of time management by students and instructors		

Inadequate planned practicals		
Lack of protective gears to be used during practicals		

Source: Primary data

Researcher and stakeholders agreed to focus on solving short-term causes, which included: Inadequate preparation by instructors to teach, limited time allocated for practical periods, inefficient training materials, inadequate skills in use of some tools and equipments in plumbing, poor attitude of learners towards practicals, lack of time management by students and instructors and Lack of protective gears to be used during practicals.

Civil Engineering Students

Civil Engineering Instructors

Figure 1: Students and instructors of Civil Engineering department brain storming on the areas of improvement/challenges

Table 3: Causes in short term challenges clustered

S/n	Un Clustered challenges	Clustered challenges
1	Inadequate preparation by instructors Inadequate skills in use of some tools and equipments in plumbing Inadequate planned practical skills	Lack of plumbing practical skills and methods of delivery by instructors
2	Inadequate training materials Inadequate tools and equipments in plumbing	Limited resources to facilitate teaching and learning process

	Lack of protective gears to be used during training	
3	Limited time allocated for practical periods Lack of time management by students and instructors	Lack of time management by instructors and students
4	Poor attitude of learners towards practicals	Poor attitude of learners towards practicals

Source: Primary data

The major causes of inadequate teaching and learning of plumbing practical skills are as follows:

- Lack of plumbing practical skills and methods of delivery by instructors
- Limited resources to facilitate teaching and learning process
- Lack of time management by instructors and students
- Poor attitude of learners towards practicals

Using pair wise ranking matrix, Lack of practical skills in plumbing and methods of delivery by instructors to handle the teaching and learning of practical work emerged as a key challenge.

c) Fantasy/utopia phase

The researcher and stakeholders came up with an imagination, to draw picture of the future possibilities and most pressing causes identified in the critique phase. All the ideas were collected basing on what was discussed in the critique phase and put in an "idea store", as suggested by the stakeholders.

The following were solutions brainstormed by stakeholders aimed at improving plumbing practical skills using problem based learning.

- Increase the time for practicals as compared to theory lessons
- Instructors to guide learners on how to use performance guides during practical exercise
- Retool the instructors to adopt student centered learning pedagogy
- Instructors be taken for refresher courses on active teaching and learning
- Increase contact hours in a day from six to eight hours
- Sensitize learners about the importance of learning practical skills
- Encourage students to impress research as part of learning process in PBL
- Instructors to guide learners on how to formulate the SMART objectives

- Develop templates to be used in the assessments of practical exercise
- Impress Information Communication Technology (ICT) to boost PBL
- Instructors to be motivated by college administration to work beyond normal hours

Stakeholders' brainstormed the above solutions imagining that every situation was possible and that resources were available to address the gaps in solving the problem of inadequate teaching and learning of practical skills in plumbing.

This assumption was not realistic since resources are scarce and we had to prioritize the more pressing challenges that could be solved within our means amidst the scarce resources by use of pair wise matrix tool. Stakeholders further brainstormed on most workable solutions to improve performance of plumbing practical skills for Civil Engineering students. This included:

- Training Instructors to adopt PBL method
- Train students on how to use performance guide as designed to different practical work
- Develop assessment rubric to be used to evaluate the practical work done.

d) Reality phase

Under this phase, the researcher together with the stakeholder agreed to revisit all the challenges with their possible solutions to reach a consensus on what is possible to implement with the resource available, see Figure 3. These challenges were ranked depending on what is most pressing and attainable in short term. To get the most pressing challenge, a pair wise matrix tool was used as seen in Table 5 where inadequate teaching of practical skills was ranked first. It was against this background that stakeholders agreed on improving on plumbing practical skills for Civil Engineering students at National Instructors College, Abilonino.

Figure 2: Researcher together with stakeholders participate in the ranking of the challenges.

Table 4: Ranking the challenges using pair wise matrix tool during the Future workshop held.

	Lack of plumbing practical skills and methods of delivery by instructors (1)	Limited resources to facilitate teaching and learning process (2)	Lack of time management by instructors and students (3)	Poor attitude of learners towards practicals (4)	TOTAL	RANK
1		1	1	1	6	1ST
2	1		2	2	4	2ND
3	1	2		3	3	3RD
4	1	2	3		0	4TH

Source: Primary data

From the table 5 above, the stakeholders ranked the challenges whereby **"Lack of plumbing practical skills and methods of delivery by instructors"** scored the highest tally of six (6). This was ranked to be the first and most pressing challenge in teaching and learning process for Civil Engineering students at National Instructors College, Abilonino, when both situation or work process analysis and future workshop was conducted.

e) Implementation and Evaluation phase:

From the reality phase, action was drawn where the challenges with their possible workable solutions were stated while considering the time and resources available to improve plumbing practical skills using PBL for Civil Engineering students at National Instructors College, Abilonino. Thus solutions which were agreed upon included;

Training Instructors to adopt PBL method through reflesher courses,

Train students on how to use PBL method and Performance Guide (PG) as designed to different practical work.

Develop assessment rubric to be used to evaluate the practical skills done.

Stakeholders implemented solutions following an action work plan (Table 6). The roles of trainees, instructors and administrators were clearly agreed upon. The role of researcher was to follow up on action implementation by the responsible persons, to note what was implemented and what had not worked well.

Table 5: The Action Implementation Work Plan

S/N	Activities	Indicators	Responsible personnel	Duration Schedule	Remarks
1	Examine the causes of inadequate practical skills acquisition.	Situational analysis Work process analysis	Administration Instructors/Lecturers Students Researcher	March To April 2021	Done as planned.

2	Give strategies of improving the plumbing practical skills while using PBL.	Attendance list Future workshop Performance guides (PGs) working drawin gs Modelling Practical Exercises for practice	Administration Instructors/Lecturers ’ Students Researcher	April To May 2021	More has been done.
3	To implement the possible strategies for improving plumbing practical skills using PBL.	Develop the templates for the pedagogical process. Training by use of PGs, visuals and modelling. Administer practical exercises	Administration Instructors/Lecturers Students Researcher Supervisors	April To May 2021	Moving on well
4	To evaluate the possible strategies used in improving plumbing practical skills	Record of attendance Record of work Record of marks Photos of participants Develop the rubric for the evaluation process	Head of department Instructors/Lecturers ’ Trainees Researcher & supervisors	May To June 2021	
5	Report writing and Editing		Researcher Supervisors	May To July 2021	

	Mocks, viva presentations		Administrators Supervisors Mentors & Researcher	August 2021	
	Submission of Thesis		Administrators Supervisors	August 2021	

Source: Primary data

Follow up on implementation of action work plan: The follow up was conducted on the performance of the trainees, instructors and administrators at National Instructors College, Abilonino to find out if there was any change and improvement revealed within the time frame of the action research. This was done so as to determine the success or failure of the research project through the evaluation of the intervention strategies that were agreed upon during the Future Workshop with the key stakeholders as illustrated in figure 4.

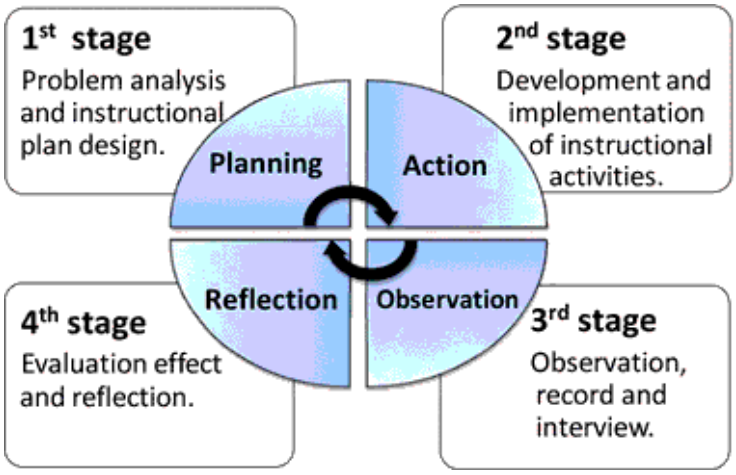


Figure 3: Action research cycle and Conceptual framework of PBL characteristics.

Source: (Dick, 2002)

1.4 Statement of motivation

Uganda's current economic situation requires teachers with skills, knowledge and competences that meet the needs of the world of work. This coupled with Uganda's Education Reforms on vocationalising education,The demand for a workforce that is practical and problem solving oriented, intensified.

Working on building projects for the past fifteen years and observations on the relationship between teaching and learning in various institutions and the world of work, forms a core inspiration for undertaking this study. Based on this background, this study is targeting at

improving instruction-learning processes for the enhancement of trainees' skills acquisition in plumbing training for Civil Engineering students at National Instructors College, Abilonino. The researcher is actively involved in teaching plumbing practical sessions in the department of Civil Engineering at National Instructors College, Abilonino and has noted that the skills acquisition in plumbing trade has always been inadequate.

In respect of this, the researcher is motivated to find out why Civil Engineering students after graduating from college cannot handle plumbing practicals and water related projects despite of the college/department having to undertake the study. The findings of the study would solve the problems in practical skills acquisition in DITTE Civil Engineering most especially in plumbing training as evidenced in students final research reports .

1.5 Statement of the problem

From the work processes analysis and future workshop conducted at National Instructors College, Abilonino,the researcher together with the stakeholders identified the major challenge for plumbing practical skills for Civil Engineering students at National Instructors College, Abilonino. In this case the challenge was "inadequate practical skills" in the current vocational pedagogical approaches during the teaching and learning processes.

It is on record that under Civil Engineering, one is supposed to do building and construction works, where as this course combines three (3) trades i.e. building, plumbing and carpentry. There is a noticeable laxity in engagement of learners in other trades like plumbing. This has left learners passive in plumbing skills. This situation if not addressed, National Instructors College Abilonino will continue to produce graduates who cannot perform to the required expectation in the world of work hence this will eventually impact on the enrollment of the college. This therefore requires engaging stakeholders in identifying possible solutions towards improving plumbing practical skills through PBL method.the repercussion of students who cant perform to expectations are layed off their work,perform poorly and get a challenge of inferiolity complex among fellow collegues.

1.6 Purpose of the study

The purpose was to improve plumbing practical skills using problem based learning for Civil Engineering students in DITTE programme at National Instructors College, Abilonino (NICA), at the Department of Civil Engineering through a participatory action research approach.

1.7 Study Objectives

Specfic study objectives included;

i. To identify challenges in plumbing practical skills for Civil Engineering students at National Instructors College, Abilonino.
ii. To identify possible strategies to address the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College, Abilonino
iii. To implement the possible strategies addressing the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College, Abilonino
iv. To evaluate the implemented possible strategies.

1.8 Research questions

The research questions of the study included;

i. What are the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College Abilonino?
ii. What possible strategies to be used to address the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College Abilonino?
iii. How can the identified strategies be used to address the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College, Abilonino?
iv. How can the implemented strategies be evaluated?

1.9 Justification of the study

This research sought to improve plumbing practical skills using problem based learning for DITTE Civil Engineering students at National Instructors College Abilonino**.** The world of work expects graduates from National Instructors College to be knowledgeable, competent and equipped with necessary skills and competences needed in construction industries and as well as in training institutions. On the contrary, the graduates/ students who come out of these institutions fear to join the industries because they do not have enough practical skills. Instead, they join training institutions where they could teach more of the theory than practicals because that is the training they have under gone. Therefore, the researcher wanted to contrubute towards bridging the gap in plumbing practical skills, which was identified from the situational analysis conducted from Civil Department.

1.10 Significance of the study

This action research was of great importance designed in a way to assist the trainees and employers of labour to become aware of the employability skills required to gain and retain employment. If the trainees' skills were enhanced, that would help the trainees' when they graduate to meet the demands in training institutions and industries hence success could be registered in the world of work.

Globally, this study is important because it forms the back bone of development of a nation. It was worth to be noted that, Vocational education gained its grass root from the time when the First World War took place between 1914 and 1918. Vocational education as a recognizable sector grew out of this unregulated mess. Largely, as the result of thinking by progressive educators, especially in USA and UK, they began offering courses in practical living and careers. In my view, from such a war a lot of destruction and loss of lives took place, then they had to start afresh i.e. trained work force with skills that required, hence vocational education had to start immediately to put back what was destroyed.

Institutionally, the study will help the institution to produce competent students hence creating popularity and marketing the institution. It will help the learners to get skills that match with the labour market and world of work. The study also will help the stakeholders especially the learners in civil engineering department to be critical thinkers and collaborative while solving a problem at hand, by doing so they Will be able to equiped with practical knowledge and skills. The instructors in the department were the study was conducted were able to teach practical skills using problem based method and integrated other learning modes like, learning by observation and participation.

Rjoff, (2007) he argued that cultures where home and work are not separated children are able to learn skills through direct observation and participation what she calls "pitching in". Basing on the perspective of the "learning science" Claxton et al, (2010) argued that, learning by practice include; demonstration that's "getting the feeling", Automating, the learner need to automate the skills to the point when conscious thought is no longer required for each element of action (Ericsson,2002). I am sure that this study will cause an impact in improving practical skill acquisition in plumbing when PBL is used together with the above-mentioned modes of learning.

At an individual level, this study will help me to participate in creation of new knowledge and experience into skills development training. The study will be beneficial to both the researcher and instructors on how practical skills in plumbing can be taught and improved using PBL.

Academically, this study will help the use of lesson plan at unit levels to provide them with the needed information about the existing gap (s) between the graduates expected in the world of work. This information will be of much importance during the review of the curriculum as being a basis of teaching and learning process.

This study also will encourage having active learning, better understanding and retention of knowledge. Hence, this will help to develop life skills that could be applicable to improve plumbing practical skills for DITTE students of Civil Engineering Department in the world of work.

1.11 Scope of the study

It comprised of geographic , time and content scope.

1.11.1 Geographic scope

The research was geografically carried out at National Instructors College , Abilonino in Kole District, Lango sub region in Northern Uganda. The study was purposively chosen as DITTE students at the Department of Civil Engineering, NIC, Abilonino.

1.11.2 Time scope

Action research process at National Instructors College, Abilonino, began in December 2019 in which we conducted situation and work process analysis leading us to a future workshop. During this time, the activities conducted in the program include; identification of challenges in plumbing practical skills, identification of possible strategies to address the challenges in plumbing practical skills, implementation of possible strategies in addressing the challenges in plumbing practical skills and evaluation of the implemented strategies. The whole process is cyclic in nature as it involves stages of planning, acting, observation, developing and reflection, which greatly helps in continuous improvement of the situation at the work place.

1.11.3 Content scope

The study concentrated on the improvement of plumbing practical skills using PBL for Civil Engineering students at NIC-Abilonino. Under this, the study employed four specific objectives that include; identification of challenges in plumbing practical skills, identification of possible strategies to address the challenges in plumbing practical skills, implementation of possible strategies in addressing the challenges in plumbing practical skills and evaluation of the implemented strategies.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section on literature review is guided by the research objectives and thus focuses on: theoretical framework.This chapter hightened a literature review related to practical skills, problem based learning, challenges in practical skills, strategies to address the challenges in practical skills, implementation of the strategies to address the challenges in practical skills, evaluation of the implemented strategies, conceptual framework, action research and future workshop.

2.1 Meaning and role of practical skills

Practical skills refer to work while using hands, attitude and brain, to perform Practical work gained through learning and practice (Duggan, 1995). Practical work has a key role in the teaching when selected carefully with a clear purpose in mind. According to Ian (2009) in his study reported on how practical work could be effective and realistic to both the teacher and learner in order to understand the content taught hence leading to motivation to the learners during the learning process. In my view, I agree that work has a key role in technical education and in the world of work. Basing on the 21st century there is need to do away with traditional system of education where theories dominates practicals. Yet, it should be the reverse such that learners graduate with skills required for the world of work. During instruction, practical skills motivate the learners and they become critical thinkers.

The current curriculum prepared by the National Curriculum Development Centre emphasized that need for practical skills on active engagement of learners for better skills acquisition in all trades. The identified ATL methods strategized for the Instructors Colleges, Technical and Vocational Training Institutions include; problem based learning, project based learning, learning stations and learning contracts.

The Active Teaching and Learning (ATL) techniques such as; brainstorming, performance guide, coaching, modelling, group work, presentation and demonstration, role play, storytelling and simulation enable instructors and learners to put the identified methods of instruction into practice.These teaching techniques are intended to make the students active participants in learning process. Many trainees learn best and become proficient in skills by

practicing them rather than being a spectator to the skill or listening, reading, talking and watching the instructors performing the skill (Herman & Toth, 2006).

2.1.1 Problem-Based Learning (PBL) method and practical skills improvement.

Problem-based learning (PBL) approach is one of the best pedagogical methods being implemented in the education sector. It creates effectiveness in facilitating student problem-solving and analysing self-directed learning skills which has become increasingly popular across all the disciplines in higher education (Hung et al. 2008).

PBL was first conceived in the early years of 1960s at a medical college. It was later developed into a learning method to implement constructivism. It is a learner-centred form of education, based on non-structural issues in reality and the process of the learners' active problem solving. In the process of learning, learners play the roles of active problem solvers, and are responsible for learning and cultivating self-oriented lifelong learning skills, problem-solving competence, and communication skills for teamwork.

Teachers on the other hand, play secondary roles, where they become partners in learners' problem solving. They are the guides, consultants and coaches. PBL aims to encourage students to ponder on "what to learn and how to learn" by issuing ambiguous structures and definitions in real situations, and they are there to change, modify and expand the process by collaborative learning. Finkle and Trop, (1995) suggested that problem-oriented instructions address both curriculume and instructional systems, which also develop problem-solving strategy, knowledge database and skill learning. Learners that were involved in meaningful or real learning situations were thus able to adapt to problems in real life. Learners were provided with useful resources, instruction and exploration; thus, they were active in problem solving in order to construct knowledge and problem-solving skills.

However, for traditional lecture instruction allows students to obtain knowledge but, students will not be able to solve problems in the real world with merely classroom knowledge acquisition (West and Watson 1996). Barrett (2005), Sage (2000) and Stepien (2002) suggested that PBL should integrate technology in various measures such as, e-mail, briefing message, internet tools and special software. In problem solving, technology can provide more favourable and effective tool selection, as well as confirm and organize information, learners can be creative in multiple dimensions and cooperate with each other to solve the problems.

However, business technique courses aim to cultivate students' skills, combine instructional content with students' life experience, trigger students' learning motivation and values teaching method to cultivate students' teamwork. PBL is an instructional activity that can motivate students toward an educational approach of "learning to learn". Thus, students in groups can find ways to develop real-life problem-solving capabilities and develop the competences to become self-guided learners. PBL therefore includes competence learning pedagogy instead of simply to traditional knowledge acquisition techniques (Wu, 2002). This ultimately allows students to step outside their expectations about how to learn (Keegan and Turner, 2001).

Based on studies of several scholars, a PBL model includes five stages: analysis, design, development, implementation and evaluation. The whole process is based on teamwork and discussion. Students actively analyze the problems and ponder on their recognition of the issues. They obtain and compare new knowledge, reorganize what they have learned and experience, and are in charge of finding the necessary means for problem solving. In comparison to traditional instructions dominated by teachers, PBL is more inspiring . From the perspective of learners, students in a PBL team must solve the problems by more open, reflective, critical and active learning attitudes, in comparison with traditional courses (Margetson,1991; Engel, 1997). For teachers, PBL allows students to mutually challenge the problems, search for problem-solving plans, explore new knowledge in experience, obtain experience that is more practical and become better learners with self-learning capability (Hewitt-Taylor 2002; Connolly and Donovan 2002).

The world is in a time of rapid development in the economy of knowledge, with a wide array of technological information in a fast changing society. In order to meet the coming of a knowledge-based society and face its new challenges, suitable professional talents are required. After graduation, most students from traditional instruction but learning systems have difficulty adapting to the workplace and do not meet the demands of industry.

A good learning method must suit different instructional strategies and be demonstrated to be effective after evaluation (Felder and Brent 2005). In recent years, different learning approaches have been introduced and curriculum content is being revised in Taiwan and other foreign countries. PBL originated from within medical education but since it trains students' competence to deal with problems in reality, it is gradually becoming popular in the educational fields of law, business, administration management, engineering college, chemistry, physics, educational psychology and educational administration in higher education. Some scholars

(Boud and Feletti1998; Wilkerson and Gijselaers1996) have observed that PBL is being widely applied in medical education, but is still rare in management education.

Tseng et al,(2008) also indicated the PBL was not used widely in research methods and instructional practice by engineering education in the past. Therefore, Hallinger and Bridges (2010) appllid PBL to management Education and students learning outcomes were observed to be better than those with ordinary learning approaches.Therefore,four (4) ATLmethods are identified for the instruction in technical and vocational education namely; Problem Based Learning, Project Based Learning, Learning Stations and Learning Contracts.

2.2 Challenges in imparting practical skills in vocational training institutions

The process of skills transfer possesses a number of challenges as discussed in the ensuring sub-sections.

2.2.1 Under-estimation on practical teaching

Vocational and Technical institutions are targeted to impart practical skills to their learners as a fundamental characteristic of vocational schools to offer competences and skills required for practice in technical fields in their major trades. The influences of traditional education in terms of teaching content, theory are over emphasized, while practical training is ignored. Theoretical teaching is dominant while practical teaching is placed at a secondary position, which cannot reflect characteristics of vocation and technique. (Zhang, Zhe,2009). It is an established fact that students are lacking practical skills and practical manipulative ability, which cannot satisfy demand of the society on vocational-technical education deviate from normal education philosophy Yu, et. al,(2004).

2.2.2 Weakness of teacher force in practical teaching

Teachers are the most important resource in vocation-technical schools, and their practical capacity plays a crucial role in training of application-based talents. However, a large majority of teachers in vocational- technical schools came with inadequate practice experiences. Therefore, a large number of teachers do not have working experiences in enterprises. Besides, they are lacking necessary practice and experience, so it is difficult for the m to conduct “application-based” education on students.

Furthermore, vocational-technical education lack “double-quality” teachers, in the sense that, young teachers in most vocational-technical institutions account for a larger proportion, most of whom “enter schools from schools” and are shot of specific working experiences in the fore front of enterprises, so their manipulative ability is generally far from enough (Wei, 2002).

In my view, this is inevitable especially in developing countries, most of the vocation-technical institutions comply with such teachers who are relatively weak in terms of practical teaching and their theoretical teaching usually goes out of joint with practice.

2.2.3 Limited teaching funds in vocational-technical schools and institutions

Practice teaching staff are not paid due attention, which results in such a situation that teachers are not willing to give correct guidance on practice teaching. The teachers are the leading factor in teaching, and without perfect teachers in a school and without stability of teaching staff, the quality of practice teaching is unlikely to get deserved guarantee (Wei, 2002).

In relation to this, limited teaching funds in vocational-technical schools and institutions for the teaching staff who are double professional, if you compare what one takes home at the end of the month is not proportional with his input. Therefore, teachers tend not to give correct guidance on practice teaching because they are not stable to their jobs.

2.3 Improvement of practical skills through PBL srategies

2.3.1 Strengthen establishment of teaching staff / instructors

The effect of practical teaching in vocational-technical institutions mainly depends on establishment of a perfect teaching team. First of all, instructors should be sent to relevant production units for short-term and medium-term practice. Those lacking in practical experiences and skills should be regularly sent to corresponding production department for specialized practice and skill practice, so as to improve their competence of practical teaching. This could encourage instructors to shift towards “double-quality”. Furthermore, instructors should be encouraged for further education (Zhang, 2009).

However, it is my belief that when instructors are exposed to the construction industries, Directorate of Water Development, National Water and Sewerage corporation to gain competences in practical skills this will help them to close the gap in imparting practical skills while using problem based learning by solving the real problems related to plumbing practical

skills by doing so the trainees will gain practical skills and experience which is necessary in the world of work.

2.3.2 Student centered learning approach

The students centered learning approach is where learners desire to participate actively in the teaching and learning process while an instructor is a facilitator. If this approach is well administered it is capable to improve plumbing practical skills, in this case problem based solving strategy can be used hand in hand with this approach to achieve better results in teaching and learning process. Stauffacher, (2006) explains the instructor's role as a facilitator and distributor of knowledge and skills to help students in their learning process by initiating reflection process and supporting them where necessary on substantive matters.

Basing on that argument, I adopted the constructivism theory of learning to back up my study and according to this theory; Jean Piaget stated that individuals construct knowledge through action and experience, which plays a major role in teaching and learning in schools today to reinforce both knowledge and skills.

Experiential learning methods praises the constructivist approach of Piaget (1936) and Vygotsky (1962) but their content is criticized by scholars as being un-dimensional in nature . The ground under constructivism is the understanding of the learner to explore their own knowledge and competence in the world of work.

Constructivists explained that learning is not a mere understanding of the 'true' nature of things, nor its remembering perceived ideologies , but rather a personal and social construction which is based on the explanations given to the learners. This therefore implies that a learner has to employ past experiences to reflect and construct personal and social meaning of the problem they face in real life.

Piaget (cited in Bjerknes, 2002, p.13) concerning learning as structuring of experiences that involve the process of adaptation, assimilation and accommodation. In this respect, Piaget describes adaptation as construction of new knowledge based on the already existing knowledge and experience of the individual. This is a clear indicator that one's knowledge and experiences is more than a contributing factor to their new learning as evidenced in the teaching and learning process.

Piaget went further to describes assimilation as integration of new knowledge into exhibited experiences and knowledge in the learning process. Reflecting on accommodation according to piaget,refers to a process of re-organizing past experiences for incorporation in the new knowledge. Therefore basing on Piaget's theory of constructivism, which states that individuals construct meaning through action and experience, this plays a major role in teaching and learning process. In a constructivist classroom students learn by doing, rather than passively absorbing knowledge. I observd that learning can be hard without past knowledge and experience as a point of departure.

In regard with experiential learning (Kolb, 1984, pp.26-27) it explains that learning is a process in which concepts are formed from continuously modified by experience. In my understanding Kolb indicates that knowledge is continuously achieved and convenged in to practice in the experiences of the learner. In my own view, thus without previous experience problem based learning may not yield better results and its hard to emulate another alternative.

2.3.3 Intensify evaluation and assessment of practical teaching

To improve hands on skills, evaluation and examination of practical work / skills should be emphasized such that, industrial standards, occupational skills and international standards are merged in the teaching program and assessment in order to improve students' occupational competences according Wang (2009).

2.3.4 Provision of effective feedback

When students are given the feedback regarding their piece of work, they are most likely to accept it and quickly act upon it this is a way of reinforcing effective learning (William, 2013).

2.4 Implementation of PBL strategies to improve practical skills.

The researcher thinks that the conceptual framework of PBL characteristics and action research cycle that involves planning, action, observation and reflection according to Dick (2002) will be very effective in implementation, follow-up and evaluation of the strategies addressing the challenges to improving practical skills ealier discussed in section 2.3.

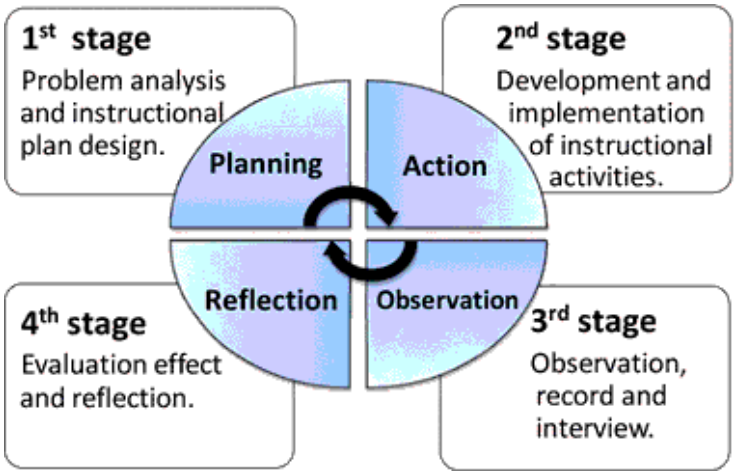


Figure 4: Conceptual framework of PBL characteristics and action research

Source: Dick, (2002)

By combining the characteristics of PBL and action research cycle, the researcher plays the roles of an instructor and learning assistant. Therefore, from the beginning, the researcher analyzes problems; designs instructional plans and then develops and implements instructional activities, observes the performance of the learners, then reflects and evaluates the learning process. (Elliott, 1991).

Emphasized the importance of action to enhance reflection. Besides lecturing, the researcher assists students in overcoming the obstacles to learning. During the instruction, the mentor observes and record students' learning process and instructors teaching methods. The mentor summarizes the observation process on how the teaching and learning goes. Course-learning evaluation and reflections are conducted and the results used to plan the next teaching program. The cycle continues until the end of the course, as shown in the conceptual framework in Figure 5.

2.5 Evaluation of strategies implemented to improve practical skills

According to Johnson & Johnson (1999) he defined 'evaluation" as an aspect in a learning process that focuses on a follow up of the progress of learning of a learner. In contrast basing on the researcher opinion evaluation refers to the proces in examining on the learners' progress to reach a conclusion whether learning exist . Assessment rubric in this case is used to convey students informative feedback about their work in progress and produce detailed evaluations of their final products or performances according to Andrade (2000). I agreed with the author that an assessment rubric can be used for evaluation and in this case, it was used to evaluate the implemented strategies.

Assessment rubrics provide timely feedback to students and this has enhanced the students ability to grasp required elements of an assignment (Stevens & Levi, 2005). Furthermore the assessment rubric judges complex performances incuding several significant criteria and provides more specific information or feedback to students (Arter & McTighe, 2001).

According to Akello & Kagoire, (1996) they defined "evaluation" to entail three segments as indicated below;

- Diagnostic test,
- Formative evaluation
- Summative evaluation.

1.**Diagnostic test stage,** means discovering the students difficulties while learning and assess the problem.

2. **Formative evaluation stage,** this is desined to provide information to help instructors improve their online instruction.For example, where challenges are identified say in methodology or resources, immediately measures are sought, for and implemented for the learning to progress. More so, (Johnson & Johnson, 1999.highted that "formative evaluation may be conducted at any time throughout the instructional process to monitor the valve and impact of instructional practices or to provide feedback on teaching strengths and challenges.

3.**Summative evaluation stage**, this occurs at the end process of learning. (Akello,R Kagoire1996). In this context, it is a stage in learning aimed at evaluating students learning at the end of an instructional unit by comparing it against some stantandard or benchmark . Therefore,summative assessements are often high stakes ,which means that they have a high point valve .

In regards to this stage therefore it entails that without vast expertise it becomes hard for every one to have a new situation. This calls for foundationto lean onto which the new knowledge is formulated. On contrary , learners find it challenging to utilize the acquired knowledge that is obstract and whose applicability is quite challenging.

2.6 Action research and improvement of communities

Lawrence Stenhouse and John Elliott were noted as one of influencial promoters of Action Research in British Education system (Mc Niff 1988). Lawrence Stenhouse first percieved his

context that, “Teachers are researchers” when he aggressively promoted school-based curriculum reform. Elliott stressed the need of action research to enhance reflection (Elliott, 1991). I agree with the author that teachers are researchers because they can identify and solve many problems in instruction and learning process basing on the knowledge of action research. Action Research can develop profound knowledge and competence in classrooms and are thus more sensitive to educational practice (Ou, 1999). I concur with the author because the researcher conducted an action research in order to close a gap in plumbing practical skills acquisition, which was not being done well at NICA.

Action research is defined as a process of systematic inquiry that seeks to improve social issues affecting the lives of everyday people (Stringer, 2008). Yes! Action research is a systematic investigation of a matter of public interest through searching of knowledge by an instance of questioning. Kemmis and McTaggart, (1988) view action research as a collaborative process carried out by those with a shared concern. Action research is cooperative since the researcher works hand in hand with the participants from problem identification to solving the problem and for this note the participants collaboratively shared views about their concerns in the focus group discussions.

Action research refers to a collective reflective enquiry undertaken by researcher in social situations in order to enhance the rationality and justice of their social or educational practices, as well as their understanding of these practices and the situations in which these practices are carried out (Kemmis & McTaggart, 1988). I agree with the authors because the action research was collaborative involving all stakeholders who had gone through the teaching and learning experience and the researcher asked questions about their experiences such that a mechanism of improvement would be devised. Broadly speaking, action research enables researchers to develop a systematic, inquiring approach toward their own practices oriented towards effecting positive change in a practice (Holter & Frabutt, 2012). The researcher concurs with the authors because the systematic inquiring approach was used to effect a positive change within the future workshop integrated within focus group discussions.

Action research can be described as, any research into practice undertaken by those involved in that practice, with an aim to change and improve it. It is therefore, a process of enquiry by you as a practitioner into the effectiveness of your own teaching and your students’ learning (Coats, 2005).

Action research is about both ‘action’ and ‘research’ and the links between the two. It is quite possible to take action without research or to do research without taking action, but the unique combination of the two is what distinguishes action research from other forms of enquiry (Coats, 2005). With this study, the researcher researched on the challenges in improving plumbing practical skills, possible strategies to address the challenges and finally took action by implementing the possible strategies and evaluating the efficacy of the possible strategies implemented collectively with the participants (stakeholders).

Action research has five phases, which include selecting the area of focus, collecting data, organizing data, analyzing and interpreting data, and taking action (Calhoun, 1994). I concur with the author because if there is a problem, it should be analyzed and an action taken as a solution. The collaborative action research process has five sequential steps: problem formulation, data collection, data analysis, reporting of results, and action planning (Sagor, 1992). I agree with the author especially in the first step because one cannot do a research without a problem.

According to Stringer (2008), a common process of action research inquiry cycle includes the following components; designing the study, collecting data, analyzing data, communicating outcomes and taking action. When designing the study, researchers carefully refine the issue to be investigated, plan systematic processes of inquiry, and check the ethics and validity of the work.

Therefore, the researcher decided to have an action research because, it provides teachers with the technical skills and specialized knowledge required to effect positive change within classrooms, schools, and communities (Johnson, 2012).

CHAPTER THREE METHODOLOGY

3.0 Introduction

This chapter difines the methodological methods employed during collection of data,documentation, transcription, discussion ,reporting. This chapter indicates design of the research, area where the research is being carried out , sample population and size,sampling technique employed, data collection methods tools,procedure and ethical consideration of the study. The overall aim of this action research was to improve practical skills using problem based learning for civil engineering students at NIC-Abilonino, all the research activities were tailored to it in order to achieve this at the end. The methods that are discussed below were guided by an Action Research approach and therefore I find it necessary to first introduce action research as far as my research context is concerned.

3.1 Action Research approach

Action Research is a form of investigation designed for use by teachers to attempt to solve problems and improve professional practices in their ownclassroom study,and workplaces which involves systematic observation and data collection which can be then used by the researcher in reflection decision making and development of more effective classroom strategies. According to Kurt (2012), Action Research approach is best described as comparative research on the conditions and effects of various forms of social actions and research leading to social change. His reflective study required critical stakeholder's examination of the participants . Stakeholders in this study were the instructors, instutional administrators and students of the DITTE class who were introduced to learning process of practical skills. Stakeholders' role was to work together to come up with ideas and ways of improving instruction to create an environment that could lead to improved practical competence.

3.1.1 Research Design

This refers to the basic plan of how the researcher carried out his research. The research was a Participatory Action Research (PAR) Model,which was qualitative and descriptive in nature. This was because, it puts emphasis on describing observable changes, results are interpreted from a variety of perspectives and it allows all participants in the research to have a voice. As supported by Taylor, (2016), who noted that, this model of PAR has a broard sense of capturing people's own words, in order to produce descriptive data of the way in which people see

problems. It involves the researcher and participants working together to understand a problematic situation and change it for the better. In this study, the researcher used a future workshop as a tool for collecting information.

These approaches of research emphasized participation and involvement of stakeholders to partcipate in problem identification through democracy to understand the given world of work by trying to change it, collaboratively and following reflection. Selener 1999 (cited in Reason and Bradbury, 2001, p.1) describes participatory research as a process through which members of community identify a problem, collect and analyze information and act upon the problem in order to find solutions and to promote social, economical and political transformation. In this regard, teaming with Instructor trainees, lecturers from Civil Engineering department, administrators and members from workplace have comeout to share and collaborate to achieve the constructive ideas to solve the problems indentifield in the study.

This study sought to gather data on how practical skills in plumbing trade could be improved, basing on focus group samples to gather in-depth feelings from participants. The researcher employed a qualitative research because action research emphasizes more of human communication with critical reflection on both the process and outcomes instead of numbers and statistical data's which is not easy to interpret (Coats, 2005). Since this is an action research I conquer with Coats to use qualitative and descriptive research design in this study through focus groups which leads to human communication, critical reflection and thinking whereby solutions to challenges could be obtained.

3.2 Area of Study

The action research study was carried out in National Instructors College Abilonino in Kole District. The study targeted the DITTE trainees of Civil Engineering, instructors in Civil Engineering Department and administrators of National Instructors College Abilonino. The researcher found it convenient to carry out the action research at National Instructors College Abilonino since he is a plumber and also an instructor in the same department. That enabled him to organize participants for focus group meetings and discussions where ideas were solicited and generated for the fulfillment of the action research objectives.

3.3 Study Population sample size and selection

3.3.1 Study Population

The participants were second academic year students from the Department of Civil Engineering, the participants were second year students, lecturers from the Department of Civil Engineering, and members of top administration of the College. There were ten (10) out of forty (40) students, three (03) out of five (05) lecturers and three (03) out of five (05) top administrators of the College. The department of Civil Engineering has a proportionate plumbing workshop and as well as class rooms. This presents an enabling situation for carrying out plumbing practical skills, theory and general knowledge.

Members of administration were chosen purposively in order to get records of data in the College and policies in running the college functions and programmes. On top of that they are decision makers and can support the implementation of the recommendation of the study. The lecturers from the Department were selected purposively to work as a team on how practical skills could be improved for civil engineering students, they belong to civil engineering department, and also they could help in the implementation of the agreed strategies for the improvement of the performance in real life projects.The selection of participants in a case study does not have to be done through random selection only, but the researcher was to handle the selection within the condition that was available.

Ten students of second year semester II academic year 2020 were chosen,because they formed the entire population of the department from all trades namely plumbing, building and carpentry and had enough experience as compared to those ones in year one. while putting that in mind the majority should have the background of plumbing trade.

Two industrialists from the work place were purposively selected because they are experienced, and aware of operating procedures and performance guides in the industry. This enabled the researcher to collect valid information relating to the study and fallow up the implementation processes with key participants.

3.3.2 Sample size and selection

This research involved the following stakeholders as shown in Table 7.

Table 6: Sample size for the study

Stakeholder	**Number**
Trainees	10
Lecturers (Instructors)	03
Administration	03
Employers	03
Graduates (former trainees)	03
Total	**22**

Twenty two stake holders were involved in this research and all of them were selected rondomly by the researcher and consented to participate by signing consent formand however this was done through a written consent as mandatory for enrolment as presented in Table 3.1

Table 7: Composition of study participants

S/n	Category of participants	Study population	Sample size	Sampling technique
01	DITTE students in Civil Engineering Yr II academic year 2020.	40	10	Purposive
02	Instructors in Civil Engineering department	05	03	Purposive
03	Administrators	05	03	Purposive
04	Graduates/ former trainees	05	03	Purposive
	Total	55	22	Purposive

Source: Primary data

The researcher used purposive sampling for selecting key participants for the case of this research.Purposive samping refers to a group of non –probability sampling techniques in which units are selected because they have characteristics that you need in your sample.in other words units are selected on purpose in purposive sampling.

3.4 Data Collection Methods

3.4.1 Focus group discussions

Focus Group Discussion refers to a participative method that involves a homogenous group of respondents or participants in the discussion of issues of common concern through a moderator (Stewart & Shamdasani, 1990). In this case, the common instructional concern was to improve plumbing practical skills acquisition for Civil Engeneering students in DITTE programme at National instructors' College, Abilonino. Focus group discussions were used because they are popular methods used in obtaining information regarding numerous topics as well as identifying areas of concern and can provide insight into issues which cannot be covered on a survey.

In this study, focus group discussions were held with participants who included: the researcher, first and second year students and lecturers from the Department of Civil Engineering and members of the College administration. Guiding questions were introduced by the researcher and the ideas and opinions of individuals and group respondents/participants were recorded as the discussions continue. The discussions were organized during the time that was convenient for the participants. The participants discussed the challenges in plumbing practical skills and possible strategies to address the challenges in improving plumbing practical skills, implementation of the possible strategies addressing the challenges in implimenting plumbing practical skills and evaluating the efficacy of the implemented strategies.

3.4.2 Future Workshop

Future Workshop (FW) was used as problem identification tool and critically analyse the area of concern. That helped the stakeholders to establish the most pressing gaps and lay strategies to address them. The FW was used as a tool in this study because it was aimed at guiding participants in identifying common problems, generating ideas and in collaboration to come up with workable solutions in order to improve on plumbing practical skills for Civil Engineering students at year. In that respect, Future workshop has procedures to be followed, thus involves four phases; the preparation, critique, fantasy and reality phase. During critique phase, critical questions are posed to the participants for discussion. This enables participants to fully participate with authority, responsibility and accountability for required decisions.

Future workshop, this is a method/technique, which was developed, by Jungk, Luiz and Muller in 1980's. This method guides participants to gather new ideas identifying the most critical

issue, identifying a research topic and generating solutions to the challenges/concerns in a collaborative effort towards existing problems. A future workshop emphasizes critical learning, democracy, teamwork and empowerment (Lauttamaki, 2014).

The future workshop that was held on 2nd December 2019 started with registration, self-introduction of the researcher followed by the introduction of the purpose of the gathering, going through the program and expectations. The researcher explained the guiding principles to be observed during FW as being collaborative, transparency, democratic and equity. Brainstorming and discussion methods were used throughout the study.

3.5 Data collection procedure

The data was collected basing on the research objectives using the future workshop model, which involves four phases, that is, preparation, critique, fantasy / utopia and reality / implementation. In the process the participants were urged to identify the challenges hindering trainees' skills acquisition in plumbing practical skills. During the future workshop the participants identified the key short term challenges affecting skills acquisition and were as follows: inadequate training materials, poor instruction methods, and poor time management

3.6 Data collection tools

The researcher employed observation, interview, focus group discussion and future workshop methods as key tools of data collection. These tools were used in the data collection process as discussed below;

3.6.1 Observation Guide

The researcher and stakeholders employed observation as a method of data collection using observation guide as a tool to extract data. We listened and took notes in all stages how the participants, were responding to the challenges in plumbing practical skills and how they could be addressed or implemented. The objective was to identify challenges in plumbing practical skills for civil engineering students at National Instructors College Abilonino. This data collection tool was my eye opener to analysis information based on evidence of the process as emphasized by White head and McNiff, (2006).

During the process of observation, the researcher endeavored to be a genuine participant observer in the research (McMillan, 1996). Observation was undertaken with the purpose to: observe the entire activities, participants and physical aspects of the situation and participate

in activities that are appropriate to a given situation (Spradley, 1980). This way, the researcher observed the students participation in the different activities, particularly during the implementation phase using the observation guide as a tool.

The researcher employed observation guide as a means of obtaining data because, the research was based on Action oriented and he got involved in all activities of the research. Through the participant observation technique the researcher constantly made choice about what was noted and what to leave out.On the other hand a smart phone and note book were also used to record the observations

3.6.2 Interview Guide

Kvale and Brinkmann (2009) defined an interview guide as a list of the high level topics that you plan on covering in the interview with high level questions that you want to answer under each topic purposely to obtain thorough information and knowledge. Therefore, the researcher used an informal conversational interview and an open-ended interview to collect data from administrators' NICA, Lecturers from civil engineering department and DITTE trainees' year II from civil engineering department.

3.6.3 Informal conversation interview

The researcher employed oral discussion interview among DITTE staff ' due to its modification on the nature of their work since questions were emerging from the context and interviewed depending on the programme they were undertaking .this was modifield in the teaching and learning process that were prevailing in the workshop and classroom during plumbing practical work, the nature of questions that were administered emerged and from observations of what was going on during the session. Photos were taken during the process of instruction to help to confirm the data collected.

3.7 Documentation of research activities

Each research activity was documented in time witout allowing time to forget what took place. Manila papers and filp charts were used alongside the pictures and videos so that nothing will be forgetten. These were done as a team to ensure that all the dats is properly captured.

3.8 Ethical considerations

The approval for conducting this study was granted by Kyamogo University Graduate School. The study was guided by technical supervisiors from Kyambogo University and Civil Engineering Department at National Instructors College-Abilonino. During the

research, I vowed to protect the information given in by the respondent confidential. Consent was sought from all study participants, was expressed in writing and participation was voluntary.

CHARPTER FOUR

ANALYSIS, PRESENTATION AND INTERPRETATION OF THE FINDINGS

4.0 Overview

In this chapter, the researcher interprets the results obtained in an attempt to improve plumbing practical skills using Problem Based Learning (PBL) at NIC, Abilonino. Action in this research was purposefully undertaken aiming at producing a competent graduate in plumbing trade in terms of knowledge, practical skills and attitude.

The results were interpreted according to the four specific objectives linked to each other in respect of development competence (attitude, knowledge and skills). Data in relation to objective (i) was gathered through the situation analysis and future workshop. For the second specific objective, a second future workshop was held and different learning strategies were listed to supplement data for objective (ii) PBL method and PG technique. Objective (iii) focused on how to implement the suggested learning strategies to improve the students' practical competence.

The PBL Method was an activity that was given first priority of implementation because it was geared towards improving the attitude of students towards the plumbing trade. In order to improve students' practical knowledge and skills, an intensive training on the PBL method and PG technique were organized and implemented. Data for objective (iv) was captured using focus group discussions, on the general information and feedback received to evaluate the implemented strategies as PBL method and PG technique. In general, the activities posed a unique impact to the department and this impact was closely related to the positive side than the negative. The students were delighted and they kept their appreciation comments coming to show how the activities were helpful in shaping their attitudes, improving their knowledge and skills.

4.1 Presentation of data

The data was presented chronologically following the specific objectives.

4.2 Challenges in imparting plumbing practical skills for Civil Engineering Students at NIC-Abilonino

An analysis of the students' practical competence in the plumbing trade for Civil Engineering students at NIC-Abilonino was done. This analysis was intended to obtain information from

different stakeholders in particular the students, in order to identify challenges in plumbing practical skills for the students' in civil engineering. Methods like, Interviewing, Focus group discussion and Future workshop were used.

The following challenges were generated:

1-Lack of plumbing practical skills and methods of delivery by instructors

2-Limited funds and resources to facilitate teaching and learning process

3-Lack of time management by instructors and students

4-Poor attitude of learners towards practicals

5- Weakness of instructors / lecturers in practical teaching

Figure 5: Focused group discussion during future workshop

All the participants agreed that out of the five challenges, lack of plumbing practical skills and methods of delivery by instructors was a major challenge that needed to be solved and therefore, it was the most serious challenge and this was arrived at using pair wise matrix.

4.3 Possible strategies to address the challenges

This was done through brainstorming and discussion from the fantasy phase of the future workshop. This enabled the participants to come up with the best possible strategies to address the challenges on plumbing practical skills for Civil Engineering students at National Instructors College-Abilonino could be improved. All the participants agreed and recommended to use PBL method and PG technique to improve the performance of plumbing practical skills for civil engineering students at National Instructors College-Abilonino and to be implemented.

4.4 Implementation of strategies at N I C, Abilonino

The strategy of using PBL method and performance guide technique as shown in table 4.1 was agreed upon by the participants to be implemented therefore, the implementation work plan was generated.this was done through focus group discussion which was done at every end of the session. The implementation plan was collectly agreed upon by all participantsand formulated thereon.

Table 8: Implementation of the work plan at N I C-Abilonino

Activity	**Objective**	**Duration /Time**	**Personnel**	**Comment**
Internal training on how to use PBL method and Performance Guide	To train participants on how to use the PBL method to carry out plumbing practical work	March 2021	Participants Teachers	Completed well.
Practicing the use of performance guide.	To train participants on how to use the performance guide to carry out plumbing practical work	April 2021	Participants	Completed well
Follow – up	To evaluate the efficacy of the implemented possible strategies towards the use of PBL & P.G	April 2021	Participants and Researcher	Done

4.4.1 Internal training on how to use PBL method and Performance Guide (PG)

This training attracted stakeholders from the department such as the instructors, management and students. They were selected to provide multifaceted information to the research based on everyone's view. A four hours training was conducted on how to use PBL method and PG.

First and foremost,the researcher allowed the trainees to observe the conceptual frame work of PBL method characteristics and every one to present what he/she has in mind. After which the researcher took the trainees through the four stages of PBL. i.e. Problem identification; instructional design plans, development of implemention and instructional activities, observation of the performance of the learners, reflection and evaluation the learning process. The researcher gives guided practice to enable learners to carry out independant practice inorder to overcome obstacles towards practical skills. During the instruction, the researcher observes and record students' learning process. Therefore the learning process continues to be followed as it is shown in the conceptual framework.

The PBL method

The researcher explained in details how PBL method could be adopted while using the conceptual framework of PBL characteristics and action research cycle as seen in which involves; Planning, Action, Observation and Reflection according to (Dick,2002). This approach was found very useful in implementation (that is carrying out the work), follow-up and evaluation of the strategies addressing the challenges of improving plumbing practical skills.

Instructors were supportive to the PBL-method,and it should be addapted to carry out meaningful and proper instructions during learning process. Because this method reflects on a problem, its solutions and how you can do it practically. Hence leading to innovativeness of instructors and students at large.

Students revealed that this PBL-method could help them to close the gap in plumbing practical skill's acquisition.

In the 1st stage, the researcher and stakeholders carried out problem analysis within the college critically basing on the existing water born system to find what could be done and instructional plan design basing on the PBL-method.

In the 2nd stage, the researcher together with the stakeholders carried out the development and implementation of instructional activities basing on the identified problem to be solved.

In the 3rd stage, the researcher observed, recorded and interviewed the trainee during the instructional process basing on the identified problem

In the 4th stage, the researcher carried out evaluation and reflection. The results will be used to plan for the next teaching program. The cycle continues until the end of the course, as shown in the conceptual framework (Dick 2002).

PBL method it is based on the concept of learning by doing according to Dewey's laboratory school of research in Chicago. John Dewey promoted workshop learning and cooperation in his works. Recalling from Julius Caesar one of the Roman leader noted that, "Experience is the teacher of all things". With experience one can accomplish many tasks in life and can be a roll modal. This kind of learning is highly practical and requires physical involvement.

Therefore under PBL method,a learner / trainee learn by solving a problem at hand. For example, replacing a broken wash hand basin. This implies that, the wash hand basin cannort be used by the community because it is broken and it is leaking. Hence, refering to a small focus group the plumber will be able to use PBL method to install back the broken wash hand basin. Inorder to be able to carry out such work the instructor /researcher will be able to develop the P.G which will be followed step by step until the work is done succesfuly.

4.4.2 The Performance Guide (PG) preparation

This approach is defined as step by step procedure of carrying out a skill or practical work.This was done through a process of small focused group meetings whereby a Practical Training was conducted through four phases on PBL method and PG.

Table 9: Performance Activities

Step	Performance Activity	Practice Activity
1	Introduction	Attract trainees attention Indicate each operation and explain its importance Explain its relationship with the past and future Place the trainee where they can see the instructor and the demostration.
2	Presentation	Write down the performance guide, Explain, demonstrate. Emphasize important points and point out safety concerns Demostrate step by step clearly and accurately
3	Practical training/trainees exercise	Give trainees practice Conduct guided practice and allow independent practice, evaluate performance process Correct errors if any Ask trainees to explain the procedure, important points and the reasones for its importance.
4	Conclusion	Evaluate trainees product Answer trainees questions Give further advise Give advance information abount subsequent training

4.4.3 Implementation of the PBL method and PG technique

This was done through a process of small focused group meetings whereby a Practical Training was conducted through four phases on PBL method and PG. That is, introduction, presentation, practical training and conclusion.

- **Introduction**

The researcher made an introduction before the small focused group which was selected. This attracted the trainees attention as the researcher was trying to make a review about PBL-method and PG . He indicated each operation and explained the relationship and the importance of these learning strategies and clearly explained the connectivity of the three activities of the

implementation work plan that had the objectivies which were to enhance and improve on plumbing practical skills for civil students at national instructors college Abilonino.

- **Presentation**

Before the small selected group the researcher presented a practical skill as **"to install a high level suit"** to be carried out using PBL-method and PG technique. The performance guide was developed together with the participants while following the proper order of the steps to be followed when carrying out that practical skill. The researcher emphasized the important steps, pointed out safety and critical steps which should be observed to come up with quality and starndard work.

- **Practical training/trainees exercise**

In this case the researcher and management identified a wash room from the staff quator at National Instructors College-Abilonino which had no water born toilet system. Hence the researcher and the small selected group had to install a water born toilet system to solve that problem, using PBL-method and PG technique. During this practical training the researcher conducted a guided practice and allowed independent practice among the participants,and at the same time had to evaluate the performance process.

During the practical training with the focus group, the researcher followed the flow charts as shown below to perfect such skill training process which was conducted by traineers from Napal Asia.

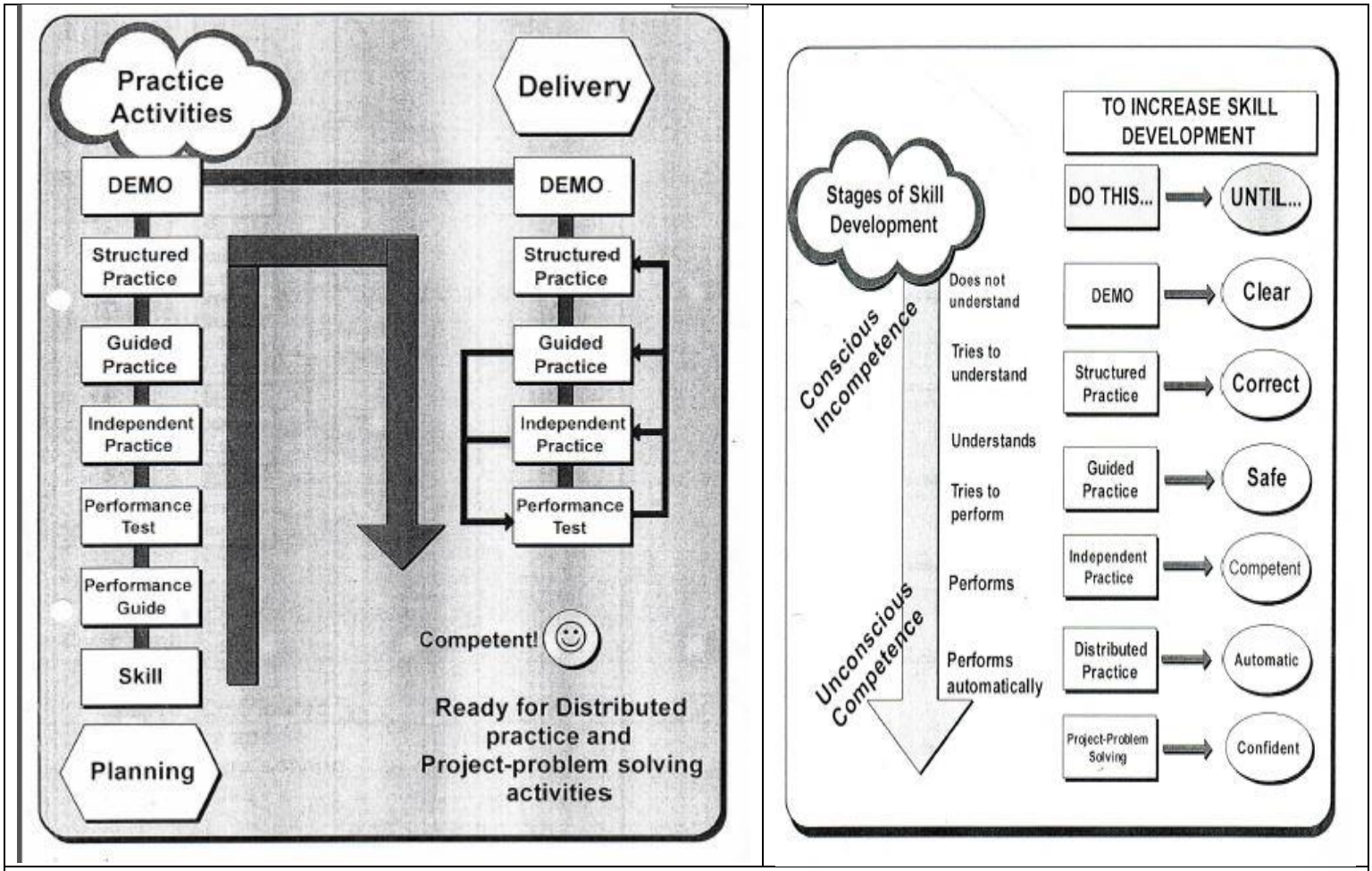


Figure 6:Practical training session plan

- **Conclusion**

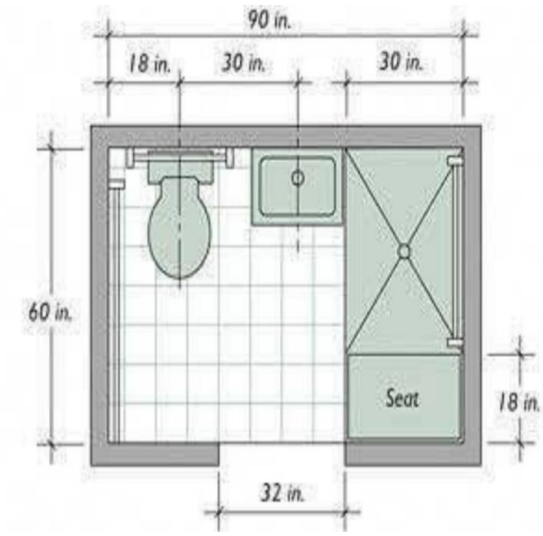
After the 6 days training, the students were glad and excited and this was reflected in their comments as one student said that he used to see water closet suits in public places, hotels and individual homes, admiring how they were installed, now they learnt how they are installed following the performance guide.Others commented that they learnt high level suit components how they are assembled during installation process. Other students felt that their knowledge about safety and critical steps were enhanced while following the PG to avoid accidents and also to come up with quality work.

Above all they appreciated having learnt how to use PBL-method and also to generate a performance guid for a practical skill to be carried out saying that, this could help them to master plumbing practical skills. This was an eye opener to them and students were encouraged to participate in more coming practical exercises. They were reminded that the world of work needs people with competences or skills , an instructor should have two proffesions in one.

Recommendation

It was recommended that problem based learning method and performance guide should be adopted during the performance of practical skills.

TRAINEES ON SITE PREPARING PIPES TO SUPPLY WATER TO THE WATER CLOSET.



TOILET ROOM READY TO RECEIVE A HIGH LEVEL SUITE (WATER CLOSET)

BILL OF QUANTITIES FOR A HIGH LEVEL SUITE (WATER CLOSET)TO BE INSTALLED

S/N	ITEM	QTY	RATE	AMOUNT
1	Water closet Suite, complete set	1 pcs	450,000	450,000
2	PPR-Pipes ¾''	2pcs	25,000	50,000
3	PPR-Elbows ¾''	8pcs	3,500	28,000
4	PPR-Tees ¾''	2pcs	3,500	7,000
5	PPR-Reducers ¾''x ½''	2pcs	3,000	6,000
6	Flexble tube ½''	1 pcs	15,000	15,000
7	Thread tape	5pcs	3000	15,000
8	Tape ½''	1pc	15,000	15,000
9	Silcon tube	1 pcs	15,000	15,000
	TOTAL			**601,000/=**

Figure 7: Installation of a High level water closet suite

Table 10: Workshop practices

Subject or unit		**WORKSHOP PRACTICE** **Date: 4/5/2021**
Task, Skill		Install a High level suite (Flushing water closet).
TPO	**Given**	Working drawing
	Cues	When a client requested to have a High level water closet suite.
	Who	The Plumber will be able to,
	What	Install a High level suite.
	Within	6 hours
	How Well	The high level suite must be; Fixed to the height between (1828 to1970)mm high. Firmly fixed. Well leveled and Properly connected with water, and ready to be used
List of tools,Equipment and Materials		Power drill, sprit level, hammer, screwdriver, chisel, trawel, tape measure,marking tool,water pipes, taps and waste fittings.
Direction for the Test		put a tick on yes column when that step is done
Name of the Learner(s)		Civil Students year II
Name of the Assessor		Kabunga Peter

Table 11: Performance Guide (PG)

S/N	STEPS	YES	NO
#1	Put on safety geares i.e. overall, helment, boots, glavoos	✓	
#2	Prepare the tools, equipment and materials	✓	
#3	Interprite the working drawing	✓	
#4	Mark out the height (1970mm) for the flushing cistern.	✓	
#5	Mark out the position of the bruckets	✓	
#6	Drill the marked positions of the bruckets	✓	
#7	Fit the flushing cistern to given hight to be firm and strong	✓	
# 8	Level the flushing cistern using the spirit level	✓	
#9	Fit the bruckets on level underside of the cistern using the screws.	✓	
#10	Fix the water closet on level ready to be connected with the flushing pipe.	✓	
#11	Insert the lower end of the flush pipe into the wc pan via the multi-quick seal.	✓	
#12	Carry out the test	✓	
#13	Store tools and materials in proper place	✓	
#14	Clean the work place	✓	

Criteria for successful completion: All the steps must be marked **"YES"**

Safety / Critical Steps **(#)**:1,2,3,4,5,6,7,8,9,10,11,12,13 and 14.

This initiative was intended to show the stakeholders that,PBL-method and P.G can improve plumbing practical skills. In this sense skills and knowledge could be passed on to students.

PERFORMANCE EVALUATION SHEET

Name of Assessor/ Instructor……Sign……Date……

Institution……

Test Item: **Installation of a High level water closet suite** Time…6hrs…….

Table 12: Performance evaluation sheet

#	Assessment criteria	Scoring guide	Max. score				Comments
			Process	Results			
1	Preparation for the work	Surveyed the work area		2			
		Interpreted the working drawing		2			
		Selected the tools and equipment to be used		2			
		Organized materials to be used		2			
2	Safety and health observed	Put on protected gears		2			
		Helmet		2			
		Overall		2			
		Gloves		2			
		Strong shoes		2			
3	Installation of a high level water closet suit.	**FLUSHING CISTERN**					
		Marked height of the flushing cistern 1970mm	2	2			
		Drilled positions for bruckets	2	2			
		Fixed bruckets	2	2			
		Fixed the flushing cistern firmly	2	2			
		Leveled the flushing cistern		2			

		Fixed the flushing pipe	2	2			
		WATER CLOSET					
		Fixed water closed on floor level	2	2			
		Connected the flushing pipe to the water closet	2	2			
		Connected water supply to flushing cistern	2	2			
		Tested leakage and firmness and flushing		2			
4	Work area organized	Tools and equipment cleaned and kept		2			
		Organized work area and removed left over materials		2			
		MAXIMUM SCORE	16	40			
		Process +Results	56				
		TOTAL SCORE (Process +Results)					
		PERCENTAGE SCORE	**(X/56)X100**				

4.5 Evaluation of the effectiveness of the implemented strategies

This was carried out during the implementation of the problem based learning method while using the performance guide technique. Information was recorded basing on the feedback from the trainees during the evaluation meetings held at every end of activities as planned. The participants were glad and appreciated having learnt how PBL-method and PG technique could be used during the instruction process for the practical skill. They appreciated the assessment guide because it reflects on the performance guide and the scores which are either a process or result. They learned how to develop a marking guide for the practical work, as being instructors in making this was an achievement

CHAPTER FIVE
DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter lights the the problem indentified during the future workshop and workprocess analysis ,the objectives which guided the study and the discussion of the findings that were carried out to investigate on how plumbing practical skills can be improved using PBL-method for Civil Engineering students at National Instructors' College, Abilonino to enhance skills acquisition.

5.1 Discussion

The discussion of results was guided by the objectives of the study that is to say;
Specfic study objectives included;

i. To identify challenges in plumbing practical skills for Civil Engineering students at National Instructors College, Abilonino.
ii. To identify possible strategies to address the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College, Abilonino.
iii. To implement the possible strategies addressing the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College, Abilonino.
iv. To evaluate the implemented possible strategies.

5.2 Challenges in improving plumbing practical skills using PBL-method

The participants in three groups from civil engineering department were set to identify challenges in teaching and learning plumbing practical skills. The crosscutting challenges across the three groups where all participants in their respective groups during the work process analysis noted that, lack of plumbing practical skills is due to poor methods of delivery by instructors. Some lecturers, students and administrators did not know how to use Problem Based Learning (PBL) method and Performance Guide (PG). The discussion and analysis of the results were based on the stakeholders' views, findings, observations, documentary analysis about the plumbing trade and the researcher's experience. Therefore there is a need of training the participants on how to use PBL-method and PG.

5.2.1 Under-estimation on practical teaching

This is another challenge whereby vocational and technical institutions are targeted to impart practical skills required for practice in technical fields however, the influences of traditional education in terms of teaching content, theory content is over emphasized while practical training is ignored. This cannot reflect the characteristics of the vocational and technical education. It is an established fact that students are lacking practical skills and practical ability, which cannot satisfy demand of the society on vocational-technical education deviate from normal education philosophy.

5.2.2 Weakness of the technical teachers who are imparting practical skills

Teachers are the most important resource in vocational-technical schools and institutions, their practical capacity plays a crucial role in imparting practical skills. However, a large number of such teachers do not have working experiences in the world of work. Therefore, a large number of teachers do not have working experiences in the industries. Besides, they are lacking necessary practice and experience, so it becomes difficult for them to conduct practical-based education on trainees.

In my view, this is inevitable especially in developing countries, most of the vocational-technical institutions comply with such teachers who are relatively weak in terms of practical teaching because of the failure to udergo industrial exposure.

5.2.3 Limited teaching funds in vocational-technical institutions

This is another challenge while improving plumbing practical skills. Technical and vocational training institutions and teaching staff are not paid due attention, which results in such a situation that they are not willing to give fully their time for practical / skill teaching since most of them do not have enough training materials. The teachers are the leading factor in teaching and learning process therefore, without perfect teachers in a school, the quality of teaching and learning process is unlikely to get deserved guarantee

5.3 Strategies to address the challenges in improving plumbing practical skills using PBL method

The stakeholders and the researcher unanimously agreed on two strategies, namely;

- To have internal training on how to use both PBL- method and PG technique.
- To strengthen establishment of teaching staff / instructors.

5.3.1 Internal training on how to use PBL- method and PG technique

Basing on the challeges raised by the stakeholders from their focus groups, future workshop and the ranking process indicated that, “lack of the plumbing practical skills” was the most pressing and critical issue which needed immediate attation. To improve plumbing practical skills for civil engineering students the researcher together with the instructors and stakeholders agreed to have a training on how to use Problem Based Learning (PBL) method and Performance Guide (PG).

The training was conducted basing on the characteristics of the PBL-method through four stages as,

- 1st stage- Problem analysis and instructional plan design (Planning)
- 2nd stage-Development and implementation of instractional activities (Action)
- 3rd stage-Observation record and interview (Observation)
- 4th stage- Evaluation effect and reflection (Reflection)

In the first stage stakeholders analysed the given problem i.e. install a water closet suit. In the second stage carry out the implementation while following the performance guide. In the third stage take observation and feedback, while in the fourth stage carry out evaluation for the entire work done using the performance evaluation form for the test item.

5.3.2 To strengthen the establishment of teaching staff / instructors

The researcher and stakeholders agreed and suggested to strengthen the establishment of teaching staff. This is because, the effectiveness of practical teaching in vocational-technical institutions mainly depends on establishment of a perfect teaching team with positive attitude. First of all, instructors should be sent to relevant industries for short-term and medium-term practice. Those lacking in practical skills and experiences should be regularly sent to corresponding industries to acquire specialized practical skills, so as to improve in their practical teaching approach.

5.4 Evaluation of the implemented strategies on how PBL method could be used to improve plumbing practical skills

The researcher checked whether practicing the use of the PBL method and PG technique led to a positive change or had the capacity/power to produce a desired effect. Training on how to

use the PBL method and PG technique was necessary for effective evaluation of the implemented strategies.

Evaluation is an aspect in a learning process that focuses on a follow up of the progress of learning of a learner. In my opinion, evaluation is the process of checking on the learners' progress to ascertain whether learning takes place. Assessment rubric in this case was used to give students informative feedback about their work in progress and to give detailed evaluations of their final products or performances .

Formative evaluation stage was adopted to be used during the practical work sessions to evaluate the trainees work done. It is essential for a teacher to regularly monitor and interven in learners learning process to assess the progress.The purpose of this assessment was to give students informative feedback about their work in progress and to give detailed evaluations of their final products or performances.

In this study, when feedback was given after evaluation, the assessment rubric provided feedback to the students accordingly.

5.5 Conclusions

Basing on the findings, it was concluded that, lack of plumbing practical skills was the main challenge of civil engineering students; PBL- method and PG were effective and efficient tools which allowed the entire objectives of the study to be responded to. The feedback that students received through organised practical work helped them to improve their performance under different job tasks carried out. This allowed the learners also to know what they are supposed to do. How well they are doing it? What is the work environment like? And what skills and knowledge required to do the job? The results showed that there was an improvement in quality of students' work when the PBL-method and PG was used in improving plumbing practical skills. The study concluded that, PBL- method and PG technique make a valuable contribution to improving plumbing practical skills and enhancing skills acquisition by the students.

5.6 Recommendations

All in all, there were specific recommendations which were hightlighted by the stake holders as illustrated below.

- In the college,the researcher and the stake holders urged that there was urgent need for the Department of Civil Engineering at NIC- Abilonino to continuously apply the use of PBL- method and Performance Guide technique during practical lessons such that plumbing practical skills may improve and furthermore enhance the acquisition of skills by the students, and the PBL- method and PG technique should also be adopted by other departments in the College.It was also emphasised that TVET Instructors, they should reflect more to the Active Teaching and Learning methods like PBL-method. This would make it possible for both instructors and trainees to develop skills and knowledge to solve a problem at hand because with this method a problem is presented first then the instructor offers guided practice to the learners to come up with possible solutions.
- Stake holders recommended PBL-method to be adopted in all various vocational and technical training institutions because it was the most appropriate method to solve the problem at hand during the teaching and learning processfor the learner to aquire competence in practical skills.
- The stake holders recommended that the TVET policy should address the shortage of practical skills exhibited by the graduates passed out from the training technical and vocational institutions. This will enable the current trainees look at acquisition of practical skills and competencies needed in the world of work instead of academic certifcates. This calls upon TVET to come up clearly with a policy to address the deliverly methods to be used and the corabollation between training institutions and industries to work hand in hand during the teaching and learning process, for the trainees to acquire employeable skills and competencies required in the world of work.

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LIST OF APPENDICES

Appendix A: Introductory letter

KYAMBOGO UNIVERSITY

P. O. Box 1 Kyambogo, Phone: 041-285001/2 Fax: 041-220464
www.kyambogo.ac.ug

SCHOOL OF ART AND INDUSTRIAL DESIGN

DEPARTMENT OF VISUAL COMMUNICATION

Masters in Vocational Pedagogy Programme

3RD .../JAN.../2022

PRINCIPAL, NATIONAL INSTRUCTORS
COLLEGE – ABILONINO

Dear Sir/Madam,

RE: INTRODUCTION OF .....KABUNGA SSENDI PETER.....

This comes to introduce to you ..KABUNGA SSENDI PETER..... A student of Masters in Vocational Pedagogy (MVP) Programme at Kyambogo University.

This student bears registration **no**...18/U/GMVP/19613/PD..... and in his/her final year.

In partial fulfillment for the ward of MVP Programme of Kyambogo University, This student is expected to conduct a future workshop at his/her workplace.

The purpose of this letter therefore, is to request you to allow ...KABUNGA SSENDI PETER..... conduct his/her Research at NATIONAL INSTRUCTORS COLLEGE ABILONINO and accord him/her the necessary support for his/her study.

Looking forward to your usual support.

Yours Sincerely,

pp Dr.Nabaggala Justine
Head of Department, Visual Communication

Appendix B: Letter to conduct a research expedition at NIC-Abilonino

KYAMBOGO UNIVERSITY

P. O. Box 1 Kyambogo, Phone: 041-285001/2 Fax: 041-220464
www.kyambogo.ac.ug
FACULTY OF VOCATIONAL STUDIES
DEPARTMENT OF ART & INDUSTRIAL DESIGN

20th, September 2019

To the Principal

National Instructors' College Abilonino.

Dear Sir,

RE: RESEARCH EXPEDITION ON WORK/PRODUCTION PROCESSES AT NATIONAL INSTRUCTORS' COLLEGE ABILONINO.

We appreciate your contribution and continuous collaboration with Kyambogo University for improving Vocational Education and Training (VET) in Uganda. Kyambogo University runs the masters in vocational pedagogy Programme and it is in regard to this that we request you to host Mr. Kabunga Ssendi peter who is a lecturer in your college and two mentors from Kyambogo university to conduct a research expedition on the work/production process in your college.

The program requires students to carry out action research (AR) in any given occupation or profession. Besides generation of new knowledge, action research contributes to the improvement of the involved occupation or profession which is beneficial to the vocational institution or work place where it is conducted.

The initial stage of this action research is the analysis of the work / production processes of the occupation or professional. At the end of this stage the stakeholder and the researcher have a clear overdue and in-depth understanding of the process and challenge(s) or area(s) of concern in carrying it out. This is followed by a future workshop (FW) in which stake holders together with the researcher scrutinizes the area(s) of concern to work out solutions to improve the process. At the end of the FW a tentative problem statement for the AR is formulated. This provides a basis for the construction of the AR proposal.

So their expedition is centering on the work/ production analysis is guided by the following objectives:

1. To identify the work/production processes at National Instructors' College Abilonino
2. To determine the tools, materials and equipment used in the work/production processes at National Instructors' College Abilonino.
3. To examine the competences involved in the work/production processes at National Instructors' College Abilonino
4. To establish the challenges involved in the work/production processes at National Instructors' College Abilonino

I kindly request you to allow them interact with your staff to collect data based on the set objectives of the study from your institution. The time allocated for this study is between 24th and 26th September, 2019. Please select a date and time that will be convenient for the exercise.

The findings of this study will be handled with confidentiality.

I look forward to your positive response.

Thank you,

Yours Sincerely,

Christopher Serwaniko
Coordinator, Masters in Vocational Pedagogy Programme
NORHED MVP PROJECT

Appendix C: Letter of consent for participation

KYAMBOGO UNIVERSITY

PROGRAMME: MASTER'S IN VOCATIONAL PEDAGOGY

VP 711: PROPOSAL WRITING.

CONSENT FOR PARTICIPATION

Dear respondent(s),

We are second year students of Kyambogo University pursuing a Master's Degree in Vocational Pedagogy. We are carrying out a study to analyze the work/production processes, determine the tools, material and equipment used in the work/production processes and examine the competences in the work/production processes in your college.

The program requires students to carry out action research (AR) in any given occupation or profession. Besides generation of new knowledge, action research contributes to the improvement of the involved occupation or profession which is beneficial to the vocational institution or workplace where it is conducted.

The initial stage of this action research is the analysis of the work/production processes of the occupation or profession. At the end of this stage the stakeholder and the researcher have a clear overview and in-depth understanding of the process and challenge(s) or area(s) of concern in carrying out. This is followed by a Future Workshop (FW) in which stakeholders together with researcher scrutinize the area(s) of concern to work out solutions to improve the process. At the end of FW a tentative problem statement for the AR is formulated. These provide a basis for the construction of the AR proposal.

Your responses will be kept confidential with anonymity of names and raw data under lock and key. Participation in this study is voluntary. The risks of participation in the study are very low and of a social or reputational nature. In the event that you are willing to participate in this study, you will be required to offer consent by signing on this form, a copy of which will be given to you.

The consent form has been explained to me, and I have understood the purpose of the study, risks involved and that participation is voluntary. I am willing to participate in this study.

Name; …… Signature; …….

Appendix D: Purpose of the research expedition

PURPOSE OF THE RESEARCH EXPEDITION:

To analyze the work/production processes at National Instructors' College Abilonino.

OBJECTIVES OF THE RESEARCH EXPEDITION: \

To identify the work/production processes at National Instructors' College Abilonino

To determine the tools, materials and equipment used in the work/production processes at National Instructors' College Abilonino.

To examine the competences involved in the work/production processes at National Instructors' College Abilonino

To establish the challenges involved in the work/production processes at National Instructors' College Abilonino.

Research Questions:

A). Identification of the work/production processes at National Instructors' College Abilonino

Which training programs are available in the institution?

What activities are involved in the abovementioned programs?

What is the ratio of female to the male students?

B). Determination of the tools, materials and equipment used in the work/production processes at National Instructors' College Abilonino.

What are the tools, materials and the equipment used in the training programme

How effective are the training tools, equipment and materials in the training process?

Does training tools, materials and equipment march with the number of trainees?

C). Examination of the competences involved in the work/production processes at National Instructors' College Abilonino

What competences are acquired during the training Programme?

How do you relate the competences with the world of work?

Which types of technologies (machines/tools) are available?

D).Establishment of the challenges involved in the work/production processes at National Instructors' College Abilonino.

What are the challenges faced in the work/production processes at National Instructors' College Abilonino?

Kabunga Ssendi Peter -Student Cohort VII-Masters in Vocational Pedagogy

Appendix E: Focus group of Administrators during work production process.

Appendix F: Implementation plan

Implementation plan for Instructors / Researcher

Activity	**Responsible personnel /Participants**	**Indicators**	**Period**
To mobilize resources	Researcher / Instructor, Class coordinator.	Records of resources and materials to be used.	January 2022
To instruct trainees on PBL-method & P.G technique to improve plumbing practical skills.	Researcher / Instructors Head of department	Records of attendance Photos of participants	January 2022
To evaluate the PBL-method & P.G	Head of department, Instructors, Trainees, Researcher, Supervisor	Minutes of the meeting Records of the attendance Photos	January 2022

Implementation Plan for Trainees

Activity	Responsible personnel	Indicators	Period
To maintain the classroom, sites and workshop clean	Trainees	Clean environment	January 2022
To attend instructions for plumbing practical skills	Trainees, Instructors, Researcher	Record of attendance, Record of marks from practical work done	January 2022
To evaluate the impact of PBL-method & P.G as used	Head of department, Trainees, Instructors, Researcher	Minutes of the meeting, Records of attendance	January 2022
Interpretation and analysis of data	Researcher	Report	January 2022
Presentation	Administrators Supervisors Mentors Researcher	Report	February 2022
Submission of Thesis	Administrators Supervisors Mentors Researcher	Report	March 2022

IMPLEMENATION PLAN, BASING ON THE OBJECTIVES OF THE STUDY AND RESEARCH QUESTIONS.

Objectives of the study

The general objective of the study was to improve plumbing practical skills using problem based learning for civil engineering students in DITTE programme at NICA, through the following specific objectives;

i. To identify challenges in plumbing practical skills for civil engineering students at National Instructors College Abilonino.
ii. To identify possible strategies to address the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College.
iii. To implement the possible strategies addressing the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College.
iv. To evaluate the implemented possible strategies.

Research questions

1. What are the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College?
2. What possible strategies to be used to address the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College?
3. How can the implemented strategies be used to address the challenges in plumbing practical skills for Civil Engineering Students at National Instructors College?
4. How can the implemented strategies be evaluated?