ENHANCING TRAINEE COMPETENCE FOR BOAT BUILDING DESIGNS AT FISHERIES TRAINING INSTITUTE ENTEBBE

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19/U/GMVP/19021/PD

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

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DECLARATION

I **OPWONYA NELSON** do hereby affirm the originality of this document and never in any case has been submitted to any institution for award of marks or academic document

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APPROVAL

This research Dissertation has been written under our supervision and submitted to the Directorate of Graduate Research and Training , Kyambogo University for the purpose of an award of Master degree of Vocational Pedagogy of Kyambogo University.

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DEDICATION

The research work is appropriated to my beloved spouse Aliya Florence and the children: Onen Benjamin, Lamunu Gift, Otto Moses, Opiyo Charles, Apiyo Paska, Aloyo Docila, Nimaro Joseph, Lawino Paska and Lagen Jane Ruth.

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ACRONYMS AND ABBREVIATIONS

CAD: Computer Aided Design

ICT: Information and Communication Technology

TVET: Technical, Vocational Education and Training

L.O.A: Length Over All

FTI: Fisheries Training Institute

DRW. Drawing

DRWN: Drawn

KyU: Kyambogo University

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ABSTRACT

The study aimed at enhancing competence development among boat building trainees at Fisheries Training Institute in Entebbe. The study was based on three objectives: To identify challenges hindering competence development in boatbuilding and marine mechanics. To select strategies, lay procedures and incorporate the identified gap in teaching and learning processes of boat building and marine mechanics; and to evaluate the incorporated strategy in drawing plans of boats. The study embraced Participatory Action Research (PAR) design, and purposive sampling technique was used. The sample (respondents) comprised of three administrators, a head of ICT department, two lecturers of boat building, three assistant lecturers, one artisan, and fourteen boat building students Data were collected through use of; work process analysis, observations, interviews, future workshop, and focused group discussion methods. Findings revealed challenges such as a shortage of staff and teaching resources, difficulties in preserving traditional drawings, traditional hand tools making learners miss out modern skills relevant in industries, lack of computers and software required for boat plan construction. Interventions included recruiting knowledgeable staff, creating an ICT laboratory, training staff in modern drawing tools like AutoCAD, integrating AutoCAD into the curriculum, and providing ongoing support for staff and students, and a lack of familiarity with modern drawing technologies among boat building staff. Conclusively, active engagement of students in the new strategy is essential, especially by use of tutorials and online teachings. Recommendations included further staff recruitment and training, establishment of an ICT laboratory, integration of modern technologies into the curriculum, investment in learning resources, and implementation of evaluation mechanisms.

Key words: Competence development, Boat building trainees, Fisheries Training Institute, Tutorials and online teachings.

CHAPTER ONE: INTRODUCTION

1.0 Overview

The chapter introduces the background to the study focusing on vocational pedagogy as a discipline. In this chapter, the researcher focused on skills enhancement in the teaching and learning of boat building and marine mechanics at Fisheries Training Institute. The chapter further provides the historical backgrounds of the study, situational analysis, statement of the problem, purpose of the study, objectives, justification, significance, scope and definition of terms.

1.1 Vocational Pedagogy

Vocational pedagogy is a discipline of learning that tends to orientate a learner with knowledge, skills and attitudes required to promote trade, occupation and profession in a satisfactory manner. 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, 2006, p 6). It is therefore observed that Vocational pedagogy is not only based on generation of knowledge like in general education, but it also emphasizes on the learning in which a learner is carefully taken through hands on training. This kind of practical learning equips the learner with the skills required in the world of work such as interpersonal skills, creativity, communication skills, critical thinking, and innovativeness. It also creates in the learner the confidence required in handling work. These skills are generally expected of the employees in the world of work or industry. According to (Evans, 2013) vocational pedagogy critically examines how best knowledge can be created, skills developed and useful habits for the world of work established among the learners. According to (Lucas, Claxton and Spencer, 2013), vocational pedagogy is the science, art, and teaching craft that prepares people (learners) for working life. Following is the background of boat building which is a vocational subject.

1.2 Background of boat building

Boat building was a process of constructing water craft (Kilchermann, 2022). The constructed boat provides means of transport on water for passengers, goods, and fishing activities.

The first boat or earliest ever recorded/recovered vessel on water was the "Pesse Canoe" which dates back to 8040 BCE. The canoe was a dug-out (carved out of a log) vessel of three meters long. It obtained its name from the village where it was made from. Pesse is a village in Netherland, the Dutch province of Drenthe, Hoogeveen Municipality (TeamStoryWeavvers, 2021). Pesse canoe did not have even a single oar; instead people used their hands to paddle under their own weight.

Figure 1 ***Europe's Famous Mesolithic Pesse Canoe***

Source: https://www.ancient-origins.net

Another development that came after Pesse Canoe was the assembling of reeds and logs especially the bamboo logs, to form rafts that float on water to provide means of transport.

Figure 2 Prehistoric rafts made of logs of bamboo   Source https://blog.byjus.com

In Africa, the first country recorded to use boats as means of transport was Nigeria, followed by Egypt. By 4000BC, Egyptians had learnt how to make boats from papyrus reeds (Ducksters, 2022). The Egyptians didn't build roads to travel around their empire. Nature had already built for them a super highway through the middle of the empire; the Nile River. As most of the major cities in the Ancient Egypt were constructed along the banks of the Nile River, boats were used as transportation means to link those cities. They then became experts in building boats and navigating the river southwards and northwards. Many types of boats were developed by the Egyptians from papyrus plants and later wood. Some were specialized for fishing and travelling while others were specifically designed for carrying Cargo and going for war. Some of the boats used sails. And the design of the boats was pointed at both ends.

Figure 3 An ancient Egyptian papyrus boat on the Nile River
Source: **https://www.bing.com**

The Arabs advanced from this technology into the production of dhows which were used for trading in slaves, ivory, fruits, fresh water and other goods along the coast of Arab countries, India, Pakistan, Bangladesh and East Africa by around 600 BC (HIDEAWAYS, 2020).

In Uganda, the first boat to be used for fishing and transport was a dugout canoe. The second type being used up to now was the “Ssesse Canoe” which fashion and design follows the Arab design (Goodings,1969). Ssesse Canoe was modified from the Arab design of constructing boats, by cutting the behind (aft) of the boat and changing it from a pointed end to a flat board called transom board (Goodings,1969). The transom board is now used for mounting engines. The third fashion which was developed from the Ssesse Canoe is the flat bottom boat. Flat bottom boats are meant to operate only around the shores on the shallower waters or at a sheltered areas with less waves. These boats were constructed using traditional methods of construction. As technology evolved, conventional boat building was introduced in Fisheries Training Institute in 1972;

Since the introduction of boat building in Fisheries Training Institute, drawing of the boat designs have been a practice for all learners. Lofting of the boat plan full size takes place onto the mould loft floor (a wide flat floor prepared for drawing boat plans full size). All these activities take place by each learner using hand tools such as flexible batten, straight edge, pencils, protractors, rulers, pair of compasses, pair of dividers, rubber, set squares, pencil sharpers, drawing sheet of papers, pins and nails.

In making comparison with the beach boat building technics, learners are always taken for field trips to the beach boat building sites at the landing sites to observe the kind of technology used. The difference noted were that beach boat builders do not have designs laid down in drawing form. A beach boat builder has his design in his head and keeps observing the curvature of the boat using the plan in his mind. No other person can continue with the construction of his boat and finish it using the exact plan as he started in case he transferred or died. Boats constructed by the beach boat builders have no frame fastened together with floor boards and all the boats lack gunwales, hog and knees.

1.3 Vocational pedagogy and practice of teaching – learning boat building and marine mechanics at Fisheries Training Institute

1.3.1 Fisheries Training Institute

Fisheries Training Institute Entebbe is a government aided institute situated in Bugonga Parish, division A, Entebbe municipality. It was established by an Act of Parliament of Uganda under the then Ministry of Animal industry, Game and Fisheries. The foundation stone was laid on 27th June, 1966 by His Excellency the Vice President of Uganda, Honorable J.K. Babiiha (who was also the minister of Animal Industry, Game and Fisheries) and the official opening took place on 23rd February, 1968 by the same officer (fti.ac.ug). It was opened as regional institute to train students from Central and East Africa in fisheries resource management.

Its vision in service is to be a center of excellence in providing fisheries, aquaculture and maritime value chain education in the east and central African region. And the mission is to provide skills-based training and services to its client in fisheries, aquaculture and maritime sub-sector.

1.3.2 Boat building and marine mechanics

Boat building and marine mechanics is a department within Fisheries Training Institute. Boat building course was introduced in Fisheries Training Institute in 1972, six years after its establishment, in order to train technicians that would be able to build strong boats and provide maintenance services of boats for Fisheries Department, Ministry of Animal industry, Game and Fisheries.

According to (Marjadas, 2014) Boat building and marine mechanics encompass a wide range of skills and knowledge essential for constructing, repairing, and maintaining boats, and other watercrafts. When training learners in this field, the department typically covers several key functions:

Boat Design and Construction

Boat Design and Construction help in teaching learners the principles of boat design, including hull shapes, materials, and construction techniques. This involves understanding various types of boats, from small recreational crafts to larger vessels, and the engineering principles behind their designs

Marine Systems

Marine Systems are usually engaged in educating students on the various systems present in boats, such as propulsion systems (engines, propellers), electrical systems, plumbing, steering mechanisms, and more. This includes learning about the installation, maintenance, and troubleshooting of these systems.

Materials and Techniques

The institute also use **materials and techniques in** providing knowledge about different boat-building materials (wood, fiberglass, aluminum, etc) and the specific techniques involved in using them. This may include hands-on training in cutting, shaping, laminating, and joining materials.

Safety Standards and Regulations

Like anywhere else safety standards and regulations helps in emphasizing the importance of adhering to safety standards and regulations in boat building and repair. This includes teaching learners about safety procedures, equipment, and compliance with maritime laws and standards.

Repair and Maintenance

For any equipment used substantially repair and maintenance are key training in diagnosing issues and performing repairs and maintenance tasks on boats. This involves understanding common problems, conducting inspections, servicing engines, fixing electrical faults, repairing hulls, and maintaining other components to ensure proper functionality and safety.

Considerations of environmental

Considerations of environmental in educating learners about environmentally friendly practices in boat building and maintenance was well catered for. This includes using eco-friendly materials, minimizing waste, and adhering to environmental regulations to reduce the impact on aquatic ecosystems.

Business and customer service skills

For those interested in pursuing careers in boat building or marine mechanics as entrepreneurs or working in service centers, teaching business skills such as budgeting, marketing, client relations, and effective communication is valuable.

Hands-on practical experience

Providing ample opportunities for hands-on learning, apprenticeships, or internships where students can apply their theoretical knowledge in real-world scenarios under the guidance of experienced professionals.

Technology integration

Technology integration helps in keeping learners up-to-date with technological advancements in the marine industry, such as advancements in materials, tools, diagnostic equipment, and computer-aided design (CAD) software used in boat building and repair.

While at Fisheries training Institute, the trainees are exposed to a number of activities to equip them with the various skills and knowledge as outlined by (Marjadas, 2014), except technology integration which was not included. These activities clustered into course units to equip them with the skills required in the real world of work. The course units include: technical drawing, workshop practice, mould loft practice, applied mathematics, applied mechanics, elementary marine mechanics, boat handling and safety at sea, navigation and seamanship, business management, real life projects, environmental science, and industrial training. Industrial training is designed to take places at the end of each academic year.

1.3.3 Boat building as relates to vocational pedagogy

Vocational pedagogy involves the utilization of methods, strategies, and principles in instructing and acquiring specific skills and knowledge pertinent to a trade, profession, or occupation. This pertains to tailored instructional approaches that ready individuals for hands-on work within a particular industry or field. It emphasizes furnishing practical, job-specific training, often focusing on applied learning, experiential education, and real-world experiences. Its aim is to equip learners with the necessary competencies, technical expertise, and problem-solving abilities required to excel in a specific vocational or professional domain.

This educational approach commonly includes apprenticeships, internships, technical training, on-the-job learning, and a blend of classroom instruction and practical skill development. The objective remains to bridge the divide between education and the workforce's demands, ensuring individuals possess the skills and knowledge necessary for success in their chosen vocations.

As such, the Masters in Vocational Pedagogy (MVP) program at Kyambogo University (KyU) holds significance in facilitating hands-on training and producing qualified technicians. The MVP program specifically focuses on teaching, training, and learning in technical and vocational education, emphasizing specific trades and occupations. In boat building and marine mechanics, vocational pedagogy aims to develop workplace competencies through six contact hours of hands-on per week for 15 weeks of teaching in a semester, integrating learners of different age groups to gain individual experiences and group projects (Ali, 2019).

The MVP program was designed to enable the acquisition of general knowledge, theory, and practical training required by the labor market in educational institutions and workplaces (Mjelde, 2017). Participants in the program are required to proficiently execute experience-oriented tasks and engage in problem-based learning activities related to their field of attachment, while emphasizing creativity, group participation, and teamwork (Ali, 2019).

Skills acquisition through active participation in group work forms the core of learning processes in Vocational Pedagogy (Mjelde, 2006). Furthermore, vocational pedagogy empowers technicians, particularly in enhancing learner-centered approaches to hands-on training in boat building and marine mechanics practices.

1.3.4 Impacts of studying vocational pedagogy at KyU on boat building practices

Studying vocational pedagogy from Kyambogo University provided the researcher with the knowledge to plan, reorganize and streamline educational issues within boat building and marine mechanics department, and acting as a game-changer. This goes beyond the technical skills of boat building but delves into the art of teaching those skills effectively.

1.3.4.1 Industry connection

By studying vocational pedagogy, it has been realized that there should be a strong connection between the learning institution and the world of work “boat building industry”. This is done through: industrial training placements, field trips or visits, formation of industry partnerships, and inviting guest speakers to talk to the students. This has opened up opportunities for dialogue with responsible firms who were invited for designing a new curriculum for boat building and marine mechanics, space was also provided for placing students for industrial training in the firms that specifically service outboard engines along the shores of Lake Victoria, in ferries with Uganda National Roads Authority, and with other ship builders withing the shores of Lake Victoria. The good news is that some of the students were retained for employment after the industrial training.

1.3.4.2 Real-world relevance

Boat building was a hands-on, practical skill training. Vocational pedagogy emphasizes the application of knowledge to real-world scenarios. This ensures that the teaching remains relevant and prepares students for the actual challenges they might face in the boat building industry (OECD, 2023). The hands-on and the practical skills development at Fisheries training institute is supported and facilitated by fixed and portable machines because the workshop is attached to the electricity distribution grid. But since we understand that the greater percentage of boat building activities is done in areas where electricity supply is either poor or not in existence, learners are also trained to manually mark, rip timbers, plane, mortise, cut tenons, and cramp using the local means that fit the real-world situations. This is to equip learner with the skills of being flexible to meet and withstand all situations.

1.3.4.3 Collaborative group projects

Designing learning activities that require students to work together in groups. Encourage them to share ideas, discuss concepts, and collaborate on projects or problem-solving tasks. This promotes active engagement, peer learning, and the construction of knowledge through interactions with diverse perspectives. This approach always prepared basing on problem-based learning. Structuring learning around real-world problems or scenarios that require critical thinking and collaboration to solve. This encourages students to explore, research, and apply knowledge from various sources to address complex issues, thereby constructing their understanding of the subject matter. For example, sending student to repair a boat at a particular landing sit

1.3.4.4 Tailor made instructions

Vocational pedagogy equipped the researcher with the skills to customize teaching methods based on the needs and learning styles of the students. The instruction styles have been changed to suit the unique challenges and strength of each boat building student in the class. This was manly based on learner centered approach which promised learners to work in line within the pace of their abilities, but to complete the task set for all.

1.3.4.6 Communication skills

Teaching boat building involves more than just demonstrating technical skills. Vocational pedagogy equips the teacher with appropriate communication skills, enabling the teacher to convey complex concepts in an understandable and engaging manner. To ensure smooth communication in the learning environment, learners with difficulties in literacy and numeracy are supported to develop skills and expertise (Lucas B. , 2014). But with the increasing technological development where ICTs and AutoCAD are involved, institutions that have advanced to use these facilities find it very easy to communicate with the learners.

1.4 Statement of Motivation

The government of Uganda is prioritizing a shift in skills development towards creating employable skills and competencies aligned with the needs of the labor market, as outlined in the BTVET Act of 2008. Drawing from personal experience, graduates of the Fisheries Training Institute, specifically in boat building and marine mechanics, often lack the practical skills necessary to establish their own workshops and generate employment opportunities. Consequently, when required to submit bid documents for boat building contracts, many graduates hesitate to participate in the bidding process due to their apprehension about preparing boat plans.

Those who gather the courage to compete often submit their bid documents towards the expiry period, as they spend considerable time creating boat plans using traditional hand tools. Despite their efforts, the majority of contracts are awarded to graduates from the Dar es Salaam Maritime Institute in Tanzania, rather than those from the Fisheries Training Institute.

Upon investigation, it became apparent that Fisheries Training Institute graduates in boat building and marine mechanics are losing out on contracts due to their insufficient competence in drafting boat plans, which are crucial for demonstrating the intended boat construction. In light of these challenges, the researcher anticipates that this action research will facilitate collaboration among stakeholders to devise strategies for enhancing the competency development of boat building trainees at Fisheries Training Institute. As such, the researcher considered a situation analysis at the institute to prepare ground for further collaborative participation with the stakeholders (Administrators, lecturers, assistant lecturers, students and artisan)

1.5 Situation analysis

The researcher carried out work process analysis at Fisheries Training Institute. The analysis employed observation as the most reliable method of obtaining information or data. The observation was carried in the classrooms where learners were carrying learning, in the drawing room, the compound, library, inside the student hostels, and in the computer laboratory. While in the computer laboratory, the researcher realized that other departments at fisheries training institute such as, Aquaculture, fisheries resource management and technologies, Crop science and animal husbandry; use computer laboratory to benefit from the projectors for display of skills that they need learners to adopt, but not incorporating modern technology into the teaching and learning. The researcher also engaged students, lecturers, support staff, and administrators in verbal interactions in order to gain more insights.

Finally, the researcher specialized his observations and engagements specifically for boat building and marine mechanics department. He also went through the institute program as laid down in the curriculum book, and on the general timetable.

The analysis revealed several critical issues negatively impacting the Boat Building and Marine Mechanics department, as summarized in Table 1

Table 1 Gaps in boat building and marine mechanics department

S/N	Gaps identified in boat building and marine mechanics department
1	Few slots are given by Government for admitting boat building students
2	Storing drawings produced by traditional hand tools for future use is difficult.
3	Inappropriate practical that does not impart knowledge and skills for a competent boat building practice.
4	Inadequate staffing at the department.
5	Lack of computers and AutoCAD software to enhance competence.
6	Traditional hand tools make learners miss out on developing skills relevant in modern industries.
7	Lack of information and communication technology (ICT) in boat building department
8	Inadequate teaching learning resources
9	Absence of practical skills for using modern technology by boat building staff.
10	Lack of adequate sites for conducting industrial training for boat building students.

Source: Primary Data 2022

Therefore, the researcher decided to call for a future workshop so that the issues obtained are handled collectively with the stakeholders.

1.5.1 Future workshop

Future Workshop is a technique of developing a vision of the future by the participants (Kuhnt, 2016). It was developed by Robert Jungk and Norbert R. Müller in the 1970s (Apel, 2004). According to (DTU, 2018), Future Workshop is a conceptual equipment employed for drawing inference and simplifying tasks or problems by encouraging the participants to pool in their views, ideas and plans, and encourage them to participate in planning for the future of the organization collectively. Future workshop is an interactive method of solving organizational problems through incorporating all participating members in addressing matters of the organization collectively through linking the present organizational stand with the future position of the organization desired by all members of the organization through identifying concrete means to be followed (Rasmussen L., 2011). Following the current project of research, the Future workshop was arranged and took place on 20th March, 2022 at 10:00am inside Boatyard Mould Loft Floor. This Future Workshop comprised of the preparation, critique, fantasy and implementation phases as outlined in the subsequent sections.

1.5.1.1 Preparation phase

The preparation phase was concerned with organization, planning for the physical environment, and the management requirements of the workshop. Participants of the future workshop were selected and invited. Their background factors and motivations were considered. A room with very good atmosphere was chosen and prepared for the workshop. Time for the workshop was scheduled and meeting duration was proposed. Materials such as papers, markers, pencils, masking tapes and rubbers were made available in the room. Refreshments were also provided.

Figure 4: Participants of the future workshop on 20th March, 2022
Source: Primary Data 2022

1.5.1.2 The critique phase

At the critique phase the researcher started by brain storming the participants by asking a question; Identify challenges and gaps facing teaching and learning of boat building at Fisheries Training Institute, Entebbe (FTI). After their reactions to the brain storming question, the researcher presented to the stakeholders the challenges and gaps obtained during the work process analysis (as shown in table 1 above), and these are challenges and gaps facing teaching and learning of boat building at FTI. The stakeholders that included staff of boat building and marine mechanics department, boat building students, administrator, head of department Information and communication Technology (ICT) received the identified challenges, adding onto the ones they had already raised, reviewed them and categorized them into short term, medium term and long term as shown in table 2 below.

Table 2: Categorized challenges and gaps facing boat building and marine mechanics

Short Term	Medium Term	Long Term
• Inadequate staffing at the department; • Inadequate teaching learning resources; • Storing drawings produced by traditional hand tools for future use is difficult. • Lack of information and communication technology (ICT) in the department • Traditional hand tools make learners miss out on developing skills relevant in modern industries. • Lack of AutoCAD software to enhance competence. • Absence of practical skills for using modern technology by boat building staff.	• Inappropriate practical that does not impart knowledge and skills for a complete boat building practice. • Limited opportunities for employment, • Lack of adequate sites for conducting industrial training for boat building students.	• Low enrolment of students in boat building course. • Lack of modern text books for boat building; • Limited professional development in boat building as. no university in Uganda provides courses in boat building. • The policy in Uganda does not provide for proper control of building boats.

Source: Primary Data 2022

1.5.1.3 The fantasy phase

Participants were encouraged to think creatively and imaginatively without constraints. They were to see ideals or utopian scenarios related to the enhancement of skills of drawing boat plans using improved technology. At this stage participants had to break away from limitations and imagined the exaggerated future and also explored possibilities without interference by the current realities of state of affairs (Apel, 2004)

The participants fantasized that each situation was possible and resources were made available to address the touching challenges of boat building department at this imaginative phase of the future workshop.

1.5.1.4 The implementation phase

Here, participants merged the creative ideas generated in the fantasy phase with practical considerations.

They assessed the feasibility, resources, and practicality of the proposed ideas. They discussed issues involved by refining ideas, considering potential obstacles, and outlining concrete steps to achieve the envisioned future. This led to the idea of tackling action by ranking the short-term challenges which were considered most pressing.

Pairwise ranking matrix was used. Pairwise matrix is a mathematical structure used to compare pairs of elements from a set (Hlavaty, 2014).

and each stakeholder was allowed to tick a challenge out of the two challenges presented in each pair of boxes provided. The challenges were represented by letters A, B, C, D, E, F and G in which:

A = Inadequate staffing at the department;

B = Inadequate teaching learning resources;

C =Storing drawings produced by traditional hand tools for future use is difficult.

D = Traditional hand tools make learners miss out on developing skills relevant in modern industries.

E = Lack of information and communication technology (ICT) in boat building and marine mechanics department;

F = Lack of computers and AutoCAD software to enhance competence.

G = Absence of practical skills for using modern technology by boat building staff.

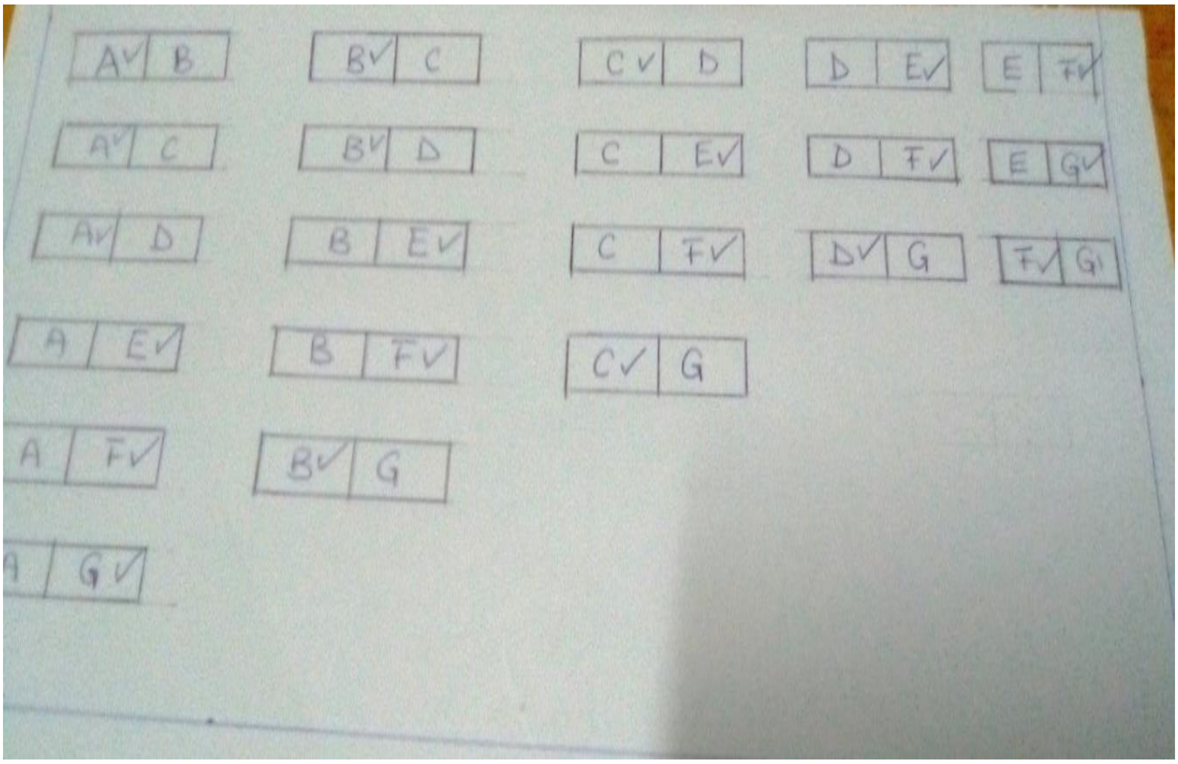

Figure 5: Sample of the paired challenges used as scoring guide for ranking during the future workshop on 20/03/2022 at Fisheries Training Institute

Source: Primary Data 2022

Table 3 Ranked challenges

Challenges	Stakeholders									Total	Rank
	1	2	3	4	5	6	7	8	9		
Inadequate staffing at the department; A	5	2	2	4	2	1	4	4	3	27	3rd
Inadequate teaching learning resources; B	4	4	1	1	4	5	2	1	2	24	5th
Storing drawings produced by traditional hand tools for future use is difficult. C	4	2	2	3	4	2	4	4	4	29	2nd
Traditional hand tools make learners miss out on developing skills relevant in modern industries. . D	3	2	4	3	1	2	1	2	2	20	6th
Lack of information and communication technology (ICT) in boat building and marine mechanics department, E	2	3	2	1	0	2	2	3	0	15	7th
Lack of computers and AutoCAD software to enhance competence. F	6	3	3	2	3	5	2	2	4	30	1st
Absence of practical skills for using modern technology by boat building staff. G	2	4	4	3	3	3 ..	4	2	2	27	3rd

Source: Primary data from the future workshop at Fisheries Training Institute

1.5.1.4.1 Result of the pairwise matrix ranking

Through the future workshop held on 20th March 2022, the challenging gaps were ranked and the most challenging gap was lack of computers AutoCAD software use in the teaching and learning process of boat building and marine mechanics.

1.6 Statement of the problem

The teaching and learning of drawing boat plan is a continuous process that keeps changing with the changing trend of drawing in the world. Ideally, students of boat building should be having competence in drawing boat plan that matches squarely with the contemporary industry requirements and needs. Students of boat building and marine mechanics are struggling to acquire skills that would make them exposed to the world of work, but there is drag and stagnation due to some existing gaps within boat building department. Therefore, the study endeavors to explore the most pressing gap hindering competence development in boat building trade among boat building trainees.

1.7 Purpose

The purpose of the study was to enhance competence development among boat building trainees by exploring how digital tools and technologies can be integrated into the training process to improve the skills and knowledge of trainees in the field of boat design.

1.8 Objectives

The objectives of the study were:

1. To identify the gaps hindering competence development in boatbuilding and marine mechanics at Fisheries Training Institute.
2. To select appropriate strategies, lay procedures, and incorporate identified gaps into the teaching and learning processes of boatbuilding and marine mechanics.
3. To evaluate the incorporated strategies and procedures in drawing plans of boats.

1.9 Research questions

a) What are the gaps hindering competence development in boat building and marine mechanics at Fisheries Training Institute?
b) What is the appropriate approach for incorporating the identified gaps in the teaching and learning processes of boat building and marine mechanics?
c) How will the implemented strategies and procedure be evaluated?

1.10 Justification of the study

Future Workshop held on 20/03/2022 through the pairwise ranking, singled out lack of computers and AutoCAD software to enhance drawing practices, as the most pressing gap hindering competence development in boat building and marine mechanics department. The adoption of computers and AutoCAD software would address the disparity between the institute's reliance on the traditional hand tools and the prevailing industry standards of employing modern tools.

Firstly, investigating the gaps within boatbuilding and marine mechanics education will provide crucial insights into the existing gaps and limitations to pave way for new strategies and procedures to overcome the challenges.

The selection of appropriate strategies and procedures is vital for the integration of AutoCAD is vital for ensuring a smooth transition and alignment with the institute's curriculum and learning objectives, fostering a conducive environment for effective teaching and learning.

The incorporation of AutoCAD strategies and procedures into the teaching and learning processes to enhance trainees' competencies, bridge the gap between academic training and industry demands.

To meet the standards and expectations of the contemporary boatbuilding and marine mechanics department, the study will evaluate the incorporated strategy and procedure to gauge the effectiveness and identifying areas for improvement.

1.11 Significance of the study

The significance of this study lies in several key areas:

The study aims to improve the skillset of boat building trainees. Revolutionize the way students learn and apply their knowledge through technology in boat design and construction at Fisheries Training Institute. Modernize boat building education and industry improvements on the methodology of the institute. Harmonize with contemporary boat building standards that are relevant.

Overall, this study's significance lies in its potential to modernize training methodologies, align education with industry standards, improve students' skills, and validate the importance of technological integration in educational frameworks within the boatbuilding and marine mechanics domain.

1.12 Scope of the study

The scope is further divided into geographical scope, content scope, and time scope.

1.12.1 Geographical scope

The study was conducted at Fisheries Training Institute (FTI) located in Bugonga sub-ward, division A, Entebbe municipality, Wakiso District, Uganda. The coordinate or google location is $0^{0}02'25.3''$ N $32^{0}28'05.5''$ E. This institute is a specialized training center that focuses on skills development for the fisheries industry. The geographical scope was limited to FTI's campus, involving its boat building trainees, lecturers, assistant lecturers, artisan and facilities. The study also considered the surrounding Lake Victoria basin, where boat building skills are crucial for the local fishing communities and maritime activities.

1.12.2 Content scope

The study focused on identifying and improving the competencies required for boat building design among trainees. It included:

Technical Competencies that involved core boat design principles, material selection, construction techniques, safety standards, and maritime regulations; practical skills emphasizing on hands-on training in boat construction, use of modern boat-building tools and equipment, and incorporation of sustainable and environmentally friendly practices in design;

the pedagogical approaches that examined how trainers at the institute impart boat-building skills, highlighting gaps and suggesting methods to enhance teaching and learning processes; technology integration that explored the role of digital design tools such as CAD (Computer-Aided Design) software in modernizing boat-building methods; and stakeholder involvement during challenges identifications, selection of strategies for incorporation of identified gap, incorporation of the digital modern tools and evaluation of the integrated modern tools in order to generate proper feedback.

1.12.3 Time scope

The study covered a 33-monthsperiod (February, 2022–Octobber,2024). Included in this period were:

A review of past training methods and outcomes for boat-building design from 2022 onwards, assessment of ongoing training initiatives, evaluation of improvements and innovations implemented during this timeframe to enhance trainee competence in boat building,

The study also projected future trends in boat design training, focusing on preparing trainees for emerging challenges and opportunities in the next five years (up to 2029). This timeframe ensures the study captures recent developments, addresses current challenges, and plans for future improvements in the boat-building sector at the institute.

1.10 Definition of terms

Aft perpendicular is a vertical line drawn perpendicular to the baseline at the aft end of the boat showing where horizontal measurements for the boat stops from behind.

Baseline is the first horizontal line drawn where measurements of all heights start from.

Beach boat building is the traditional method of boat building that takes place at the landing sites or beaches without the guide of a printed boat plan.

Beam is the widest part measured across the boat.

Boatyard is a building used as workshop for making boats.

Body plan is a drawing showing appearances of frames at different positions of a boat.

Building line is a line shown on the plan of a frame of a boat showing the position of spreader when constructing a frame.

Centre line is a line that divides a boat into halves longitudinally along its center. It is also a line where measurement of the width (half-breadth) of the boat begins from.

Chalk line is a thin long-colored thread used to produce a long straight line called the center line to guide boat construction.

Chine line is a line drawn to show the meeting point between the bottom planking and the side planking in a “v”- shaped bottom boat.

Computer Aided Design is software used for manipulating technological shapes using design methods.

Construction line is a faint line drawn to show steps of obtaining a particular shape or structure but remains faint.

Deck is the horizontal covering of a boat using timbers or fiberglass matt of metal to provide strength, beauty and walkway on the boat.

Flexible batten is a strip of wood or plastic used as a tool for drawing curved lines when lofting.

Fore perpendicular is a vertical line drawn perpendicular to the baseline showing the end of the length of the boat on the plan of the boat.

Frame is a vertical structural member fitted in the boat to hold side planking and provide support to the boat.

French curve is a tool or an instrument used for drawing short curves.

Hard-chine boat is a boat having the first two planks at the bottom in the form of letter “v” and the bottom planks meet the side planks forming and angle called a chine.

Half breadth plan is a lines drawing showing the plan of a boat drawn half the beam.

Hull is outside curve forming the shape of a boat and prevents water from entering into the boat.

Learning is the process of acquiring knowledge, skills, attitudes, manners from the environment.

Length overall (L.O.A) is the total length of a boat from aft to fore.

Lofting is the process of reproducing a boat plan full size on a mould loft floor such that parts of the boat such as frames can be extracted for building the actual boat.

Mould loft floor is a large floor inside the boatyard prepared specifically for drawing boat plans full size.

Outline is a darkened or confirmed part of the construction line that clearly shows the shape or structure required in the drawing.

Profile of a boat is a pictorial side view of a boat showing the overall length of the boat from transom to the stem.

Sheer line is a line showing where planking of the boat ends. It shows the top most part of the side planking of a boat.

Stem is the piece of timber fitted at the fore part of the boat to seal the gap left by the side planking.

Table of offsets is a table containing all measurements required for the construction of a boat plan.

Teaching is imparting knowledge and skills to the learners.

Transom is the part that covers the boat from the behind to prevent water from entering in the boat and also used for mounting outboard engine

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents the work of other scholars, academicians and researchers in line with enhancing trainee competence in drawing plans of boats. This review is based on the objectives: Identifying the gaps hindering competence development in boatbuilding and marine mechanics at Fisheries Training Institute, selecting appropriate strategies and lay procedures for implementation of identified gap, incorporating identified gap into teaching and learning of boat building and marine mechanics, and evaluation of the incorporated strategies and procedures in drawing plans of boats.

2.2 Evolution of boat building

Boat means a small watercraft used for fun or for carrying small loads but larger vessels that carry many people or tons of goods over long distances are called ships (Encyclopaedia-Britannica, 2023)**.** Boat building was a process of constructing water craft (Kilchermann, 2022).

The evolution dates back to prehistoric period where man used purely traditional means to operate on water; the Egyptian operation period; premodern period; and modern period.

2.2.1 First are the prehistoric boats

Prehistoric crafts in the history of boat building were built by Apes “Homo erectus”. According to (Britannica, 2023) Homo erectus are the extinct human genius, which perhaps are the ancestor of the modern humans. Homo erectus is a Latin word which means “an upright man”. Homo erectus most likely originate in Africa.

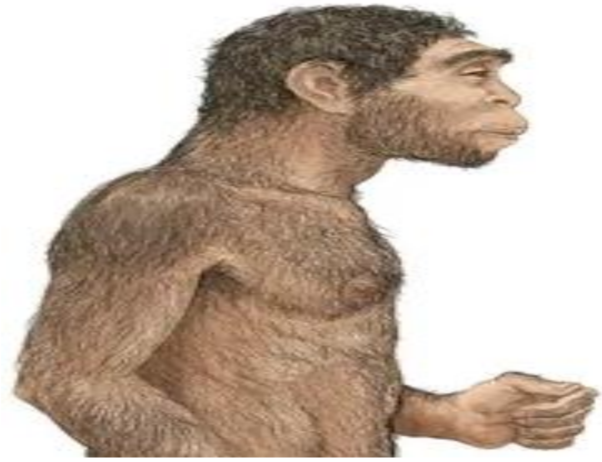

Figure 6: Homo erectus *Reeds craft made by Homo erectus*

Source: https://www.bing.com/image *Source: https://www.bing.com/images*

2.2.2 Homo erectus started by Assembled reeds

The prehistoric craft made by Homo erectus were inform of reeds gathered together and allowed to float on water and used for transportation. The craft made of bamboo reeds reached Indonesia Island around 800,000BCE (Vaucher, 2014). The prehistoric crafts were constructed without any drawn plans to guide the construction. The homo erectus developed the idea by seeing logs float on water.

2.2.3 Homo erectus advanced from reeds to dugout canoes

Dugout or monoxylon or log boat is a boat obtained from a trunk of a tree by hollowing it. Monoxylon is a Greek word, meaning, 'wooden vessel hollowed from a single tree trunk' (Jens, 2023). Dugouts are the oldest type of boat archaeologists have recorded dating back to 8,000 years to the Neolithic Stone Age. The size of the canoe depends on the size of the tree trunk chosen for the construction. There is no any plan laid down in a written form for this kind of boat construction.

Figure 7: Dugout canoes *Source: https://www.bing.com*

2.2.3.1 Construction of monoxylon boat

The construction of dug-out canoes starts with the selection of a log with suitable dimensions. Construction of a dugout begins with the selection of a log of suitable dimensions (the free encyclopedia). Some amount of wood should be removed from the log to create a hollow space inside the tree trunk that reduces the weight of the trunk and creating buoyancy for floatation. The portion of the trunk providing the hull must be strong enough to support the crew and the cargo carried in. selection of the tree species depended on strength, durability, and density. The boat's shape is then fashioned with sharp ends (bow and stern) to minimize drag by water and wind.

The first thing to do is to remove the bark from the trunk. The tool used for this operation was stone adze. The hollowing of the interior part of the trunk was done by setting fire to burn the wood with precise control of the fire. Then a knife is used to smoothen the inside of the vessel. For the dugout to meet the needs to ply on the ocean waters, the dugout canoes were fitted with riggers (one or two smaller logs) were mounted parallel to the main hull by long poles.

2.2.3.2 Dugout canoe in Europe

Like anywhere, a dugout canoe in Europe took the earliest position. The Pesse canoe is the oldest dugout canoe known in the whole world.it was made in Netherlands in Europe. In ancient Europe monoxylon were made from linden wood for several reasons (Freeencychlopaedia, 2023). Linden is a popular wood for construction (Palanski, 2022)

a) The Linden trees were excessively readily available.
b) Linden grew to be of the tallest trees at that time in the forest creating ease in building longer boats.
c) Linden wood accept carving without splitting or cracking.
d) Boats made of Linden wood have better cargo carrying capacities because Linden wood is lighter in weight than most of the trees in Europe.

Pesse canoe was constructed between 8040 BCE and 7510 BCE.

2.2.3.3 Dugout canoe in Africa

The dugout canoe in Africa came slightly later. Dufuna canoe in Nigeria was the oldest boat in Africa. It was an 8000-year- old dugout canoe which by varying accounts, the second oldest in the world (Okoro, 2023). Dugout canoes were used for transport, fishing, and hunting of hippopotamus (Things-Nigeria, 2018).

Figure 8: Dufuna canoe Nigeria Source: Things Nigeria

2.2.3.4 Fastenings used for building boats by Homo rectus

Homo erectus built reed boats by using primitive fastening techniques based on the natural resources in their environment. Here are some possible methods of fastening that they used:

First, plant fibers and vines:

Twisted plant fibers or vines have been a natural resource for binding reeds together. These materials acted like ropes, holding the boat structure securely.

Reeds could be bundled together and lashed tightly with strips of plant fiber to form a floating platform or boat hull.

They may have used sinew (animal tendon) or leather straps obtained hunted animals.

Second, interweaving of reeds:

Interweaving the reeds themselves might have been one of the methods to fasten them. This technique could have involved arranging the reeds in alternating patterns, creating a tight bond between them.

The natural flexibility of reeds would allow them to be bent and woven together, helping to create a more stable structure without the need for advanced tools.

Third, binding with bark strips:

Strips of tree bark, particularly from trees like willow that produce flexible bark, could have been used to wrap and secure the bundles of reeds together. Bark is strong and durable when wet, so it might have provided additional support to prevent the reeds from coming apart in water.

Fourth, using wood pegs

In some cases, small wooden pegs could have been inserted through the reed bundles to hold them in place. This method might not have been as secure as fiber bindings but could have provided additional stability.

These techniques reflected the basic survival skills of Homo erectus, relying on easily available natural resources and simple methods to create practical solutions for transportation. Their cognitive abilities, while not as advanced as modern humans, were likely sufficient to construct basic watercraft like reed boats using such methods.

2.2.3.5 Tools used during pre-historic period

Homo erectus, one of the earliest human ancestors, is thought to have used relatively simple tools out of stones (George, 2020), that included

Hand axes (Acheulean tools) made from stone was the most characteristic tool of Homo erectus. It was multi-functional, used for cutting, chopping, and scraping

Choppers were crude stone tools used for chopping or breaking materials, possibly useful in constructing boats by cutting and preparing reeds or branches.

Scrapers were used for cleaning hides or scraping wood, these tools may have helped prepare wooden surfaces for building boats.

2.2.4 Egyptian operational period

The Egyptians were among the active participants in the development of boat building technology in the world. They constructed boats using papyrus reeds and planks obtained from tree trunks.

2.2.4.1 Papyrus reeds boats

The Egyptians did not build roads to travel around their empire. Nature had already built them a superhighway called Nile River right through the middle of their empire.
Most of the major cities in Ancient Egypt were located along the banks of the Nile River. As a result, the Egyptians used the Nile for transportation and became experts at building boats and navigating the river

Figure 9: Egypt Tomb Oar boat ***source: https://www.bing.com***

Early Egyptians learned to make small boats out of the papyrus plant. They were easy to construct and worked well for fishing and short trips. Most of the papyrus boats were small and were steered with oars and poles.

The earliest boats on the Nile River were constructed of bundles of papyrus reeds (Migaki, 2019). While the earliest use of papyrus reed boats in Egypt is unknown, it is possible that they began being used around the 4th millennium BCE (Angelucci & Cucari,1975, p.18) as cited in (Migaki, 2019). Reed boats were produced from bundles of naturally water proof papyrus reeds tied together using ropes. Reed boats were made by Egyptians for various kinds of activities and of different shapes depending on the purpose to which it was made. They were used for fishing, navigation, hunting, carrying livestock, crops, war, funeral procession and many more along the Nile. Even after introducing wooden planks vessel, long reed rafts of about ten meters and above were still in existence. These boats were produced without any written plans as guide to construction works. The producers kept the plans in their heads.

Figure 10: Egyptian papyrus reeds boat   Source: https://www.bing.com

The benefit of using papyrus reed were that: They were readily available, inexpensive, needed little technical skills to work on and the thick reeds provided good buoyancy. However, the shortcomings of the papyrus reed boats were found to be less durable and could loose shape as they become water logged.

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2.2.4 .2 Building of boats using planks

When development was on the rise, the need to carry bigger loads emerged. The dugout canoes and reed boats were insufficient. New idea of using wood planks came into existence. Building boats out of planks indicated that bigger canoes than hollowing a tree trunk would solve the problem. Plank canoe is believed to have been developed in Southern California 8500 years ago (ScienceNews, 2014).

In Africa, by 3,000 B.C Egyptians had known how to assemble boat hulls using planks. They used woven straps to tie the boards together and stuffed reeds or grass between the boards to seal the seams. One example of their technology is the Khufu, a 143-foot (44 m) long ship buried at the foot of the Great Pyramid of Giza around 2500 BC and found intact in 1954 (ScienceNews, 2014). These developments of construction of boats were done without proper drawing of plans to guide the constructions.

2.2.4.2.1 Shell-first

Shell-first Construction is a method of construction in which the hull is formed without a frame. Strakes either overlap, fastened to one another by clenched nails as in clinker boat construction (Juan-Pablo, 2015)

The shell-first technique comprises the construction of the “shell “of the boat first, thereafter laying in the frames. This approach is still common up to today with the traditional beach boat builders. There are no plans set for boat building. Lofting is not necessary.

2.2.4.2.2 Frame -first

This is where the internal framing is built first and planking takes place on the framework. This enables stronger and bigger vessels to be constructed (Royal-Museums-Greenwich, n.d.). Frame-first involves the wooden and metallic boats construction. Although frame-first boat construction method has taken greater part in the modern boat building technology, some few traditional boat builders are still practicing building boats using this method. The traditionally constructed boats may have the sketch plan but the sketches are not drawn to scale and there is no table of offsets for the storage of data required in drawing of the plan (figure 11).

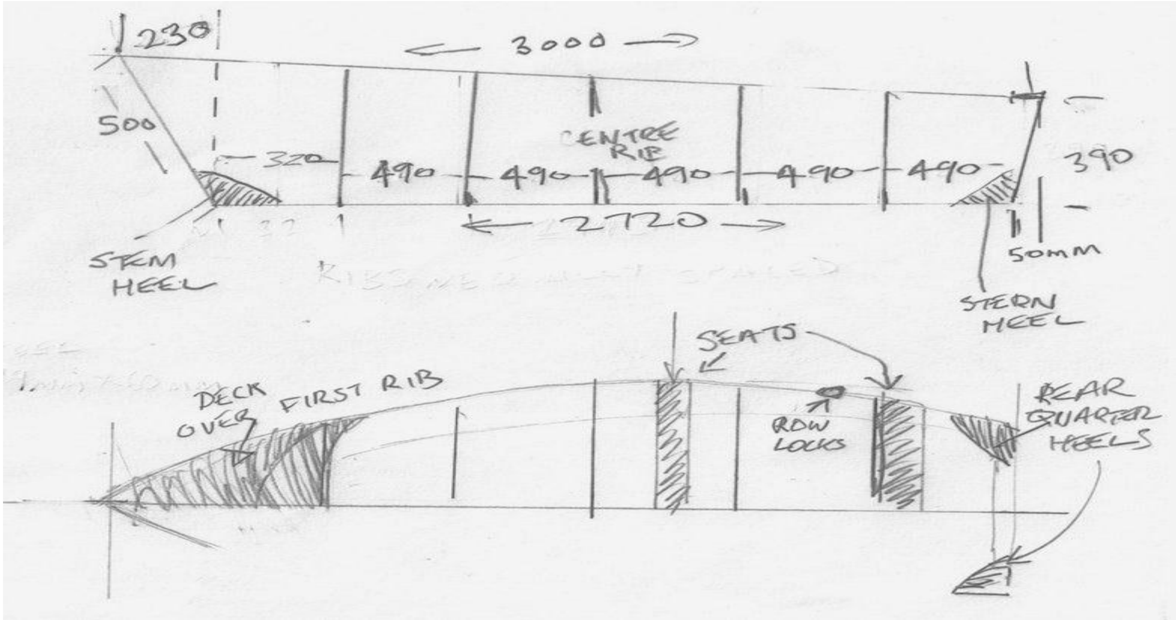


Figure 11: Plan of a boat drawn using hand tools.
Source: https://content.instructables.com

Figure 12: Frames and other structural members before planking

Source: https://content.instructables.com

The Egyptians used this method to build bigger vessels including ships with sails using wood. The frames are majorly useful for strengthening the vessel and provide for the measurements of the width of the vessel.

2.2.4.3 Materials used during Egyptian period (Millmore, 2018)

Papyrus reeds: Bundled together and tightly bound to form the boat's hull.

Ropes and fibers: Made from **flax** or other plants, used to tie and bind the reeds together.

Pitch or resin: Sometimes used to seal the boat and make it more watertight.

Wood: Timber was mainly imported, as Egypt had little suitable wood for boat-building. **Cedar wood** from Lebanon was prized for its strength and durability. Other woods included **acacia**, **sycamore**, and **tamarisk**.

Mortise and tenon joints: Wooden planks were fitted together using these joints to create a sturdy structure.

Rope lashings: Ropes, likely made from **hemp** or **flax**, were used to lash planks together.

2.2.4.4 Tools used for building papyrus reeds and plank boats by Egyptians (Millmore, 2018)

Flint knives were used to cut papyrus reeds. Flint blades were sharp and commonly used by the Egyptians for various cutting purposes.

Stone hammers were used to shape or crush reeds, or for basic hammering.

Cordage (ropes) made from plant fibers, ropes were used to bind the bundles of papyrus reeds tightly together to form the hull and frame of the boat.

Needles and awls (sharp-pointed tools) were used to make holes in the reeds, and needles helped in sewing them together with fiber cords to keep the bundles secure.

Adzes were the most important woodworking tools. An adze is a tool with a curved blade, used for smoothing or carving wood. Ancient Egyptian depictions often show workers using adzes to shape wooden planks for boats.

Bronze saws; as metal tools became more common, Egyptians used bronze saws to cut planks of wood. Bronze was more durable and efficient compared to earlier stone tools.

Mallets and chisels were used for detailed carving and fitting wooden parts together, especially for creating mortise and tenon joints, where one plank fits into another.

Bow drills were used to create holes in the wooden planks for pegs and dowels. These drills were powered manually by twisting a bowstring around the drill shaft.

Ropes, often made from papyrus or flax, were used to bind the planks together. Wooden pegs were inserted into holes to strengthen the joints.

Spatulas or fingers were used as Caulking tools to waterproof the boats, they used reeds, grass, and sometimes bitumen to fill gaps between the planks.

2.2.5 Premodern period (1600 – 1982)

During the prehistoric and the ancient periods, technological advancement was based on artistic work based on painting. As time went on clear geometry was born in between 1400AD – 1600AD. **Leonardo da Vinci** (1452-1519) is known for being the creator of "technical drawing". Leonardo da Vinci is considered of being the first graphic artists and designer draftsman due to his ability to combine his scientific interest with artistic talent as design innovation (Ipek, 2021). As technical drawing development continues, an Architect, **Rafaello Sanzio (1483-1520)** was able to convert the two-dimensional drawing to three-dimensional drawing with isometric projection method, which the brain interprets on paper. Technical drawing knowledge steadily developed in the population, but the driving force that promoted technical drawing as a discipline and a common language was the "Industrial Revolution" (1760-1850). During this period, many technological break throughs were achieved. Industrial advances in machinery and automatic tools have created a growing need for mor understandable and accurate technical drawing. Designers felt need to explain accurately to the manufacturers their mechanical elements of the increasingly complex machine systems. Drawings began graphically using the established rules and methods (conventions), a type of sketch came into existence that interested the industry.

2.2.5.1 Manual graphics in drawing plans of boats

The introduction of technical drawing into the boat building industry, brought the use of scale drawing, isometric and orthographic projections which changed the artistic nature of the drawing to scientific base (Bathgateacademy, 2020). The tools used for drawings were basically hand tools such as ruler, set squares, pairs of compasses, and pencils. These tools were used solely as hand drawing tools until 1982 when computer aided design (CAD) software was developed. Drawings of plans of boats were produced to scale but using hand tools.

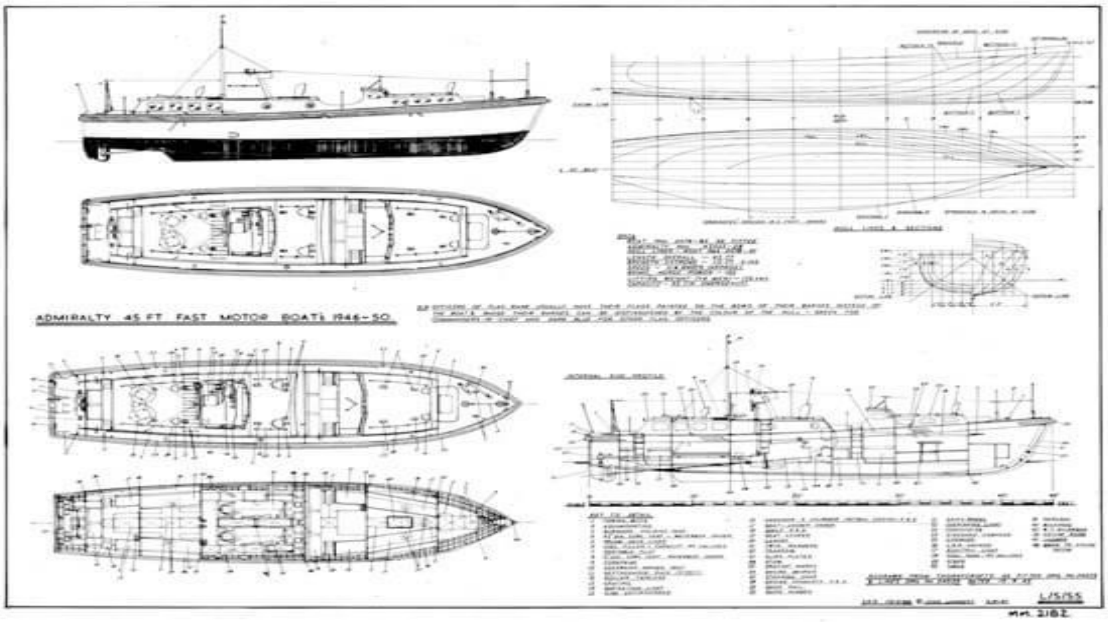


Figure 13: Plan of a ship drawn using hand tools; adapted from (sarikhobbies, n.d.)

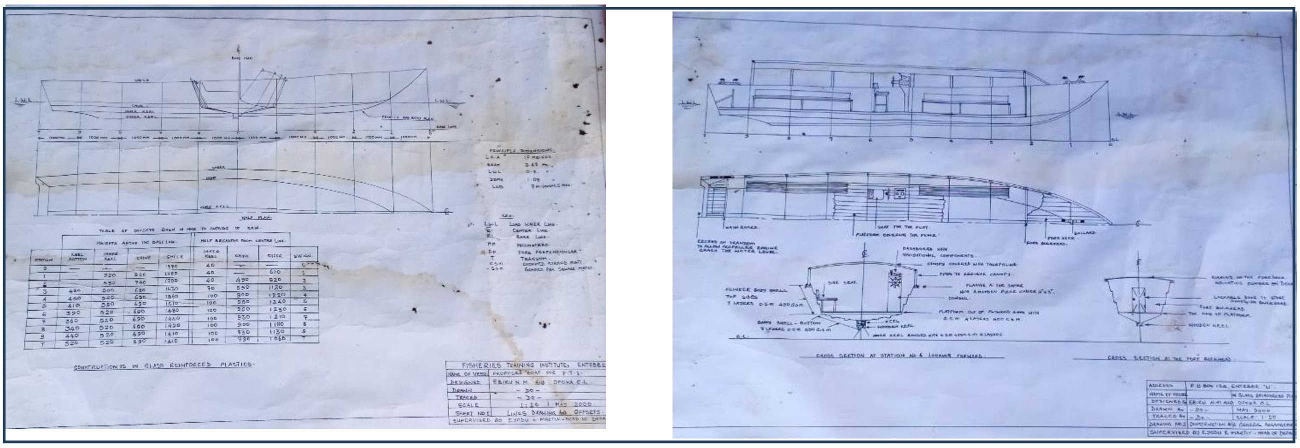


Figure 14: Boat plan taken from Fisheries Training Institute boatyard store

2.2.5.2 Materials for boat construction

During this period boat builders explored a number of materials in boat construction, despite the plans and navigational chart reading were done by using the simple geometrical hand tools. The materials used included; Wood in forms of timbers, metals, plastic and fiberglass.

Figure 15: Aluminum boat ***Source: In the bite.com***

Figure 16: Fiber glass boat ***Source: Fisheries Training Institute's album***

2.2.5.3 Design tools used for boat construction during the premodern period

The design and construction of boats evolved significantly before and after the Industrial Revolution, driven largely by advances in technology, materials, and engineering. Here’s a comparison of the tools used in boat design during these two periods:

2.2.5.3.1 Drafting tools before the Industrial Revolution

First, manual drafting tools such as drawing boards, compasses, and rulers were employed. Ship and boatbuilders relied on manual drafting tools to create plans by hand. Naval architects would create basic drawings for hulls, masts, and other components. Full-scale templates and molds were used to transfer hand-drawn designs to the timber used in construction.

Second, empirical knowledge and tradition where boat design was often passed down from master shipwrights to apprentices. Boatbuilders relied heavily on experience and tradition rather than formal scientific principles. Designs were tested and modified based on performance at sea and tat was trial and error.

Third, in selecting materials, wood was the primary material, and selecting the right wood (like oak, pine, or teak) was critical. The shape and properties of the timber often dictated aspects of the design. Hand tools such as axes, adzes, saws, and chisels were used for shaping wood. Boat building was done without scientific understanding. Boat design was more about tradition and less about scientific calculations. Buoyancy, resistance, and other engineering principles were understood informally, not mathematically.

2.2.5.3.2 Drafting tools after industrial revolution

First, Engineering and scientific principles were introduced. The field of naval architecture became formalized with the advent of engineering disciplines. Tools like the hydrodynamic equation, stress analysis, and buoyancy calculations became central to design. Designers began using precise mathematical models (prototypes) to predict a boat's performance in terms of stability, hull resistance, and propulsion.

Second came industrial machinery and tools. Steam-powered tools such as steam engines and steam bending allowed for larger and more precise cutting, shaping, and construction machinery, improving the efficiency of building hulls and fitting out boats. Shipyards introduced industrial equipment. Large shipyards employed heavy-duty cranes, hydraulic presses, and assembly lines for more rapid and accurate boat construction. Precision measuring tools such as calipers, micrometers, and other precision instruments became commonplace in shipyards, improving accuracy in design and construction.

Third, there was improvement in drafting tools. Blueprints and technical drawings were strictly adhered to. As industrialization progressed, detailed blueprints became the norm. Drafting tools like parallel rulers, set squares, and protractors were used with much greater precision than pre-industrial methods. More sophisticated physical models and later hydrodynamic testing facilities, like wave tanks, were used to test designs before full-scale construction.

Fourth, new materials were introduced. After the industrial revolution, steel and iron replaced wood as the primary materials for hulls. These materials allowed for larger and stronger ships. These new materials brought about the need for metalworking tools and techniques like riveting and welding, which required specialized industrial equipment. Another new material included was fibre glass reinforce plastic (FRP).

2.2.6 Modern Period (Computer period)

Modern advancement in technology has paved ways to many recent innovations in a number of fields. In every single feature of life, the development in technology has facilitated man to pave way forward. The construction of vessels and the facilitating technology has made full thrust progress. From better construction techniques, fueled by 3D printing, modern robotics, virtual reality and artificial intelligence, keeping environmental regulations and sustainability in view, modern vessel building and the whole maritime industry is in for a transformation with continuous research and development (Global-University, 2022) the author outlined the major innovative technologies that have hands in the transformation of modern vessel building as follow:

2.2.6.1 Electric propulsion technology- the power of future

Integrated electric propulsion technology is a power technology wherein gas turbines generate three-phase electricity to run electric motors which turn propellers or water jets. The system uses electric transmission rather than mechanical transmission which eliminates the need for clutches and reduces the use of gearboxes.

Some of the benefits of using this technology are freedom of placement of engine, less noisy vessels, reduction in weight, and volume. Reducing noise is especially important to naval vessels wanting to avoid detection and for cruise vessels seeking to gift passengers with a pleasing voyage, but is of less benefit to cargo vessels.

New technology is changing the scenario of ship building and marine engineering slowly and we are witnessing the advent of cleaner, faster and smarter vessels.

2.2.6.2 Intelligence of vessel building robotics

Robots have for sometimes been evolving as helper of mankind now for sometimes. The use of robotics in vessel building has facilitated workers to move out of heavy-duty activities. Heavy effort work like lifting and moving heavy machinery has been shifted to use of robots. Work of expertise like welding and assembling also can be done by robots. With the extensive use of robotics in vessel building and technology like sensor systems and Artificial Intelligence has developed in complexity. The vessel building industry is gradually customizing automation tech to optimize its use for vessel yards. the overall advancement of worldwide robotics technology is additionally resulting in design and interface improvements so that automated systems can be safely operated with little to no expertise, further encouraging the spread of robots to vessel yards of varied sizes and levels. Research is additionally pushing for smaller, smarter robots which will make human workers' jobs easier and safer by accessing hazardous, hard-to-reach areas.

2.2.6.3 Solar and wind power for ships

In a drastically changing world where energy sources are rapidly exhausting, switching to renewable energy has been humanity's main motto. Like many fields of life, renewable energy can transform the way vessel fleet is done at many levels and in varying magnitudes, including international and domestic transport; people and services; fishing; tourism, and other maritime pursuits. Renewable power applications in vessels of all sizes include options for primary, hybrid, and auxiliary propulsion, also as onboard and shore-side energy use. The transition to a clean energy shipping sector requires a big shift from fossil fuel-powered transport to energy-efficient designs and renewable energy technologies like solar and wind-powered vessels. Solar or wind-powered ships are not commercially produced today but can't be ruled out of future use with more technical advancements. The challenge for system designers is to develop an answer for ships that will tap into the facility of the wind and sun – yet be cost-effective and safe for the crew or vessel.

2.2.6.4 Bucky paper – the featherweight material

Bucky paper is a thin sheet created from an arrangement of carbon nanotubes (CNT). Each CNT is 50,000 thinner than the human air. Comparing with the standard material such as steel, bucky paper is 1/10th the load of steel but potentially 500 times stronger in strength and a couple of times harder than diamond when its sheets are compiled to create a composite. When its sheets are stacked together, the resulting material, similar to the carbon of a type writer, is 10 times lighter as compared to steel, though 250 times powerful. Different from conventional composites, it conducts electricity like silicon and scatters heat like steel. due to this structure, the capacity of carrying current is extremely high. It also has exceptional low optical reflectivity and thermal conductivity. This material also has safety qualities that make it a useful product for vessel building because it is fire and warmth resistant. Tests have shown that covering structures with a skinny layer of bucky paper significantly improves its fire resistance, which is thanks to the efficient reflection of warmth by the dense, compact layers of carbon nanotubes. The vessel built from this featherweight material would require less fuel, hence increasing energy efficiency of the vessel. it's corrosion-resistant and flame retardant which could prevent fire on vessels. Research has already been initiated for the utilization of bucky paper as a construction material of a future airplane. So, an identical trend can't be ruled call at the case of vessel constructions.

2.2.6.5 Introduction of computer aided design (CAD) in drawing

Computer aided design software especially AutoCAD software has simplified drawing of boat plans'

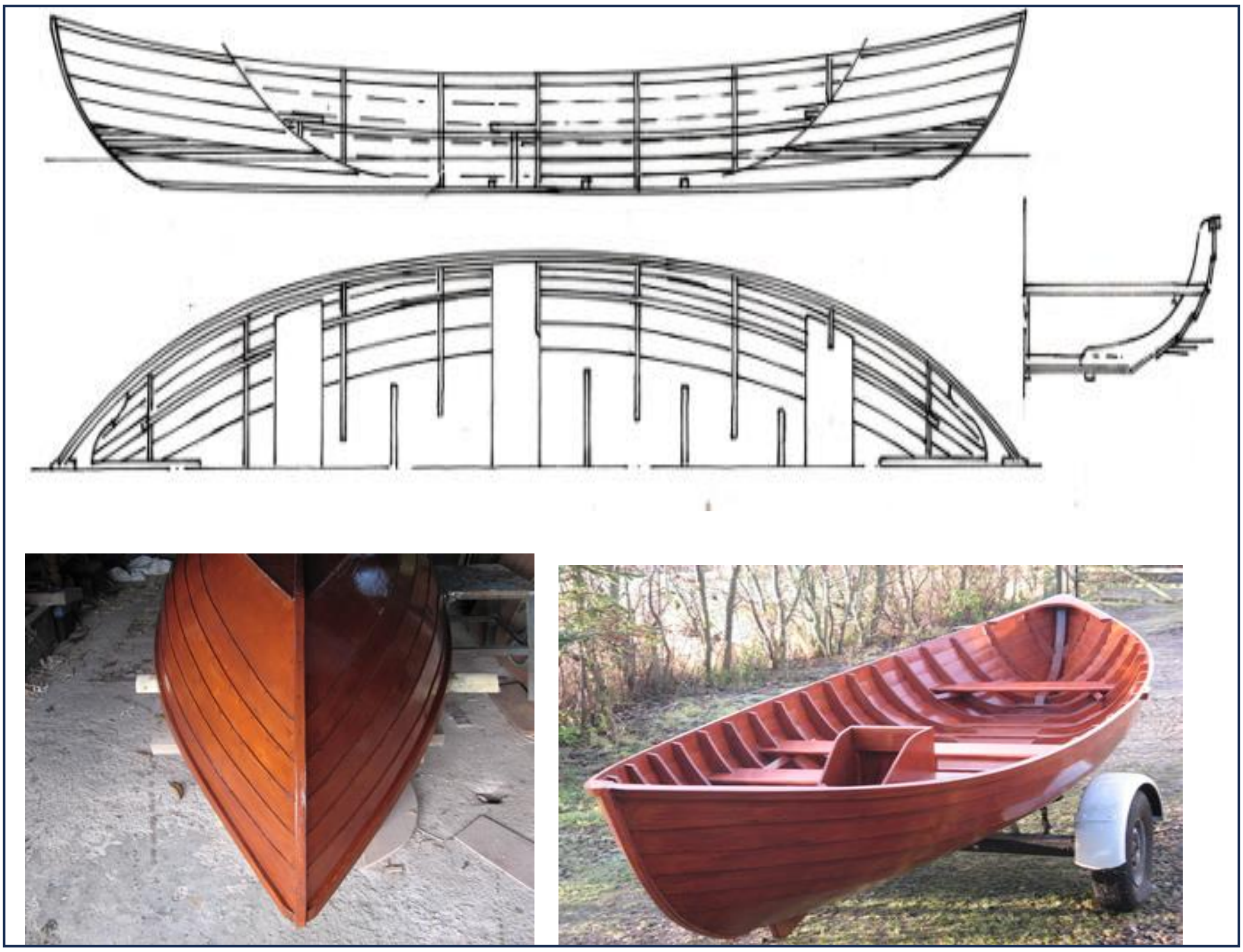


Figure 17: Plan of a clinker boat drawn using AutoCAD and boats produced from the plan

Source: https://www.bing.com.

2.2.6.6 Design tools during the modern period

The design tools in the modern era are the computer-Aided Design (CAD) tools.

First of all, by the mid-20th century, computer-aided design began to emerge, allowing for digital blueprints, 3D models, and simulations of boat performance.

Secondly, Computational Fluid Dynamics (CFD) software allowed designers to simulate water flow around the hull, optimizing designs for speed, fuel efficiency, and stability.

2.3 AutoCAD software and its relevance

"An investment in knowledge pays the best interest" (Franklin, 2022). Benjamin Franklin further stated, "Tell me and I forget, teach me and I may remember, involve me and I learn." For him he believes that; when those who seek knowledge today join hands and contribute in debate, produce new skills, write about their experiences or thoughts, conduct an experiment to see for themselves, watch a performance or compose one of their own, they are being involved. When they are involved, their learning is more enriched and far more memorable. Learning by doing is a method of learning in which a learner makes sense of his own experience, more in particular the experiences that he/she actively participates in producing products and exploring the world (Bloch, 2002). (Rogers, 2010) Supported the argument by saying, "learning-by-doing is a well-established pedagogical tool that promotes understanding of skills. This implies that drawing plans of boats using AutoCAD is a hands-on skills development approach. It calls for all learners' participation during the teaching and learning of drawings. Regular attendance by both the learners and facilitators is paramount.

AutoCAD is a commercial software applicable for 2D and 3D computer aided design and drafting used since 1982 as a desktop application; since 2010 as a mobile web and cloud-based App marketed as AutoCAD 360. AutoCAD was developed and sold by Autodesk, Inc. it was first released in December 1982, running on microcomputers with internal graphics (Hasan, 2014). AutoCAD is used across a wide range of industries, by architects, project managers, and other professionals. With innovative ideas or creative imaginations, the user of AutoCAD can create realistic presentations with AutoCAD because it provides the necessary tools and work flow to design and create great products. Auto CAD software is used to draw, design drawings, even analyze a design to realize a commercially viable product. This program is convenient to make images visually, accurately and precisely through an attractive image display (Saputno, 2020).

Before the invention of CAD programs, manual hands drafting tools like drafting boards and pencils, parallel rulers, pair of compasses, and triangles were the only options for designers to create 2D designs. Fortunately, AutoCAD was released in 1982, and since then, it has quickly become the most widely used CAD application because of its automated set of tools and features. It was a significant advantage in the AutoCAD stream. AutoCAD features include the capability to command the visual aspects of texts, design dimension styles automatically, add lighting and materials to the 3D models, and control the shading and edges of the 3D models. These features help the users to achieve realistic renders and appearances (Educba, 2023).

Professionals across many industries use AutoCAD to do everything from designing and creating different buildings, constructions, and infrastructure. AutoCAD enables companies to design and plan projects virtually. AutoCAD supports a powerful yet easier workflow that works correctly and helps users to execute commands effectively and precisely.

2.4 Theoretical support

The theories reflected and adopted for this study were social constructivism and experiential learning:

2.4.1 Social constructivism

Social constructivism emphasizes the importance of culture and context in understanding what occurs in society and constructing knowledge based on this understanding (Derry, 1999; McMahon, 1999) as cited in (Kim, 2012)

This study adopts Lev Vygotsky theory of social constructivism which states, "Cognitive development is a socially mediated process in which children acquire cultural values, beliefs, and problem-solving strategies through collaborative dialogues with more knowledgeable members of society" (MCleod, 2024). The relevance of this theory to the study is that competence development in classroom by trainees is not done in isolation. Trainees learn in groups and at least with someone who is more knowledgeable than the other; can be a trainer or a fellow learner. This theory helps to know importance of social influence in carrying out learning as a group or class members.

According to Vygotsky (1978), much important learning by the child occurs through social interaction with a skillful tutor. The tutor may model behaviors and / or provide verbal instructions for the child. Vygotsky refers to this as cooperative or collaborative dialogue.

Vygotsky derived five key points from his theory which include:

The concept of the Zone of Proximal Development (ZPD), which refers to the difference between what a learner can do without assistance and what they can achieve with guidance and support from a more knowledgeable individual. This zone highlights the importance of social interaction and collaboration in learning.

Scaffolding refers to the support within ZPD provided by more knowledgeable individuals, such as teachers, peers, or parents, to help learners reach higher levels of understanding or skill. Scaffolding as stated, can take various forms, including explanations, modeling, prompts, and feedback.

The role of cultural tools and artifacts, such as language, symbols, and technology, in shaping cognitive processes and mediating learning. These tools are seen as essential for communication, problem-solving, and the transmission of cultural knowledge.

Learning is inherently social and occurs through interactions with others. Through dialogue, collaboration, and cooperation, individuals construct meaning, develop language, and internalize cultural norms and values.

Through social interaction, individuals internalize external knowledge and skills, transforming them into internal mental structures and processes. This process of internalization is crucial for the development of higher mental functions, such as abstract thinking, problem-solving, and self-regulation.

In summary, Vygotsky's social constructivism views learning as a collaborative process, where knowledge is actively constructed through interaction with others, cultural tools, and the social environment.

John Dewey as one of the proponents of social constructivism stated that “education is not an affair of telling and being told, but an active and constructive process” (Kapur R. , 2018) Information, ideas and knowledge received from the other persons are modified and evaluated rather than just being absorbed in the present form. In this way, Dewey was meaning that knowledge is constructed by learners through cooperation and collaboration.

According to (Radhika, 2018) theory of social constructivism which states: “individuals actively construct their understanding of the world and reality through interaction with others and their environment.” Dr. Radhika Kapur’s theory of social constructivism emphasizes the importance of social interaction in the process of learning and knowledge construction. The theory suggests that is a social process that occurs though collaboration, dialogue, and negotiation of meanings within social contexts.

Key concepts of social constructivism include:

Constructing meaning: Learners actively construct their own understanding of concepts and ideas based on their interactions with others. Meaning is not passively received but actively created through engagement with others and the environment.

2.4.2 Experiential learning

Dewey (1976) asserts that individuals learn best through hands-on experiences. It is crucial for students to engage with their environment to become accustomed to it and learn effectively.

Kolb (2014) asserts that experiential learning involves students actively engaging in learning opportunities through hands-on experience and reflecting on those experiences, enabling them to connect their academic knowledge to real-world situations both inside and outside the classroom. According to Kolb, successful learning occurs when individuals progress through four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. In the concrete experience stage, learners encounter a tangible skill, which enhances their understanding of new concepts or existing knowledge. During reflective observation, learners reflect on their new understanding in light of their existing knowledge base. Or consider the experience from various perspectives, analyze the events, and note any discrepancies between what was expected and what occurred. At abstract conceptualization, the learner forms new ideas or modifies existing concepts based on their reflection. Theories and concepts are developed to explain what was observed and to generalize the learning for future situations. And during active experimentation, the learner applies the new ideas or theories in a practical context. They actively experiment with the new concepts to see if they can produce the desired outcome, leading to new concrete experiences that begin the cycle again.

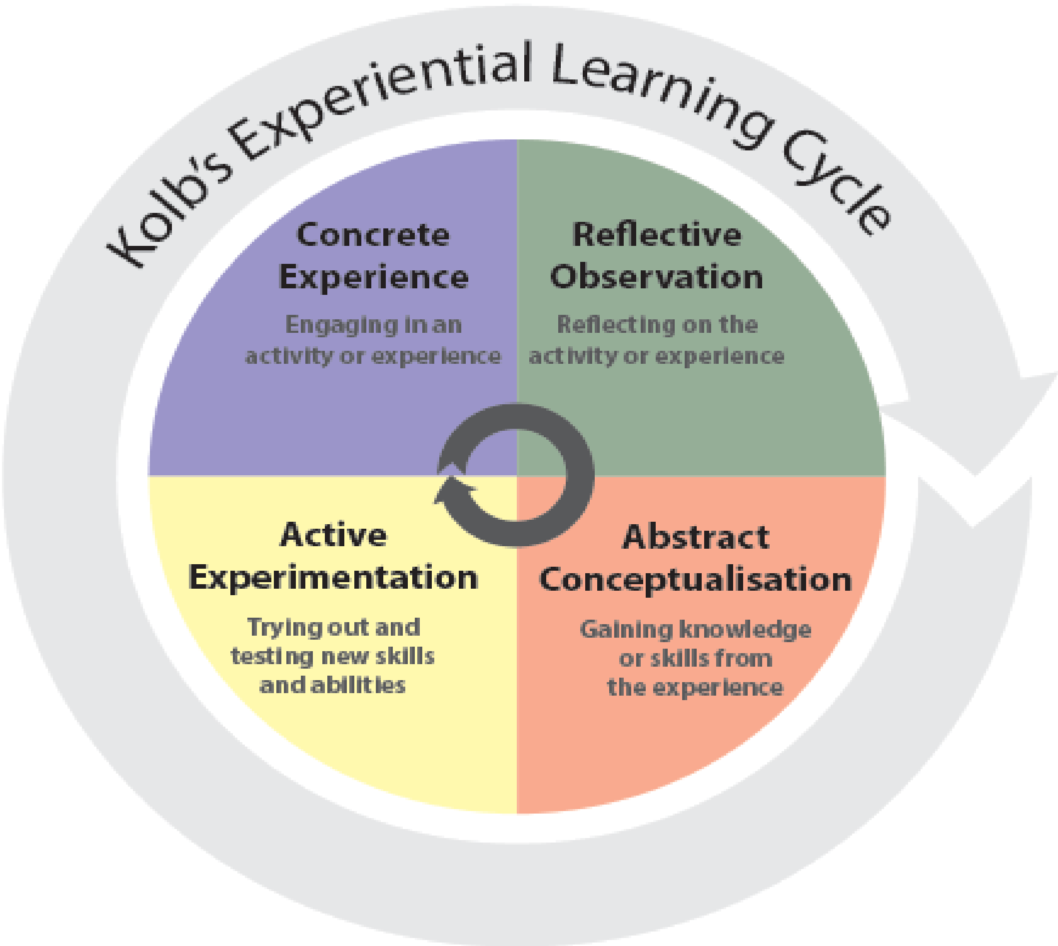


Figure 18: Kolb's experiential learning theory   Source: https://www.bing.com/images

2.5 Gaps hindering competence development in boatbuilding and marine mechanics at Fisheries Training Institute

According to (Macmillandictionary, 2017), a gap or challenge is something that needs a lot of skills. energy and determination to deal with. But in the context of the study, gap is that which hinders the enhancement of competence in the design and drawing plans of boats.

2.5.1 Unfamiliarity of boat building Lecturers with modern design tools

TVET is an important path for vocational skills developmental in the learners. The unavailability of the textbooks for referrals makes it hard and difficult for vocational teachers to find the direction of teaching using modern tools to deliver information to learners, when they lack proper knowledge of, example AutoCAD software (Zuraifah Safiee, 2019). There are four key factors that have effect on to the level of readiness; which comprise of knowledge, attitude, skills and training. (Kementerian Pendidikan Malysia,2009) the professional competencies that all teachers should fulfill and the useful requirements that should be provided by the training institute to help teachers achieve their level of competencies.

Basing on the two authors, knowledge, attitude and skills are factors required in a teacher for teaching any discipline. Knowledge is required for planning what to teach, executing the real teaching, monitoring the progress of the teaching /learning and making evaluation, assessment of learners' abilities, scoring and award of marks, recording and communicating to the learners as feedback. Attitude helps in building and maintaining relationships with learners, decision making, observing codes of conduct and self-preparation for teaching and learning. Skills are acquired through exposure, hands-on involvement and reaching precision level through actively participating in doing work.

Training comes in to bridge the gap where a teacher may have knowledge and skills of the subject, has positive attitude towards the subject and the learners, but lacks knowledge and skills on how to operate new equipment required to enhance or add more values onto the previously existing knowledge and skills. Therefore, there is need for the institute to consider training of the staff within boat building department to acquire knowledge of operating AutoCAD. A study that had been conducted by Izzati (2013) on the readiness of vocational instructors who implemented the 'School Enterprise' Program in secondary school, found that the success of this program depends on the quality and the preparations made by the instructors from various aspects such as program knowledge, program management skills and attitude to implement the program. If the opposite occurs, then the program fails to execute properly. Teachers not only do need the skills and knowledge in their teaching, but they also need to have a personality that can be proud of, emulated and followed by their students (Zaiha, 2014).

2.5.2 Inadequate resources for teaching and learning

Technical, vocational education and training has undergone transformation basin on contribution from various disciplines including vocational pedagogy. Vocational pedagogy made two great contributions:

First, the central aspect of vocational pedagogy is the understanding of the relationship between learning in school life and learning in work life (Mjelde, 2013). and

Second, the central aspect of vocational pedagogy is an understanding of human learning of “hands, mind and the heart”, in any learning situation.

This implies that in any learning situation, if we need the learner to practice using hands, use the mind in organizing the learning processes and the heart to like the learning activities, resources such as tools and materials are the key factors in facilitating that learning that must be available. Whether learning at the school, or learning at the work place; all require tools and materials. Learning at school should relate to the activities that take place at the world of work. That is knowing how to use tools and equipment to convert materials into products, which tool is required on which material in order to produce a particular product. Adequate tools and materials are vital in preparing students to fill an expanding 21st century workforce but inadequacy of tools and materials may leave gaps in students’ ability in becoming proficient in production within their field of work (OP mcCubbins, 2016). Plain teaching without hands-on exercises is wrong.

2.5.3 Lack of information and communication technology (ICT) in the department

Kiptalam et.al (2010) noted that, ICT will always progress in the European and Asian countries, while Africa will continue to lag behind in the utilization of ICT. He added that technology is used to make learning simple thus it is of value for educators to be flexible or comfortable when using the technology to make learners attain the full merit of the lesson. As observed by (Hoimner, 2015), the years 1990s and early 2000s progress was focused on information and communication technology and researches were centered on overcoming digital divide by increasing connectivity to eliminate access barriers by as many African population as possible. This was able to provide linkage to the other parts of the world and fully provided access to communications. Basing onto the above statement, the researcher wishes to state that as a TVET learning institution, lecturers were meant to possess enough skills to command AutoCAD software during teaching and learning in boat building department. But unfortunately, this is no true. ICTs in TVET schools and institutions are used for teaching learners how to use computers for typing, saving typed work, retrieving the saved work and exposing learners to internet for research purposes; but not to transform learning activities in classroom situations. Taking the case of FTI as a TVET institution, the computer laboratory is used for teaching ICT and provision of internet for students to surf. Learning in the classrooms is still based on traditional approaches of chalk and talk with the aid of a chalk board, lecture method, demonstration, field trip and project methods without involving the use of ICT in procession. (Ponelis, 2015) Disclosed that it is important to foster digital chances and ensuring social inclusion by encouraging the use of ICT for the provision of capacity building, empowerment and collective social participation for enhancing scientific research, sharing information, cultural creativity, performances, knowledge and to foster learning through access to diversified contents, delivery techniques and to strengthen the transformation to knowledge societies. This means the individual differences, social and multicultural differences that exist in TVET institutions can be overcome easily through the correct use of ICT in schools and institutions. It therefore calls for intensive use of ICT while training learners at the institutional and University levels so that the graduates are discharged into the community when they are flexible in the command of learning activities using ICTs and AutoCAD software. If this is not adequately done, ICT can be adopted for teaching and learning but since TVET institution is a multicultural institution, cybercrime will dominate the classroom learning activities and the right content to be learnt will shift to learning abusive words to disorganize teaching and learning.

2.5.4 Storing and preserving of drawings produced by traditional hand tools for future use is difficult.

Storing drawings made on sizeA3, A2, A1 and A0 papers produced by traditional hand tools requires careful consideration to preserve their quality and integrity over time. (Hatch, 2021) identified some steps to be taken to ensure proper storage:

First**,** before handling the drawings, make sure your hands are clean to avoid transferring dirt or oils onto the paper.

Second**,** lay the drawings flat to prevent creasing or warping. Avoid rolling them up, as this can cause permanent damage to the paper fibers.

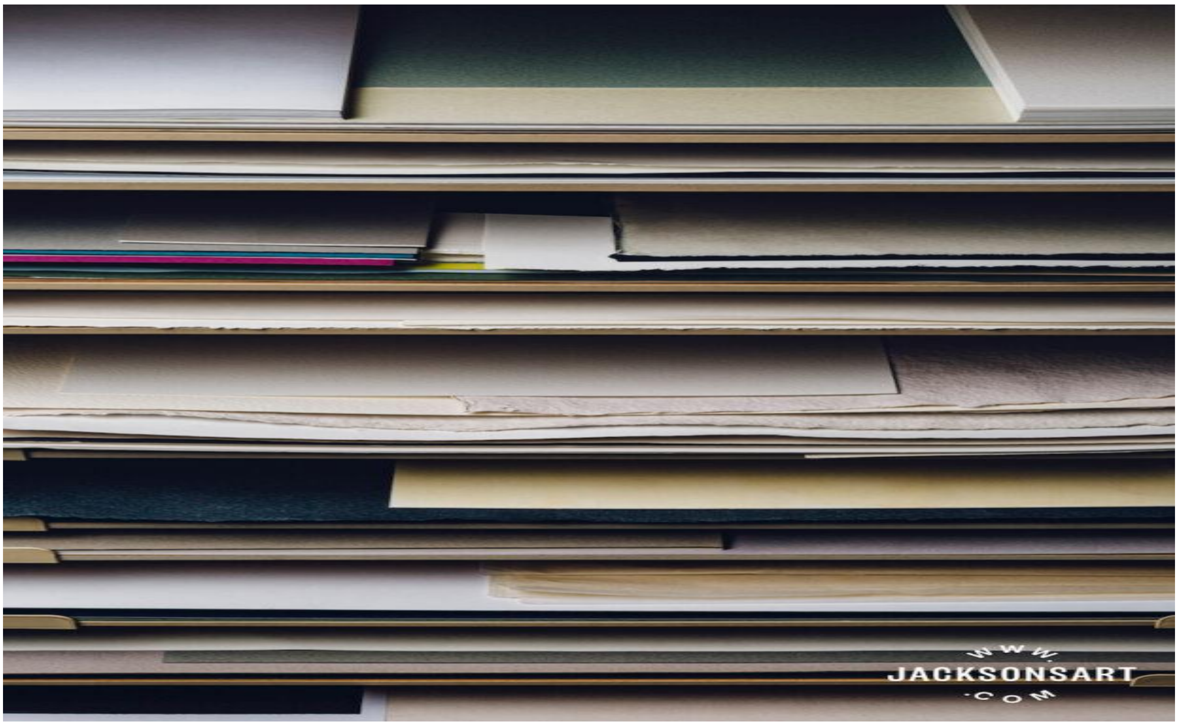


Figure 19: Storage of papers containing drawings Source https://www.bing.com/image

Third, store the drawings in acid-free folders, envelopes, or portfolios. Acidic materials can cause the paper to deteriorate over time.

Fourth**,** keep the drawings away from direct sunlight and fluorescent lighting, as UV rays can fade the ink or pigments used in the drawings.

Fifth**,** maintain a stable environment with moderate temperature and humidity levels to prevent mold growth, foxing (brown spots), or warping of the paper. Ideal conditions are around 68-72°F (20-22°C) and 40-50% relative humidity.

Sixth, keep the drawings away from sources of heat, moisture, or excessive dryness, as these can cause irreversible damage to the paper and pigments.

Seventh, place acid-free tissue paper between individual drawings to prevent ink transfer or sticking.

Eighth, store the drawings in a clean, dry, and well-ventilated area. Avoid areas prone to flooding or high humidity, such as basements or attics.

Nineth, when handling the drawings, support them from underneath to prevent tearing or bending. Use gloves if necessary to avoid direct contact with the paper.

Tenth, periodically check the drawings for any signs of deterioration or damage. If you notice any issues, take appropriate measures to address them promptly.

2.6 To select appropriate strategies and lay procedures, and incorporate identified gaps into the teaching and learning processes of boatbuilding and marine mechanics.

In order to promote competence, the following were selected:

2.6.1 Staff professional development in the use of AutoCAD

AutoCAD skills are in high demand for carriers in drafting, engineering, architecture, and design. these professionals use AutoCAD to convert designs into technical drawing s and blueprints, produce designs and specifications for various items, create floor plans and organize prototype. Frederick Taylor, a scientific manager pointed out four principals of scientific management which should be adopted by managers. Taylor pointed out that to realize effective human efforts in handling institutional activities, the following four principals must be observed: First, develop a science for each element of work. Second, scientifically select, train, teach and develop the worker. Third, cooperate with the worker. And fourth, divide the work and responsibility (Ward, 2021). Staff development in the scientific fields are new is paramount, and motivates the staff members undergoing such training.

2.6.2 Creation of ICT Laboratory

An ICT laboratory is one of the vital requirements when teaching and learning AutoCAD in an institution. Colleges and universities provide students with on-campus computer laboratories which learners can use for course works, research and other learning activities (Cloudswyft, 2023). These laboratories usually house dozens to thousands of computers equipped with different software applications for different intentions. ICT laboratories also provide internets that bring the whole global world to become a global village. As such a student learning or practicing AutoCAD can practice the drawing of components of a vessel that has been viewed through e-learning by the help of internet provision.

2.6.3 AutoCAD software installation

The installation of AutoCAD software was a clear sign that the Institute was preparing to transform its learning skills from the traditional hand tools to the modern software tools used in designing. With AutoCAD, one can produce precise 2D and 3D drawings and models, construction drawings, interior designs and more (Nobledesktop, 2023). AutoCAD enables or permits learners to produce, edit and work together by collaborating across desktop, mobile services and web.

2.6.4 AutoCAD lessons Integrated into the institute curriculum and time tabled

Time table helps administration to plan for time allocated in the curriculum design. Time table also helps teachers to visualize the allocated time for each period and the frequency of time a teacher is required in a particular class (Schooler, 2021). At the classroom level, timetable can be used to allocate time on a daily basis. This enables different subjects per grade level to be studied uniformly, and also preventing time overlapping for the subject teachers.

2.6.5 Stakeholders worked as a team

Teamwork is involving more than a single person in in a process to meet a target or achieve a goal (Raman, 2019). Team work promotes cooperation and better problem-solving approach. Team work enhances personal growth, permits innovations, boosts productivity, permits smarter risk taking and provides for happier employees (Middleton, 2023).

2.7 Evaluating the impact of the incorporated strategy

Strategy evaluation is the process by which the management assesses how well a chosen strategy has been implemented and how successful the strategy is; it embraces reviewing and appraising the strategy implementation processed measuring organizational performance (Athuraliya, 2022). Evaluating the strategy helps improve it, distinguish between what works and what does not, and contribute to the ongoing development and adaptation of the strategy to the changing conditions and complexity in the industry. According to (Chron, 2020) to measure the effectiveness and efficiency in an organization strategy, you have to examine how it links your objectives to the way you plan to achieve them and the means to plan to use.

2.8 Summary of the literature review

Boat building, as an ancient craft, holds immense historical significance, evolving in parallel with human development. From the earliest rafts made of reeds and dugout canoes to advanced plank vessels, boat building was essential for transportation, fishing, and trade across civilizations. Historical examples such as the Pesse canoe of Europe and the Dufuna canoe of Africa underscore its global importance, while ancient Egyptian innovations in papyrus reed boats highlight early technological inventiveness.

Understanding the historical evolution of boat building reveals not only the resourcefulness of ancient cultures but also how maritime technology has developed over time. Each advancement, from simple reed structures to sophisticated plank constructions, demonstrates a response to environmental challenges and societal needs. These progressions laid the groundwork for modern marine engineering, which now integrates advanced materials and tools, such as CAD software and renewable energy sources like solar and wind.

The study leverages this historical knowledge to explore gaps in the integration of traditional techniques with modern technology in today's boat-building education. It aims to identify barriers to skill development, select strategies to bridge these gaps, and incorporate them into teaching and learning practices. The goal is to ensure that students acquire foundational skills rooted in tradition while also embracing modern innovations.

This study is anchored in two key theories: Vygotsky’s Social Constructivism (1978) and Kolb’s Experiential Learning (1984). Social Constructivism emphasizes the importance of collaborative learning, active participation, and contextual learning in cognitive development. In the context of boat-building education, students engage in collaborative group work where they can learn from one another, participate actively in hands-on projects, and connect learning to real-world, culturally relevant situations.

Experiential Learning, as proposed by Dewey and Kolb, suggests that learning is most effective through direct hands-on experience. Kolb's four-stage learning cycle—concrete experience, reflective observation, abstract conceptualization, and active experimentation—is particularly relevant to boat building, where students gain practical skills by actively engaging with the material and reflecting on their experiences.

Together, these theories guide the study's methodology, which seeks to combine historical knowledge with modern teaching strategies. By doing so, it aligns with Vygotsky's emphasis on the cultural context of learning and Kolb's focus on learning through experience. This integrated approach aims to ensure that students gain both traditional craftsmanship and modern technical expertise in boat building.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

Vocational pedagogy and how it can be investigated demands for an understanding of Action research and its components explained in the first paragraph of this chapter. The chapter brings out research design, population targeted, sampling procedure, data collection methods, tools used, data analysis, ethical factors, limitation and delimitations of the action research.

3.1 Action research

Action research involves a systematic inquiry conducted by practitioners within their own context to improve practices, solve problems, or bring about change (education reform, 2015). Michael (2019) emphasized the participatory and collaborative nature of action research. He stressed the importance of involving stakeholders, such as practitioners, community members, or organizational representatives, in the research process. This participatory approach ensures that those affected by the research are actively engaged in defining problems, generating solutions, and implementing changes. He further expressed that action research is reflective practice that encourages the practitioners to carefully examine themselves and actions in order to improve practice. (Habib) in his lecture in NOMA 1 in 2021, identified six characteristics of an action research: First, research initiated to solve immediate problem. Second, it is a reflective process of progressive process of problem solving. Third, action research is led by individual working with others as a team, or as part of the “community of practice” to improve the way they address issues and solve problems. Fourth, it is participatory and action oriented. Fifth, the purpose of action research is to solve a particular problem and to produce guidelines for best practice. And sixth, Action research proceeds in a spiral step composed of a circle of; planning, acting, observing, reflecting and re-planning.

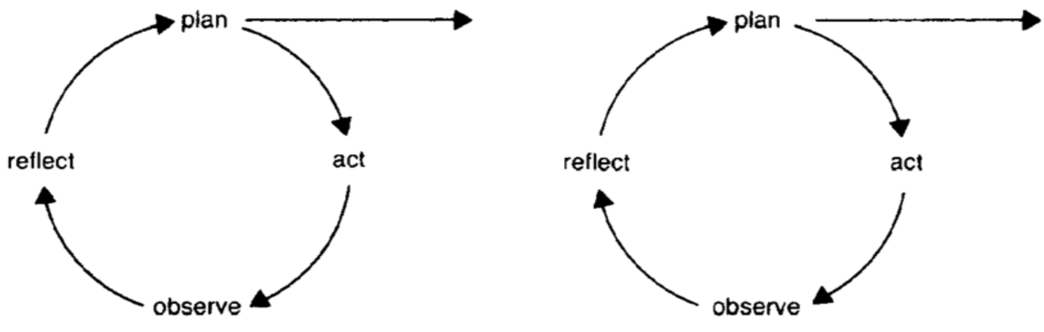


Figure 20: Structure of action – reflection cycles   Source: https://www.bing.com

Planning is the initial phase involves identifying the research question or problem to be addressed. Researchers collaborate with stakeholders to plan interventions or actions aimed at addressing the identified issue. Clear objectives and strategies for implementation are established during this phase.

Acting is the phase in which the planned interventions or actions are executed or implemented within the context. Researchers and practitioners work together to put the strategies into practice. This phase involves actively making changes or carrying out planned activities.

Observing takes place once the interventions are implemented, data is collected through various methods such as observations, interviews, surveys, or any other appropriate means. The focus is on gathering information about the outcomes and effects of the implemented actions.

Reflecting is the phase that involves critically analyzing the data collected during the observation phase. Researchers and practitioners reflect on the results, assess the effectiveness of the interventions, and consider what has been learned through the process. Reflection prompts adjustments, refinements, or changes to the initial plan based on the insights gained.

Re-Planning is based on the reflections and analysis, researchers and stakeholders collaboratively refine or revise the action plan for the subsequent cycle. This could involve modifying strategies, setting new goals, or adjusting the approach based on the lessons learned from the previous cycle.

The cyclic process continues iteratively, with each cycle building upon the insights and outcomes of the preceding one. The cyclic nature of action research enables researchers and practitioners to continually refine their understanding, test interventions, and adapt strategies in a systematic manner, ultimately aiming for meaningful and sustainable improvements within the context being studied.

3.2 Research design

The study embraced Participatory Action Research (PAR) design, which is qualitative research. Participatory Action Research involves collecting the views of stakeholders to create knowledge and basis upon which the researcher in collaboration with the stakeholders created and put into force actionable strategies. The strategies targeted improving competence development in drawing plans of boats. According to (Delve, 2022), participatory action research is the engagement of all relevant parties (community, participants, and those who have interest in what is being researched) in defining research problems, gathering data, analyzing the data collected, and preparing recommendations. The design became suitable because most of the steps required were shared with the stakeholders.

3.3 Study population

The study population comprised of a sample of the stakeholders that were selected for the purpose of this study. They included staff of boatbuilding department (lecturers, assistant lecturers, and artisan), head of ICT department, students of boat building, and the administrators. Administrators were involved in the study because they have better information about boat building and marine mechanics department; and the kind of changes that took place within the department whether positive or negative. Lecturers and the assistant lecturers were the implementers of all planned curricula at the department, which means they have better ideas about the department that can shape the development of the new plan coming up. Head of ICT department was invited to come and shed more light about skilled man power within ICT department and to inform the stakeholders about the kinds of software available in their laboratory. Year two certificate students of boatbuilding were picked because they had already been introduced in ICT lectures for at least two semesters. Diploma students were involved because they had already done several drawings of boat plans using the manual method.

Table 4: Study population

S/N	Stakeholders	Sample size target	Sample size actual	Sampling technique
1	Administrators	03	03	Purposive
2	Head of ICT department	01	01	Purposive
3	Lecturers	02	02	Purposive
3	Assistant Lecturers	03	03	Purposive
5	Artisan	01	01	Purposive
6	Boat building Students	14	10	Purposive
	Total	**24**	**20**	

Source: Primary Data 2022

3.4 Sampling method

A sample is a small group of individuals selected from a bigger population to participate in the research work (McCombes, 2019). This sample represents the entire population. The method used in the sample selection was purposive sampling, which selects participants who meet specific criteria relevant to the study. Purposive sampling (also known as judgmental sampling) refers to a technique in which elements are selected because they have the characteristics that are required in the sample (Nikolopoulou, 2022). Purposive sampling is common in qualitative and mixed methods research because the elements selected are rich in the information required, as a result reduces time for the research work to become shorter.

3.5 Methods of data collection and tools used

The study employed a number of methods in the collection of data. The methods and tools used were as shown in table below:

Table 5: Data collection and tools used

S/N	Method used	Tools
1	Observation	Use of senses, watching, log book
2	Interview	Interview guide
3	Future workshop	Cameras and log book
4	Focused group discussion	Cameras and log book

Source: Primary Data 2022

3.5.2 Observation

Observation is the process of taking a keen look or watch on a phenomenon in order to acquire possible data that may lead to making inference or conclusion about the circumstance. Observation, according to(BritannicaDictionary)**,** is the act of careful watching and listening; or the activity of paying close attention to someone or something in order to get information about it**.** Observation was used to get information concerning drawing of boat plans for boat building. The researcher carried out observation in the classroom where learners were carrying learning, in the drawing room, the compound, library, and inside the student hostels. During the observation time, the researcher had interest to identify the tools used, materials available, time schedule, duration of time taken, and challenges involved.

3.5.3 Future workshop

Apel (2004) asserts that the future workshop was established by Junk and Norbert Muller in the 1970s as a fact finding to highlight problems and find means of solving them. After carrying out a work process analysis, a Future Workshop which actually involved active participation from stakeholders comprised of administrators, lecturers, assistant lecturers, head of ICT department, artisan and the students was organized. The workshop was meant to shed more light on the challenging situations facing the boat building and marine mechanics department and generate visions for change or improvement or find ways of enhancing skills competencies in the students of boat building and marine mechanics especially when drawing plans of boats. (Lauttamäki, 2014) stress that according to Junk and Muller (1987) a “classic” future workshop consists of four phases:

Preparation phase: *The researcher prepares the conference room by organizing seats, availing materials required, sets the workshop procedure, and rules to be followed*

Critique phase; *This is the actual start of the workshop and by creativity, the stakeholders are brainstormed to make proper analysis of the situation at hand and issues are handled step by step.*

Fantasy phase: *Employing a brainstorming approach, the stakeholders work out a utopia phase in which the exaggerated picture of the future is imaginatively drawn.*

Implementation phase: *The ideas generated during the fantasy are thoroughly checked and evaluated in relation to the practicability and an action point is then singled out. The action plan was written down.*

3.5.4 Interview

Interviews were administered mainly to the administrators, lecturers and students using interview guides. These questions were to find out views of administrators, lecturers and students in relation to the incorporation of AutoCAD in the drawing of plans of boats alongside the use of manual methods.

3.5.5 Focus group discussion

Focus group discussion was carried out with boat building students, and staff of the department of boat building and marine mechanics. They emphasized that AutoCAD should be explored because it might enhance drawing skills for better output of boat plans than the manual hand tools.

3.6 Tools/Equipment used

The tools employed in the data collection were:

3.6.1 Camera

A camera mainly from a smart phone was used to take photos during the data collection. Smartphone sensor allows measurements of phenomena that are difficult or impossible to capture. Sensors can reduce the respondent burden by eliminating survey questions and improve measurement accuracy by replacing self-reports (Bella Struminskaya, 2021). In this research work the sensor of the smartphone was used for only taking photos after seeking consent from respondents.

3.6.2 Log book

A log book to record and store the information about the events, issues discussed, the strong points of interest, persons responsible, when and where the activities to be done was used. A log book is also called a research notebook that contains complete and permanent records on how the experiment or research project was done. Log books are tremendously important during the review and making reports on data collected (S., 2021).

3.6.3 Interview guide

An interview guide is considered to be a list of structured questions prepared to facilitate the collection of data on specific topics or issues during research or an interview (Interview and Interview - Schedule in Social Research). In this research short questions were prepared and directed to the administrators of the institution and the general stakeholders.

3.7 Data quality management

It is important for a researcher to maintain validity and reliability of data collected to maximum. Validity refers to the quality of the information obtained from a survey to be true, right, and meaningful; meanwhile reliability is the ability of the research instrument to consistently produce the same research result when it is used in the same situation or in repeated situations (Roberta, 2015).

To achieve the standard, data were collected from different sources using the same or similar tools.

3.8 Data processing and analysis

Data processing means the process of gathering raw data and transforming or organizing it into meaningful information (Duggal, 2022) while data analysis is the act of purifying, transforming and categorizing data to discover useful information for business decision making (Johnson, 2020).

For this program data processing involved putting each raw data under scrutiny in order to identify errors and provide possible correction to ensure correctness and accuracy. The data collected during the interviews were recorded, edited, organized and analyzed. The data were manually organized following responses from the respondents and later used for general interpretation, decision making and conclusions.

3.9 Ethical consideration

As evidence of ethical consideration, a researcher was provided with an introductory letter from the Directorate of Graduate Research and Training , School of Art and Industrial Design, Kyambogo University (Appendix 1) to the office of the Principal, Fisheries Training Institute and later to all the respondents within the Institute. The data obtained from the respondents were treated as confidential matters required only for the purpose of the research. (Pritha, 2021), defined ethical consideration in research as a set of principles that guide research designs and practices. Scientific researchers must always adhere to certain codes of conduct when collecting data from people. When one decides to do research, how he conducts that research involves key ethical considerations which include;

First, protecting the rights of the participants (voluntary participation, informed consent, confidentiality, etc), Second, enhancing research validity, Third, maintaining scientific integrity.

The importance of ethics in research is that it provides integrity, rights and dignity of respondents, and builds strong understanding between scientific research and the community. Consent will first be sought from the respondents before interviewing them and the identity of the respondent will remain confidential.

During the future workshop, interviews and focus group discussion, the information got concerning the respondents were considered confidential. Each respondent's view was considered important. At the meeting the participants were permitted to retain freedom of expression and to respect one another. Consent was sought before taking photographs during the future workshop, interview and during the implementation process. When recording the information, no name was recorded against a statement, and everything information collected during the future workshop, interview, and focused group discussions was not for an individual but was considered for the purpose of the action research.

3.10 Limitation of the action research during the study

First, the ICT department had no person with skill to operate AutoCAD.

Second, the institute had no software for Auto Computer Aided Designs (AutoCAD).

3.11 Delimitations to the action research

First, A resource person was hired to conduct the training of the staff.

Second, AutoCAD software was installed in computers inside the computer laboratory.

3.12 Validity of data

The validity of the data obtained was strengthened by employing a variety of data collection methods, including focus group discussions, interviews, questionnaires, and future workshops. (Creswell, 2014) emphasized the use of different data collection methods to obtain information from participants, as means to realize validity of the study. This multi-method approach ensured a more comprehensive and well-rounded perspective, reducing the potential for bias and enhancing the credibility of the findings. By cross-verifying data from different sources and methods, the study was able to capture a deeper understanding of the subject matter and increase the reliability and accuracy of the results.

3.13: Reliability of Instruments

Creswell (2014) describes reliability as a measure of consistency. The researcher collaborated closely with supervisors to create the items for the instruments used to collect accurate and relevant data. The focus group discussion guide and evaluation tool were pre-tested by the researcher with the same participants on two separate occasions, one month apart, to determine if the key questions were clear and free from ambiguity. Participants' responses were consistent, confirming the appropriateness of the designed data collection tools.

CHAPTER FOUR: PRESENTATION AND DISCUSSION OF RESULTS

4.0 Introduction

This chapter displays the findings obtained from the work process analysis, future workshop, interviews, focus group discussion and observations that were used to discover the strategies for enhancing trainee competence for boat building plans at Fisheries Training Institute. The participants during the study were the administrators, heads of departments (ICT and boat building and marine mechanics departments), lecturers, assistant lecturers, artisan, and students of boat building and marine mechanics. These opened up means through which responses obtained provided the researcher with ideas on how to present the results according to the objectives set in chapter one of this study.

Formative and summative evaluations of the implemented strategy were used. Formative evaluation took place right from the time of incorporating the program and went through the program. Summative evaluation was done at the end of the program through focus group discussion, and by employing the use of a questionnaire.

4.1 Objective 1: To identify the gaps hindering competence development in boatbuilding and marine mechanics at Fisheries Training Institute.

What are the critical gaps hindering competence development in boat building and marine mechanics at Fisheries Training Institute?

The research aimed at finding the gaps hindering competence development in boat building and marine mechanics at Fisheries Training Institute. The findings or results obtained indicate that:

There were two lecturers, one assistant lecturer and one artisan in boat building and marine mechanics department. Meaning the department had four staff.

There was no classroom block designed and constructed for technical drawing, tools and materials were few in comparison with the number of students in the respective classes of 10 students and above per class. Table below shows the available resources in boat building and mechanics department.

Table 6: Available teaching learning resources in boat building and marine mechanics department

Available tools	Quantity		Available materials	Quantity
Drawing boards	06		Reams of size A2 papers	00
Tee squares	06		Reams of size A3 papers	02
Set squares	00		Reams of size A4 papers	02
French curves	04		Masking tape rolls	03
Drawing pens	02		Computers	00
Mathematical sets	04		Internet connection	00
Flexible batten	02		Printers	00
45^0 set squares (chalkboard)	03			
60^0 – 30^0 set square (chalkboard)	03			
Chalk board pair of compasses	03			
Chalkboard meter rules	03			

Source: Primary Data 2022

Difficulties of storing and preserving drawings produced by traditional hand tools for future use was one of the gaps identified. The stakeholders found out that the papers (size A1, A2, and A3) which were used for drawing plans of boats were always kept in shelves and the spool or core left behind from the roll of fiber glass matt. The papers were always eaten or destroyed by rats and cockroaches or humid conditions within the storage facilities.

Figure 21: Effects of storage on traditionally produced drawings

Source: Primary Data 2022

Traditional hand tools make learners miss out on modern skills relevant in industries**.** The stakeholders found out that the activities in practice involved: Carrying drawing tools from hostels to drawing rooms and back to the hotels; **s**etting papers on the drawing board using pins or masking tapes or clips; producing drawings using pencils, set squares, tee squares, pair of compasses, French curves, and protractors; and storing the work in shelves or spools. Nevertheless, the stakeholders found that learners were missing the activities that take place in modern industries which include; opening computers, identifying and using key boards, typing work and saving it in the computer, using model tools for making drawings, printing the drawings, projecting the drawing for group discussions, and saving work and storing it within the computer, in the external hardware, in the emails or google drives.
Lack of computers and software required for boat plan construction was one of the gaps hindering competence development of drawing boat plans. The study found out that boat building and marine mechanics department did not have any single computer and appropriate boat plan drawing software. Upon being exposed to various design digital tools software, the respondents (trainees) acknowledged that AutoCAD software be best for beginners to improve on their competencies in boat plan drawings.

The stakeholders in the Future Workshop found that out of the four staff present in boat building department, none of them had experience in the use of modern drawing tools. The four staff members were not able to operate AutoCAD.

4.2 Objective 2: To select appropriate strategies, lay procedures, and incorporate identified gaps into the teaching and learning processes of boatbuilding and marine mechanics.

What is the appropriate approach for implementing the identified gap?

Pairwise section of the Future Workshop identified lack of computers and AutoCAD software as the main gap hindering competence development in drawing boat plans. This objective therefore was to guide the strategies used to implement AutoCAD as the identified gap, especially for beginners at boat building and marine mechanics department. The findings indicated:

More staff with knowledge and expertise in the use of modern technological tools for drawing should be recruited to fill the gaps of Lecturing staff within boat building department.

ICT Laboratory specifically for boat building and marine mechanics department, well equipped with computers, projectors, printers, internet, and white boards was to be built in a near future.

Boat building staff were trained in the use of modern drawing tools beginning with AutoCAD software.

A collaboration was made with Kisubi Technical Institute which provided an expert in AutoCAD software and he facilitated the training of boat building staff in learning of AutoCAD at Fisheries Training Institute.

He first conducted needs assessment to gauge the current skill level and understanding of technology among the boat building departmental members. And a training plan was developed. The content to be covered in training using AutoCAD software was also developed, and AutoCAD software was installed in the computers within the institute ICT Laboratory.

The training took place steadily from simple to complex. Trainees were initiated into the basic concepts of AutoCAD. The trainees (boat building staff) were grouped and encouraged to make use of the available internet to utilize tutorial videos to perfect their skills in managing AutoCAD.

Technical support was provided and some resources such as instruction manuals, tutorial videos, and online forums where staff trainees would seek guidance and also share their experiences were provided. Queries and challenges of the trainees were attended to during the training process.

A collaborative environment in which the staff trainees were allowed to work in groups and share their ideas, experiences and understanding was created within the training environment.

Use of AutoCAD for teaching, demonstrations, project works, and assignments were practiced by individual groups during the training period.

Periodic assessment of the boat building staff was implemented in the adoption and utilization of AutoCAD. Feedbacks were also provided.

Chances for further skill development were spelled to the boat building staff, which included advance training sessions, specialized workshop for the interested staff members.

Boat building staff were also tasked to encourage a culture of adaptability and promoting ongoing exploration of AutoCAD's capabilities and its application in boat design during teaching and learning.

The stakeholders worked as a team to assess the available hand tools and how they were used in making drawings (Appendix 13). The traditional hand tools included:

Drawing boards, flexible batten (a thin strip of timber of plastic used for drawing curves that pass through plotted points along the station lines to produce the rocker, chine line and sheer level of the boat), Tee square, rule set squares, Pair of compasses, protractor, pencils, pencil sharpener, rubber, masking tape. (See appendix 12)

The stakeholders went farther by working as a team and made drawings of boat plan using the named manual hand tools. The basics of plan drawing using traditional hand tools were discovered by the stakeholders. The boat plan produced comprises of the lines drawing and construction details shown in a sectional form (see figure 22 and appendix 20)

A table of offsets and general specifications of a boat were presented and used for the drawing of plan of a boat. It is the same table of offsets and specification which was used in the drawing of plan of a boat using modern technology. The table of offsets and boat specification used are as shown in table 7 and 8 respectively.

Table 7: Table of Offsets for making a nine-meter boat

	Heights Above Baseline (H.A.B)				**Halve Breadth (H.B)**			
Station	**Rebate line**	**Chine line**	**Sheer line**		**Rebate line**	**Chine line**	**Sheer line**	**Station**
Transom	140mm	320mm	920mm		40mm	320mm	460mm	Transom
6	100mm	240mm	840mm		40mm	520mm	680mm	6
5	70mm	200mm	800mm		40mm	660mm	800mm	5
4	60mm	160mm	780mm		40mm	720mm	840mm	4
3	80mm	180mm	800mm		40mm	680mm	800mm	3
2	100mm	220mm	880mm		40mm	520mm	640mm	2
1	140mm	320mm	1000mm		40mm	240mm	400mm	1

Source: Primary Data 2022

Table 8: General Specifications of the boat

Length Over All (L.O.A)	9000mm	9m
Beam	1680mm	1.68m
Depth	800mm	0.8m
Fore Perpendicular height	1280mm	1.28m
Fore perpendicular to ST1	1800mm	1.8m
ST1 to fore end of keel	280mm	0.28m
Transom rake	9^0	9^0

Source: Primary Data 2022

At the incorporation stage of the identified gap, the AutoCAD expert and the staff of boat building incorporated the AutoCAD software for training in the classroom at Fisheries

Training Institute ICT Laboratory. AutoCAD training was integrated into the boat building and marine mechanics curriculum and time tabled, year two, semester one students of boat building were the participants in the training program.

Students were introduced to using AutoCAD software. The AutoCAD software expert reassured learners that AutoCAD is the best software application for learners in the field of computer graphics. The AutoCAD software is used for making drawings in both plane geometry (2D) and solid geometry (3D). But for this case the learning was based on only 2D.

The facilitator then introduced the learners to AutoCAD software by:

- Clicking on the AutoCAD software to open.
- Clicking on the startup icon to get started.
- A work space opened with some tabs displayed on top and below the work space (See Appendix 13)

The facilitator informed the trainees that before starting any drawing on the work space, the first thing to do is to check the unit of measurements and confirm that it is matching with the one intended to be used; for example, metric system unit such as millimeters, centimeters, etc. or imperial system unit such as inches, feet, yards, and so on. To perform the function of unit check, you will enter a keyboard command by typing “UN” and pressing “enter” on the keyboard, and thereafter a display will appear on the screen for unit selection and confirmation. (See Appendix 13)

The findings further indicated that the trainees experienced using tutorials in making drawings even at the time when facilitators were not with them. They learnt among others: drawing of triangle, rectangles, constructing circles using center diametermethod and using points method, construction of angles,tangents to circles, construction of polygons using inscribed and circumscribed methods, using mirror tools for drawings, drawing of grids,vertical lines and horizontal lines, curved lines.Lines drawing, body plan and construction detail drawing of the plan of a boat were produced. A prototype constructed using a scale of 1:10.

4.3 Objective 3: To evaluate the incorporated strategies and procedures in drawing plans of boats.

How will the incorporated strategies and procedures be evaluated?

Future Workshop at pairwise stage identified lack of modern technology, especially AutoCAD software (for beginners) as the most pressing gap hindering competence development in boat building and marine mechanics. The stakeholders accepted that AutoCAD be incorporated to enhance competence development in boat plans. As a result, AutoCAD was incorporated into the drawing of plans of boats at Fisheries Training Institute.

In preparation to incorporate AutoCAD software, boat building and marine mechanics staff were trained to acquire the skills of handling the software for teaching and learning in the classrooms. This was done by engaging the external facilitator who conducted the training of the staff immediately after the installation of the AutoCAD software in the computers within the FTI Laboratory. Thereafter, the trained boat building staff together with the AutoCAD expert introduced AutoCAD to students in classroom setting.

Students were introduced in using AutoCAD software by:

- Clicking to open the computer.
- Clicking on the AutoCAD software to open.
- Clicking on the startup icon to get started.
- A work space opened with some tabs displayed on top and below the work space.

Learners were introduced to the use of drawing tools for making simple geometrical drawings and they were able to experiment their ideas with AutoCAD using both the guides obtained during training program and by making use of tutorials. In their experiments they were able to:

Draw basic shapes such as circles, rectangles and polygons using the various drawing tools and understanding how to manipulate them.

Learn how to add dimensions to the drawings on the workspace. Experimenting with linear and angular dimensions to understand how they work and how they affect the designs.

Explore the customization options available in AutoCAD. Experimenting with customizing tool palettes, menus, and keyboard shortcuts to streamline the workflow.

The experiments performed brought excitements:

"I am grateful to see myself having produced this shape appearing on my screen! It is a wonderful moment", said one student.

"Wow, heaven is open. God has seen us", said the second student.

"I can draw shapes, dimension and customize them! How wonderful!". "This joy is not my joy; it is for my parents!", said the third student.

"Thank God! We shall dance to the tunes of the community and industry!", said the fourth student.

"My suffering with sharpening of pencils may reduce and I move to a different world of technology! Thanks be to God!", said the other student.

"With God, all things are possible! We should cooperate o produce a better workforce for tomorrow", said a female student.

"Ooh! The storm is over, I can now see the sunshine!", expressed one happy trainee.

"What a surprise! We need a fully equipped ICT laboratory for boat building!", said a learner.

As time went on the level of skill development among the trainees in using AutoCAD started varying depending on factors such as experience in the use of computers, interest and the specific needs of the trainees.

At the beginning, trainees had limited or no experience with AutoCAD. They were not familiar with basic drawing commands, such as line, circle, and rectangle. They needed guidance on how to operate the drawing tools of the software.

As facilitation and training continued to take place in the class, some intermediate users had a good grasp of fundamental concepts and commands in AutoCAD. They were able to create and edit drawings with confidence, and apply basic dimensioning techniques.

The trainees were able to advance proficiently in all aspects of AutoCAD and efficiently produced complex drawings. At the end of the one year, they were familiar with advanced modeling techniques, especially in 2D modeling, where they were able to draw the plan of a boat. They could also customize the software using customization tools.

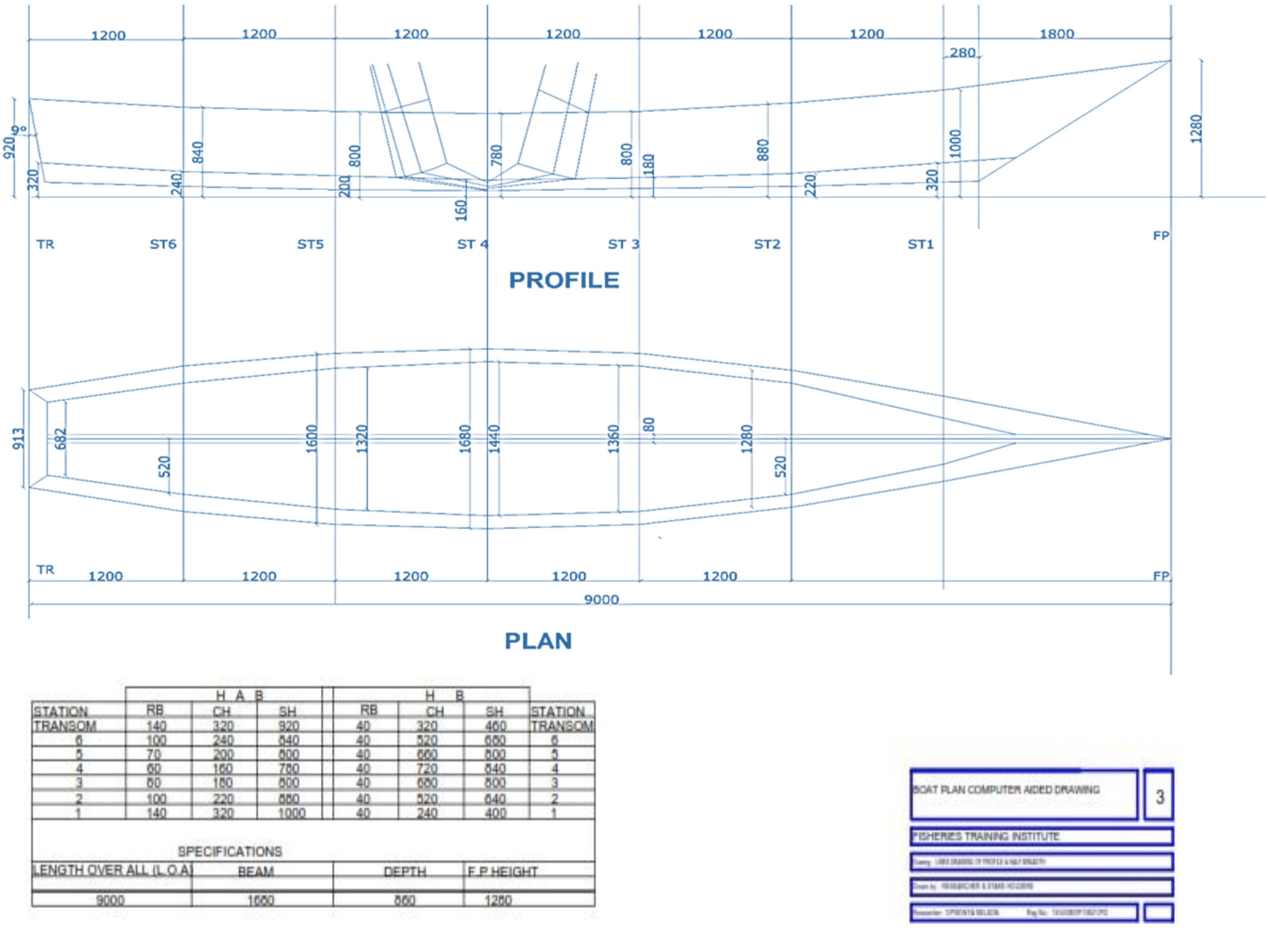


Figure 22: Lines drawing **Source: Primary Data 2022**

Trainees also realized that to develop more skills in AutoCAD, it was essential to practice regularly, explore tutorials and online resources, and consider formal training courses or certifications if there would be need to advance to higher skill levels.

In the summative evaluation, a questionnaire was organized for the stakeholders to respond to. The copies of the questionnaire were filled and views of the respondents were collected and recorded in table 9.

Table 9: A questionnaire used during evaluation of the two method of drawing boat plan

	Responses	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	AutoCAD produces better clearer drawings which are smarter than hand tools.	20	00	00	00	00
2	Two dimensional (2D) drawings are easier to produce using AutoCAD than hand tools.	17	03	00	00	00
3	AutoCAD contributes positively and beneficially in the learning Environment of technical drawing in general.	14	04	00	02	00
4	My usual output in AutoCAD is more accurate than the manual drawing output.	04	16	00	00	00
5	I apply the knowledge of AutoCAD in planning and designing.	12	08	00	00	00
6	AutoCAD has simplified drawings.	04	16	00	00	00
7	AutoCAD can be used by only one person to produce a drawing of a component.	15	05	00	00	00
8	Work in progress can be stored within the computer; when using AutoCAD.	10	10	0	00	00
9	AutoCAD uses inbuilt scales and dimensions and there is no need for hand tools for the measurements.	18	02	00	00	00
10	The administration of FTI should embrace the use of AutoCAD to improve drawing of boat plans.	17	03	00	00	00

Source of information: Primary data 2022

Basing on the results obtained from the questionnaire, almost everyone strongly agreed with the changes brought about by the use of digital tools. For instance, question one which states; AutoCAD produces better clearer drawings which are smarter than hand tools, all participants strongly agreed that drawings produced were smarter than hand drawing tools. The second question stating, two dimensional (2D) drawings are easier to produce using AutoCAD than hand tools. 17 trainees strongly agreed and only three agreed. No one was undecided nor disagreed. The third question inquiring whether AutoCAD contributes positively and beneficially in the learning environment of technical drawing in general, 14 strongly agreed, 4 trainees agreed and 02 students disagreed. The fourth question was, my usual output in AutoCAD was more accurate than the manual drawing output, 4 trainees strongly agree and 16 trainees agree. The fifth question inquired whether the trainees applied the knowledge of AutoCAD in planning and designing. 12 strongly agreed and 08 trainees agreed, nobody was undecided, nor disagreed and disagreed. The sixth question investigated to find out whether AutoCAD has simplified drawings. In response, 04 trainees strongly agreed, 16 agree, 00 undecided, 00 disagreed, and 00 strongly disagreed. The seventh question sought to understand whether AutoCAD can be used by only one person to produce a drawing of a component; 15 trainees strongly agreed, 05 agreed, 00 undecided, 00 disagreed, and 00 strongly disagreed. The eighth question tried to compare storage with modern tools and the old traditional method by whether work in progress can be stored within the computer; when using AutoCAD; 10 trainees strong agreed, 10 trainees agreed, 00 undecided, 00 disagreed, and 00 disagreed. The ninth question to find out whether AutoCAD uses inbuilt scales and dimensions and there is no need for hand tools for the measurements; 18 trainees strongly agreed, 02 trainee agreed, 00 undecided, 00 disagreed, 00 strongly disagreed. The tenth question investigated to find out trainee would accept to recommend that administration of FTI should embrace the use of AutoCAD to improve drawing of boat plans; 17 strongly agreed, 03 agreed, 00 undecided, 00 disagreed, and 00 strongly disagreed.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 Summary

The study aimed to improve competence development among boat building trainees at the Fisheries Training Institute (FTI) by incorporating modern digital tools into boatbuilding and marine mechanics learning processes: To identify the gaps hindering competence development in boatbuilding and marine mechanics at Fisheries Training Institute; to select appropriate strategies and lay procedures for implementation of the identified gap; and incorporating identified gap into teaching and learning processes of boat building and marine mechanics; to evaluate the incorporated strategies and procedures in drawing plans of boats. The research questions were: What are the gaps hindering competence development in boat building and marine mechanics at Fisheries Training Institute? What is the appropriate approach for implementing the identified gap, and incorporating it into teaching and learning processes of boat building and marine mechanics? How will the implemented strategy and procedure be evaluated?

Methods included situational analysis, future workshop, observations, interviews, and focus group discussions.

The findings revealed several gaps including: Staff shortages as many retired staff were not replaced and this limited teaching capacity; lack of tools and materials; there was a shortage of essential resources for both traditional and modern methods. ICT deficiencies; the department lacked necessary equipment like computers, printers, and projectors, and staff lacked knowledge of operating the modern software like AutoCAD. Due to the lack of ICT tools, students missed out on skills crucial for modern industries. The research also highlighted how technology adoption in Africa lags behind other regions, with TVET institutions in particular being slow to embrace digital learning tools.

Strategies to address gap: Recruitment of staff with expertise in modern technology; construction of an ICT laboratory for boat building to facilitate digital transformation; training staff in using AutoCAD occurred with the help of an external facilitator; after a needs assessment, training content was developed, and AutoCAD was installed in the institute's ICT laboratory. The software was integrated into the curriculum, and boat building students were trained to use it for drawing boat plans.

The research was evaluated using formative and summative approaches: Formative evaluation occurred throughout the program with interviews, focus group discussions, and observations, while summative evaluation was conducted through questionnaires, with feedback showing that students appreciated the intervention and improved their competence in using AutoCAD and modern technology.

The results indicated that the integration of AutoCAD significantly enhanced students' ability to draw boat plans and modernized their learning experience, meeting the objectives of the study.

5.1 Conclusions

Basing on the finding and evaluation of the incorporated strategy, the following were the conclusions made:

There were a number of gaps hindering competence development in drawing boat plans at Fisheries Training Institute such as inadequate staffing at the department of boat building and marine mechanics, inadequate learning resources, lack of ICT in boat building department, lack of computers and AutoCAD software, problem of storage and preservation of work produced using hand tools, the hand tools were making trainees to miss out on the modern technologies adopted by the world of work.

Strategies for incorporating modern technology such as AutoCAD were derived and put in place to bridge the gaps identified as hindering competence development in drawing boat plans at Fisheries Training Institute. The selected strategies included recruiting more staff (lecturers and assistant lecturers) with knowledge in using the modern technologies in drawing boat plans, creation of ICT Laboratory for boat building and marine mechanics, training boat building staff in the use of AutoCAD software, and incorporation of AutoCAD into the curriculum. Learners were able to produce several drawings using AutoCAD software tools, and to experiment with their own ideas in drawing using AutoCAD software. The evaluation tools specified that learners gained much more competence when using the incorporated modern tools.

5.3 Recommendations

Based on the discussion and conclusions drawn from the research on enhancing competence development among boat building trainees in plans of boats, here were some recommendations made:

1 The Government of Uganda through Ministry of Agriculture, Animal Industry and Fisheries, to ensure that more staff are recruited to fill the gaps identified and provide ongoing training and support for both staff and students in the use of AutoCAD and other CAD software deemed necessary.

2 The Administration of Fisheries Training Institute should collaborate with stakeholders to set up a fully-equipped ICT laboratory tailored for boat building and marine mechanics. Allocate resources for the necessary hardware, software, and construction.

3 The Administration of Fisheries Training Institute should integrate digital technologies into the curriculum: Revise the curriculum to incorporate AutoCAD and other digital tools and provide ongoing training for staff and students. Foster interdisciplinary collaboration and encourage continuous skill development

5.4 Areas for further research

1. Investigate workforce development in CAD and marine technology by the recruitment and retention strategies for staff specializing in CAD software (e.g., AutoCAD) and marine technology. Explore the impact of ongoing professional development on both

staff competency and student performance in technical fields like boat building and marine mechanics.

2. ICT Laboratory design for specialized technical training. Research best practices in designing and implementing ICT laboratory tailored for vocational education, especially in boat building and marine mechanics. This could include optimal hardware and software configurations, resource allocation, and the role of such facilities in enhancing hands-on learning experiences.
3. Curriculum innovation with digital tools in vocational education. Explore the integration of digital technologies, such as CAD software, into technical education curricula. Examine the effectiveness of interdisciplinary collaboration, continuous skill development, and the role of digital literacy in improving vocational training outcomes, particularly in marine mechanics and boat building.

REFERENCES

Abede Jawara Mark, D. W. (2021, October). *the benefits of exposing post-secondary students to entrepreneurship training in Trinidad and Tobago.* Retrieved from www.nature.com.

ActionCatalogue. (2014, September 18th). *Future Workshop.* Retrieved from actioncatalogue.eu.

alphaCADservices. (2023, March). *why CAD more efficient than manual drafting*. Retrieved from www.alphacadservice.com.

Andreas, D., & Kristina, W. (2022). An Evidence-based Study on Teaching Computer Aided Design in Higher Education during the COVID-19 Pandemic. . *Education Science*.

APA dictionary of Psychology. (n.d.). Retrieved from dictionary.apa.org.

Apel, H. (2004, February). *Future Workshop.* Retrieved from die-bonn.de.

Arimonu, P. R. (2016). Technical and Vocational Education in Nigeria: Issues, Challenges and a Way Forward. *Journal of Education and Practice*.

Athuraliya, A. (2022, November o4th). *The complete guide to strategy evaluation*. Retrieved from creately.com.

B.T.Goodings. (1969). *Development of Design and Construction of Fishing Boats in Uganda.* Kampala: Uganda Government Printing Press, Entebbe.

Bathgateacademy. (2020, August 1oth). *Advantages and disadvantages of manual graphics*. Retrieved from bathgateacademy.westlothian.org.uk.media.

Bella Struminskaya, P. V. (2021). Sharing Dtata Collected with Smart phone Sensores: Willingness, participation, and Nonparticipation Bias. *Market Research Journals*.

Between.net, D. (2011, July 11th). *Difference Between A Ruler and A Straightedge* . Retrieved from www.differencebetween.net.

Bloch, B. C. (2002, May 20th). *Learning by doing*. Retrieved from link.springer.com.

Boser, U. (2020, March 9th). *The learning curve (A magazine devoted to gaining skills and knowledge)*. Retrieved from www.the-learning-agency-lab.com.

Brau, B. (n.d.). *Constructivism*. Retrieved from The students' guide to learning design and research. www.edtechbook.org.

Britannica, E. (2023, October 10th). *Homo erectusbritannica.com/topic/Homo-erectus*. Retrieved from britannica.com.

BritannicaDictionary, T. (n.d.). *Observation*. Retrieved from www.britannica.com.

Cambridgedictionary. (2022, September 13th). *Meaning of masking tape*. Retrieved from dictionary.cambridge.com.

CBSELibrary. (2022, May 8th). *Lecture Method: Advantages and Disadvantages.* Retrieved from cbselibrary .com.

Chron. (2020, December 01st). *Strategy effectiveness*. Retrieved from smallbusiness.chron.com.

Cloudswyft. (2023). *How virtual computer lads are revolutionising the way universities teach*. Retrieved from cloudswyft.co.

Creswell, J. W. (2014, September 18th). *Research design*. Retrieved from https://books.google.co.ug.

George, A. (2020, March 05). *Homo erectus used two different kinds of tools*. Retrieved from https://www.newscientist.com/.

CUEMATH. (2012, August 8th). *Protractor*. Retrieved from www.cuemath.com.

Delve. (2022, January 11th). *What is participatory action research?* Retrieved from delvetool.com.

dictionary, M. (2017, January 22nd). *Challenge*. Retrieved from www.macmillandictionary.com.

DigitalMarketingInstitute. (2022, May 12th). *What are the Bennefits of Digital Transformation?* Retrieved from ...italmarketinginstitute.com.

DTU. (2018, November 06). *Future Workshop.* Retrieved from wiki.doing-projects.org.

Ducksters. (2022). *Ancient Egypt Boats and Transportation*. Retrieved from www.ducksters.com.

Education, A. (2021, December 24th). *Industrial Training*. Retrieved from appwarstechnologies.com.

EDUCBA. (2022). *Top Uses of AutoCAD.* Retrieved from educba.com.

Educba. (2023, May 16th). *Advantages of AutoCAD*. Retrieved from www.educba.com.

ELCOMBLUS. (20222, May 7th). *Project method in teaching.* Retrieved from www.elcomblus,com.

Elevatek-12. (2022, November 29th). *How does shortage of teachers affect students?* Retrieved from www.elevatek 12.com.

encyclopaedia-Britannica. (2023). *boats*. Retrieved from kids.britaannica.com.

Encyclopaedia-Britannica. (2023). *Boats*. Retrieved from kids.britannica.com.

ENCYCLOpedia.com. (2018, May 14th). *Chalkboard.* Retrieved from www.encyclopedia.com.

Evans, O. (2013). *A study of experiential learning in the training of Agricultural graduates: A case study for Bukalasa Agricultural College.*

Franklin, B. (2022, July 01st). *Why invest in knowledge*. Retrieved from www.linkedin.com.

Freeencychlopaedia. (2023, July 26th). *Dudout canoes*. Retrieved from en.wikipedia.org.

Global-University. (2022). *Technological advances*. Retrieved from cgu-odisha.ac.in/blog/7-technological advances-that-empower-the-shipbuilding -industry.

Godfrey, p. (2013). *The effects of shortage of teachers on curriculum implementation in community secindary schools in Tanzania, the case of Koba Municipality .*

Goodings B.T. (1969). *Development of Design and Construction of Fishing Boats in Uganda.* Kampala: Uganda Government Printing Press, Entebbe.

Gracemary Wsmbui Mbogo, O. D. (2014, April). *An Evaluation of the Implementationof Information Technology in Secondary Schools in Kenya.* Retrieved from www.researchgate.net.

Groff, J. S. (2010, February). *Technology-Rich Innovative Leaqrning Environments.* Retrieved from www.researchgate.net.

Gupta, P. D. (2018, November 08th). *Strategies for Interactive and Innovative Strategies for Interactive and Innovative* . Retrieved from https://www.academia.edu.

Habib, P. K. (n.d.). Action Research. *Classroom lecture (Action Research Proposals)* . Kyambogo University, Kampala.

Hasan, R. (2014, November 19th). *History of AutoCAD*. Retrieved from civilinfobd.worpress.com.

Hassan, B. &. (2017). The Imperatives of Technical Drawing Skills in Teaching TVET Subjects: The case of Nigeria. *Journal of Education and Practice*.

hassn, B. &. (2017). The Imperative of Technical Drawing Skills in Teaching and Learning TVET Subjects: The Case of Nigeria. *Journal of Education and Practice ISSN 2222-288X(Online) Vol.8, No.23,2017*.

HIDEAWAYS. (2020, March). *The History of Dhows - An Ancient Art*. Retrieved from hideawaysafrica.com/resources/the-history-of-dhows-an-ancient-art/.

Hlavaty, R. (2014, September). *Saaty's matrix revisited: Securing the consistency of pairwise comparisons*. Retrieved from https://www.researchgate.net.

Hoimner, S. P. (2015, April). *ICT in Africa: Building a better Life for All*. Retrieved from Researchgate.net.

Hope, C. (2022, July 2nd). *Toolbar.* Retrieved from www.computerhope.com.

Interview and Interview - Schedule in Social Research. (n.d.). Retrieved from www.mlsu.ac.in.

Inventable. (2018). *Digitizing a drawing.* Retrieved from discuss.inventable.com.

Inventible. (2018). *Diziting a drawing.* Retrieved from discuss.inventable.com.

Ipek, U. (2021, September 7th). *Technical frawing as the common language of humanity*. Retrieved from www.linkedin.com.

James Riley Estep, J. (2016, july). *When to use the Lecture Method and When Not to Use.* Retrieved from www.standardlesson.com.

Jens, A. (2023). *The monoxylon expeditions* . Retrieved from www.monoxylon.cz.

Juan-Pablo, t. D. (2015). *The use of mental templates in Clinker shipbuilding*. Retrieved from saxonship.org.

Kapur, R. (2020, November). *Lecture method: The Comprehensively used Pedagogical Method.* Retrieved from www.researchgate.net.

Khan. (2020, February 5th). *Demonstration method.* Retrieved from ...ucation.edu.blogspot.com.

Khuzainey Ismail, M. S. (2018). CHALLENGES FACED BY VOCATIONAL TEACHERS IN PUBLIC SKILLS TRAINING INSTITUTIONS: A REALITY IN MALAYSIA. *Journal of Technical Education and Training 10(2) DOI:10.30880/jtet.2018.10.02.002*.

Kilchermann, L. (2022, April 7th). *What is boat building?* Retrieved from www.wikimotors.org.

Kuhnt, P. T. (2016, March 8th). *Future Worksops - The Unthinkable and How to Make It Happen* . Retrieved from surfsharekit.nl.

Lab, T. E. (n.d.). *What is technology education?* Retrieved from www.techedlab.com.

Lauttamäki, V. (2014, October). *PRACTICAL GUIDE FOR FACILITATING A FUTURES WORKSHOP*. Retrieved from www.utu.fi/ffrc .

Leonho. (2023, February 14th). *What is learning by doing and how is it effective ?* Retrieved from www,lifehak.org/author/leonho.

Linkedin. (2021, November 10th). *Benefit of Discussion Based Teaching.* Retrieved from www.linkedin.com.

Lucas, B. (2014). *Visual conference of UNESCO-UNEVOC; on vocational pedagogy; what it is, why it matters and how to put it into practice.* Bonn Germany: UNESCO-UNEVOC International centre for Technical and Vocational education and Training, UN Campus.

Lucas, P. B. (2014, May). *Bzckground note for UNESCO-UNEVOC e-Forum*. Retrieved from UNEVOC.UNESCO.org/foleadmin/up/vocational..pedagogy.

Lucas, C. (2013, April 05). *Vocational pedagogy: what it is, and why it matters*. Retrieved from https://www.academia.edu.

Macmillandictionary. (2017, January 22nd). *Challenge*. Retrieved from www.macmillandictionary.com.

Maksymova, I. (2022, March 10th). *Top 10 CAD software in 2022: for design and engineering, for professionals and beg9nners*. Retrieved from www.appliet3d.com/software/cad-software.

Marjadas, J. (2014, April 2014). *Boat bilding training.* Retrieved from scribd.com.

Maryland, L. U. (2021). *What is Educational Technology and Whyit is Important?* Retrieved from www.loyola.edu.

McCombes, S. (2019, September 19th). *Sampling methods, types and techiques.* Retrieved from www.scibbr.com/methodology/sampling-methods/.

Mcleod, S. (2023, June 15th). *Constructivism Learning Theory and Philosophy of Education*. Retrieved from www.simplypsychology.org.

Michael, K. (2019, August 27th). *Participatory and collaboratory nature of Action Research* . Retrieved from https://www.researchgate.ne.

Middleton, T. (2023, January 25th). *Healthy teams enjoybenefits that go far beyond the company's bottom line*. Retrieved from www.atassian.com.

Migaki, T. (2019, June 16th). *Ships of History-Early boats (Egypt and the Nile)*. Retrieved from thetidesofhitory.com.

Mjelde (2006: p6). *Handbook for masters students in vocationL pedagogy.* Kampala: Harambe Publishing NOMA House, P. O. Box 1 Kyambogo.

Mjelde, L. (2013). *Handbook for masters students in vocationL pedagogy.* Kampala: Harambe Publishing NOMA House, P. O. Box 1 Kyambogo.

Narayan, e. a. (2013). *Constructivism - Constructivist learning theory* . Retrieved from psycnet.apa.org.

NewsLodge. (2022, April 20th). *Demonstration method of teaching: meaning, advantages and disadvantages.* Retrieved from www.newslodge.com.

Nikolopoulou, K. (2o22, August 11th). *What is purposive samplin?* Retrieved from Scribbr.com/methodology/purposive-sampling.

Nobledesktop. (2023). *What can you do with AutoCAD?* Retrieved from www.nobledesktop.com.

OECD. (2023, January). *Promoting innovative pedagogical approaches in vocational education and training.* Retrieved from oecd-library.org.

Ogbu, D. J. (2015). The influence of Inadequate Instructural Materials and Facilities in Teaching and Learning of Electrical/Electronics TechnologyEducation Courses. *Journal of Education and Practice.*

Okoro, D. K. (2023, May 27th). *The 8000-Year-old Dufuna Canoe* . Retrieved from refinedng.com.

Olakotan, J. O. (2019). Enhancing Effective teaching and Learning technical Drawing fo Sustainable Development in Nigerian Technical Colleges. *Innovation of Vocationa lTechnology Eduacation (invotec)*, 01.

OP mcCubbins, R. G. (2016). Teacher-perceived adequacy of tools and equipment available to teach Agricultural mechanics. *Journal of Agricultural Education, 57(3) , 223-236. doi:10.5032/jae.2016.03223*, 01.

OpenLearningCreate. (2020, August 8th). *General Teaching Methods: Demonstration* . Retrieved from www.open.edu.

Palanski, D. (2022, August 21st). *Linden wood*. Retrieved from paladimmstudio.com.

Palpanadan, S., Zuki, R. E., & Mariani, A. (2020). TVET Student Teachers' Soft Skill Profole of Computer Aided Design (CAD) Course at MalaysianTeacher Education Institute. *Open Journal of Science and Technology*, 1.

Patrick, E. N. (2023, January 10th). *Inadequacy of Teaching and Learning Infrastructure: Reason Nigerian Universities Cannot Drive Innovations.* Retrieved from https://www.academia,educ/.

Penelopethemovie. (2021, December 21st). *What are the advantages of Project method of teaching?* Retrieved from peniopethemovie.com.

Ponelis, M. H. (2015, April). *Information Technology for Development*. Retrieved from Researchgate.net.

Pritha, B. (2021, October 18). *Ethical Considerations in Research* . Retrieved from www.scribbr.

Raman, Y. D. (2019, January). *School managementand leadership: Teamwork in Schools*. Retrieved from www.researchgate.net.

Ready, N. (2018, June 13th). *Importance of Industrial Training*. Retrieved from nimsready.org.

Rogers, A. C. (2010, September 01st). *Learning by doing*. Retrieved from journals.sagepub.com.

Rowe, L., Moss, D., & Moore, N. (2017, December). *Effective Management of Tripartite Relationship of Educational Providers, Participants and Employers in Work Based Learning.* Retrieved from www.researchgate.net.

Royal-Museums-Greenwhich. (n.d.). *ship building*.

Royal-Museums-Greenwich. (n.d.). *Ship building*. Retrieved from rmg.co.uk.

S., M. C. (2021, August). *CMS Data Management: The Importance of Logbooks and Reconciling Your Data.* Retrieved from www.all4inc.com.

Saputno, B. E. (2020). *implementation of AutoCAD application in teaching vocational education*.

sarikhobbies. (n.d.). *Model Boat Builder/Plan/Scale Boat and Ships* . Retrieved from sarikhobbies.com.

Schofield, T. (2021, 12 23rd). *Field Trip: Defination and Benefits.* Retrieved from study.com.

School, T. B. (n.d.). *What makesTindustrial Taining So Important in Today's Professional World?* Retrieved from taxila.in.

Schooler, G. (2021, August 17th). *why is timetable important in a school?* Retrieved from https://goschooler.com.

ScienceNews. (2014). *Science news and research development*. Retrieved from https://academic-accelerator.com/encyclopedia/science News .

SETO. (2018, November 16th). *The top 9 educational benefits of embarking on a school trip.* Retrieved from www.easchooltours.com.

Shah, R. K. (2019, August 8th). *incorporating strategies rooted in social constructivism to create dynamic learning environment*. Retrieved from files.eric.ed.gov.

Slobodin, R. (1915). *Framed boats-artifact*. Retrieved from historymuseum.ca.

Smits, J. A. (2017). *Social constructivism*. Retrieved from www.siencedirect.com.

Somi. (2017, July 18th). *History and Government: What are the limitations of using a chalkboard?* Retrieved from ...somijnotes.wordpress.com.

SureshGautam, T. P. (2019, September). Technical and Vocational Educationfor Social Transformation and Justice. *Journal of Education and Research 8(1)*, 1. Retrieved from www.researchgate.net.

Teachmint. (n.d.). *Chalk board.* Retrieved from www.teacmint.com.

TeamStoryWeavvers. (2021, January 21st). *Sailing though history. A lookback at the origin of ships*. Retrieved from blog.byjus.com.

Things-Nigeria. (2018, March 25th). *Dufuna Canoe Rewrites Story of Water Navigation*. Retrieved from thingsnigeria.com.

Toolshero. (2023, February 22nd). *John Dewey theory of learning by doing explained*. Retrieved from www.toolshero.com/change-management/John-Deweytheory.

Tshabalala, T. M. (2013, January 1st). *An Evaluation of the Impact of Inadequate Teaching and Learning Resources in Public Institutions of Higher Learning in Zimbabwe.* Retrieved from https://www.researchgate.net.

Uwaifo, V. (2010, February 28th). *Technical education and its challenges in Nigeria in the 21st Century* . Retrieved from www.sementticscholar.org.

Vaucher, J. (2014, April). *Prehistoric Crafts*. Retrieved from iro.umontreal.ca.

Vidal, R. V. (2005, October). *The Future Workshop: Democratic problem solving* . Retrieved from www.imm.dtu.dk/~vvv.

Ward, P. (2021, October 03). *Frederick Taylor's principles of scientific management theory.* Retrieved from nanoglobals.com.

Weiss, E. G. (2019, March 26). *teacher shortage is real, large and grwing, and worse than what we thought.* . Retrieved from www.epi.org.

Williams, L. L. (2023). *What is participant observation?* Retrieved from study.com.

Yale. (2022, July 11th). Retrieved from Discussion method.

Yefremenko, S. (2021, April 22nd). *Advantages And Disadvantages od Educational Software* . Retrieved from elearningindustry.com.

Yourdictioary. (n.d.). *Pencil definition*. Retrieved from www.yourdictionary.com.

Zuraifah Safiee, Z. H. (2019, May). *Factors affecting readiness of AutoCAD*. Retrieved from hrmars.

APPENDICES

Appendix 1: Introductory letter from Kyambogo University to Fisheries Training Institute

KYAMBOGO UNIVERSITY

P. O. BOX 1 KYAMBOGO
Tel: 041 - 4286792 Fax: 256-41-220464
Website :www.kyu.ac.ug,Email: drgt@kyu.ac.ug
Directorate of Research and Graduate Training
Office of the Director

Date: **5th February, 2022**

TO WHOM IT MAY CONCERN

RE: OPWONYA NELSON

Dear Sir/Madam,
This is to introduce to you the above-named student Reg: No **19/U/GMVP/19021/PD** pursuing **Master Degree in Vocational Pedagogy**.

Department of **Visual Communication, School of Arts and Industrial Design**, Kyambogo University.

She/he intends to carry out research on **enhancing trainee competence for boat building plans at Fisheries Training Institute through use of Auto Computer Aided Design (AUTOCAD)** in partial fulfillment of the requirements for the award of **Master Degree in Vocational Pedagogy.**

The purpose of this letter therefore is to request you to grant him/her permission to carry out his/her study in your institution.
Any assistance rendered to him/her will be highly appreciated.

Yours sincerely,

Prof. Bosco Bua
AG. DIRECTOR

Appendix 2: Work Plan and Time Table

Activity	**Time**	**Actors**	**Expected outcome**
Chapter 1 Introduction	February-March 2022	Researcher/Supervisor/ stakeholders	Complete chapter 1
Chapter 2 Literature Review	February – August 2022	Researcher	Complete chapter 2
Chapter 3 Methodology	March, 2022	Researcher/stakeholders	Complete chapter 3
Proposal presentation	April, 2022	Researcher/mentor	Proposal presented to plenary.
Collection of data	April – June, 2022	Researcher	Collected data
Data interpretation and analysis	June – July, 2022	Researcher/supervisor	Interpreted or analyzed data.
Writing the research report	July – August, 2022	Researcher/supervisor.	Written research report.
Submitting hard and soft copies.	August, 2022	Researcher and supervisor.	Final report submitted.

Source: Primary Data 2022

Appendix 3: Action plan

Activity	Responsible Persons	Time Allocation
Examining the gaps hindering enhancing competence development in boatbuilding and marine mechanics at FTI	Lead researcher and the stakeholders	7th February to 18th March, 2022
Assess the hand tools used for drawing boat plans.	Lead researcher, lecturers, administrators, and students	21st March to 25nd March, 2022
Drawing boat plans using hand tools in a group of five students	Lead researcher, lecturers, and students	28th March to 1st April, 2022
Training boat building staff in the use of AutoCAD	Lead researcher, administrators and CAD facilitator, and boat building staff	4th April to 22nd April, 2022
Installing CAD software in computer laboratory for drawing boat plan.	Lead researcher, head of ICT department. Artisan	4th April, 2022
Incorporating AutoCAD for teaching and learning for students of boat building.	Lead researcher, facilitator hired by ICT department, lecturers, artisan and students	26th April to 3rd June, 2022
Printing out the drawn boat plans using CAD software	Lead researcher, facilitator hired by ICT department, artisan and students.	3rd June, 2022
Evaluating the implemented strategy of using AutoCAD in drawing plan of boats.	Lead researcher, administrators, heads of department, assistant lecturer, artisan and students.	3rd June, 2022

Source: Primary Data 2022

Appendix4: Work process analysis

Work Process	Task Involved	Competent Required	Responsible Persons
Receiving applications, admission, and orientation of learners.	Shortlist of successful applicants. Issue of admission letters. Receiving the learners at the institute. Orientating learners.	Use of information and communication technology skills. Good communication skills. Career guidance. Records management. Administration skills.	Academic registrar Heads of department And mater in duty.
Teaching and learning processes	Planning and organizing Scheming Organizing lesson notes Preparation of lesson plans Conducting teaching and learning.	Knowledge of subject matter Communication skills Management skills.	Heads of departments Subject Lecturers. Learners Artisan
Organizing field trips	Communicating to students. Preparing means of transport. Record taking. Report writing	Knowledge of subject matter Communication skills Management skills.	Heads of departments. Subject lecturers.
Industrial training attachment	Placement of trainees. Preparation of supervision tools. Supervising trainees. Supervision report writing	Mentoring skills. Observe safety Identify tools and equipment Counseling and guidance.	Head of industrial training and thesis report writing. Lecturing staff. Academic registrar
Project work	Preparation of introduction letters. Attachment of students to organizations for research work. Writing proposal and thesis report writing. Marking reports. Completing assigned practical work.	ICT skills required. Research and thesis writing report. Good inter personal relation skills. Practical knowledge of performing tasks.	Heads of Departments Head of industrial training and thesis report writing.
Assessment and evaluation	Set tests items. Preparation of formative exams. Administer assignments.	Communication skills Knowledge of subject matter. Professional ethic. Time management and item writing skills	Academic registrar Heads of departments Lecturers Uganda Business Technical Examination Board (UBTEB)

Source: Primary Data 2022

Appendix 5: Future workshop

Critique phase of the Future Workshop   *Participants at future workshop on 20th March, 2022*

Source: Primary Data 2022

Appendix 6: Future workshop consent letter

We the people listed below hereby sign this letter as a proof of acceptance that our photos taken during "future workshop" on 20/03/2022 from Fisheries Training Institute boat yard be used for the purpose of the intended research work.

S/N	Name	Title	Signature	Date
01	Behangana Urban	Deputy Principal		
02	Ojur Steven	Head of department BB & MM		
03	Orach Everline	Head ICT department		
04	Nyeko Constantine	BB& MM Lecturer		
06	Kizito Vicent	Student BB & MM		
07	NatukwasaElijjah	Student BB & MM		
08	Aziku Rashid	Assistant Lecturer BB & MM		
09	Jurua Alfred	Artisan		

Source: Primary Data 2022

Appendix 7: Interview guide for administrators, lecturers and students

Dear respondent,

I am a student of Kyambogo University pursuing a Master's degree in Vocational Pedagogy. As a culture of the university, each candidate has to conduct research in order to qualify for the award of the degree. I am therefore carrying out research as part of the requirement for the attainment of Master's degree in Vocational pedagogy. I therefore kindly request you to spare for me some time to answer some questions. The information received from this interview shall be treated as confidential matters.

The interview questions:

What are the gaps hindering enhancing competence development in drawing of boat plans at Fisheries Training Institute?

How can we uplift the standard of drawing boat plans?

Which strategy can we identify and implement in order to improve drawing of boat plants.

How relevant will the identified strategy be over the existing strategy?

Thank you for the cooperation.

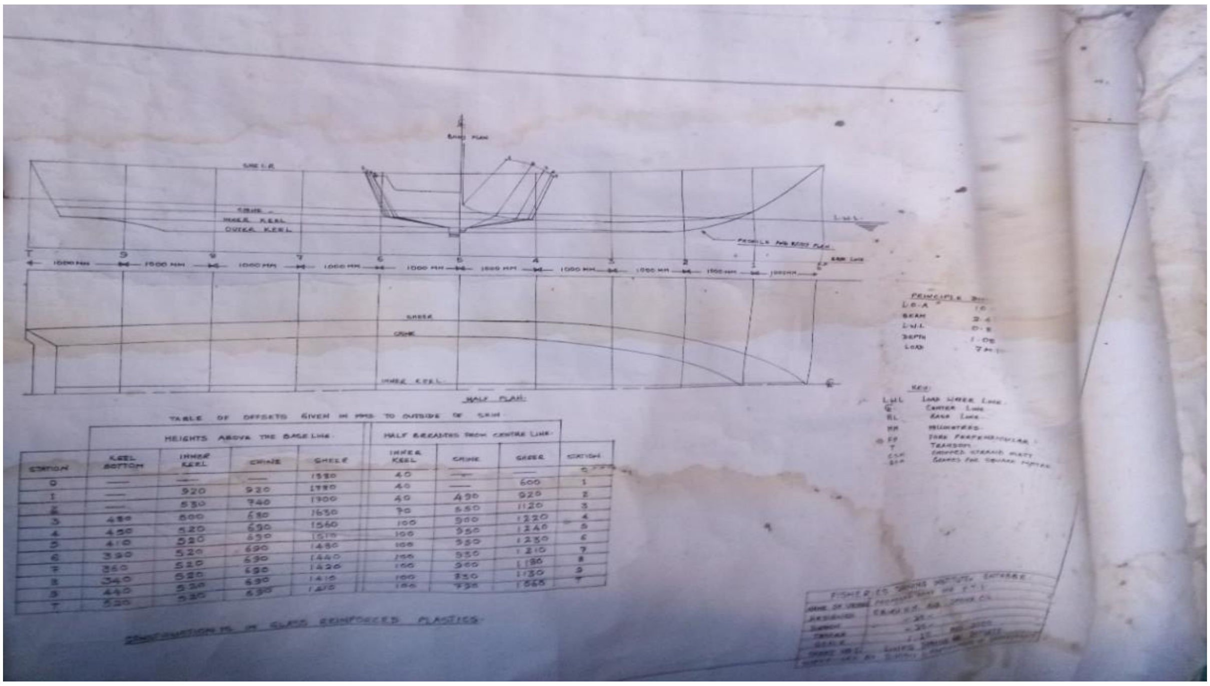
Opwonya Nelson

19/U/GMVP/19021/PD

Appendix8: Interview meeting with the Acting Principal

Source: Primary Data 2022

Appendix 9: Dampness affects drawing paper color



Source: Primary Data 2022

Appendix10: Table of offsets extracted from table 7 using scale 1:10 for the construction of prototype

	Heights Above Baseline (H.A.B)				Halve Breadth (H.B)			
Station	**Rebate line**	**Chine line**	**Sheer line**		**Rebate line**	**Chine line**	**Sheer line**	**Station**
Transom	14mm	32mm	92mm		4mm	32mm	46mm	Transom
6	10mm	24mm	84mm		4mm	52mm	68mm	6
5	7mm	20mm	80mm		4mm	66mm	80mm	5
4	6mm	16mm	78mm		4mm	72mm	84mm	4
3	8mm	18mm	80mm		4mm	68mm	80mm	3
2	100mm	22mm	88mm		4mm	52mm	64mm	2
1	14mm	32mm	100mm		4mm	24mm	40mm	1

Source: Primary Data 2022

Appendix 11: General specifications for the production of prototype - scale 1:10

Length Over All (L.O.A)	900mm	0.9m
Beam	168mm	0.168m
Depth	80mm	0.08m
Fore Perpendicular height	128mm	0.128m
Fore perpendicular to ST1	180mm	1.8m
ST1 to fore end of keel	28mm	0.028m
Transom rake	9^0	9^0

Source: Primary Data 2022

Appendix 12: Traditional hand tools used for drawing boat plans.

Source: Primary Data 2022

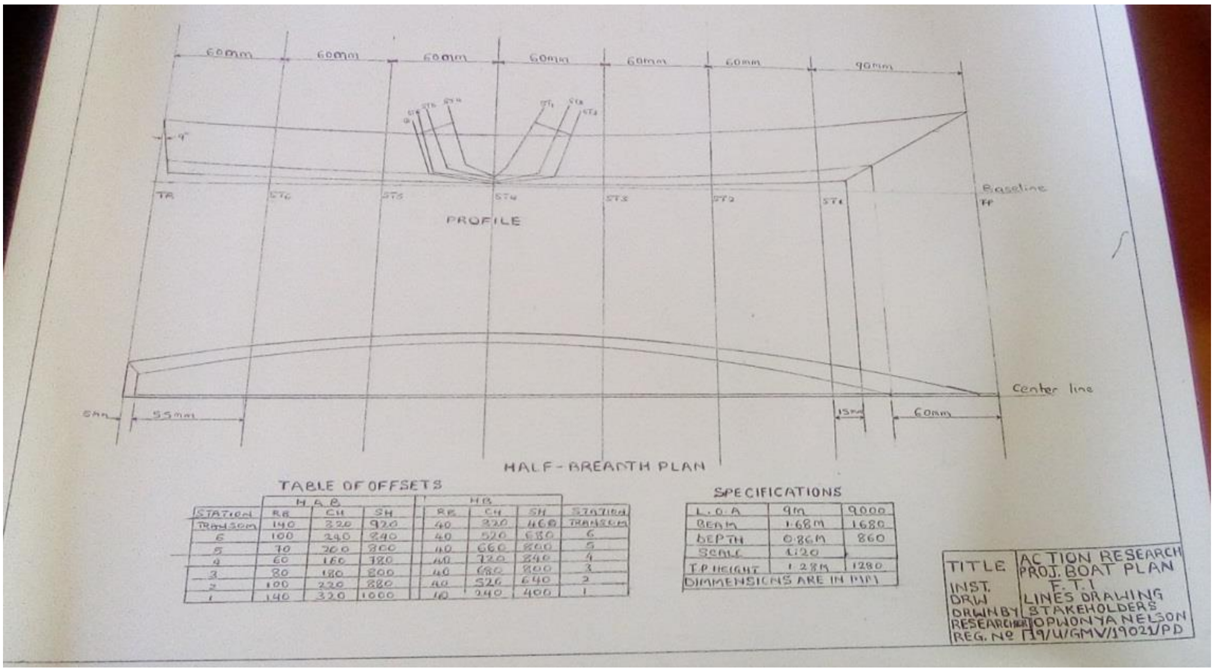
Source: Primary Data 2022

Appendix 13: Stakeholders working as a team to draw boat plan using hand tools and boat plans drawn showing lines drawing and construction details.

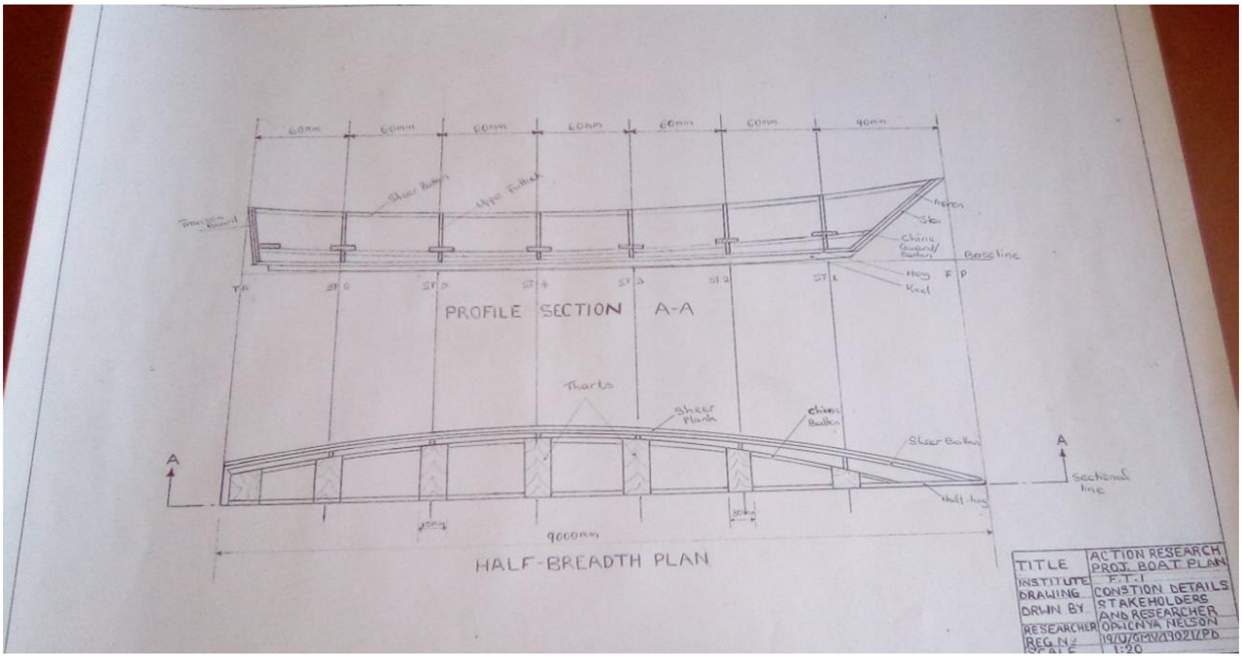
Source: Primary Data 2022

Source: Primary Data 2022

Appendix 14: Lines drawing and construction details prepared by stakeholders using hand tools



Lines drawing prepared using hand tools. **Source: Primary Data 2022**



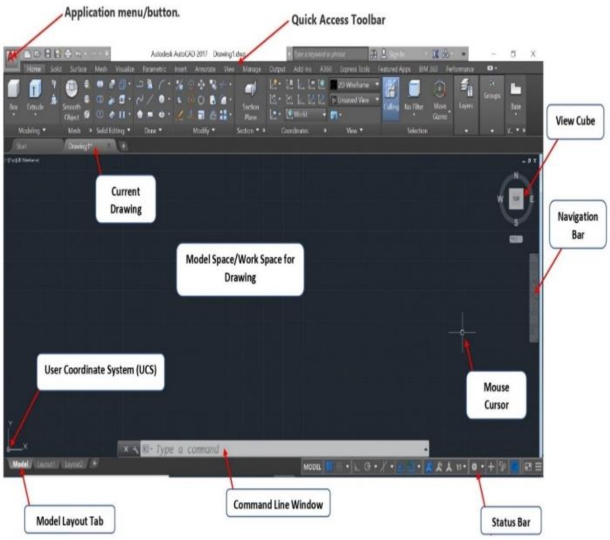
Construction Details **Source: Primary Data 2022**

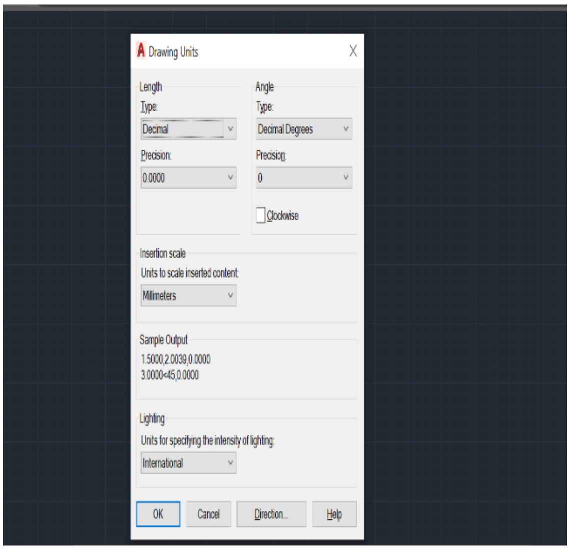
Appendix15: Learners attending introduction of AutoCAD lecture at Fisheries Training Institute ICT Laboratory.

Source: Primary Data 2022

Appendix 16: Trainees learning to open AutoCAD work space

Source: Primary Data 2022

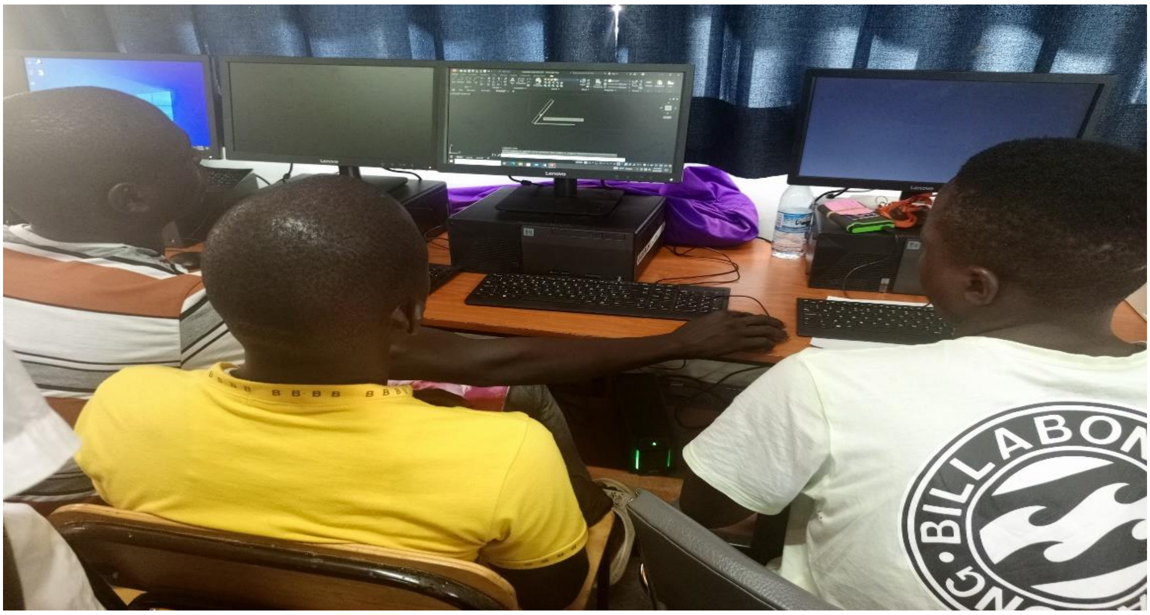


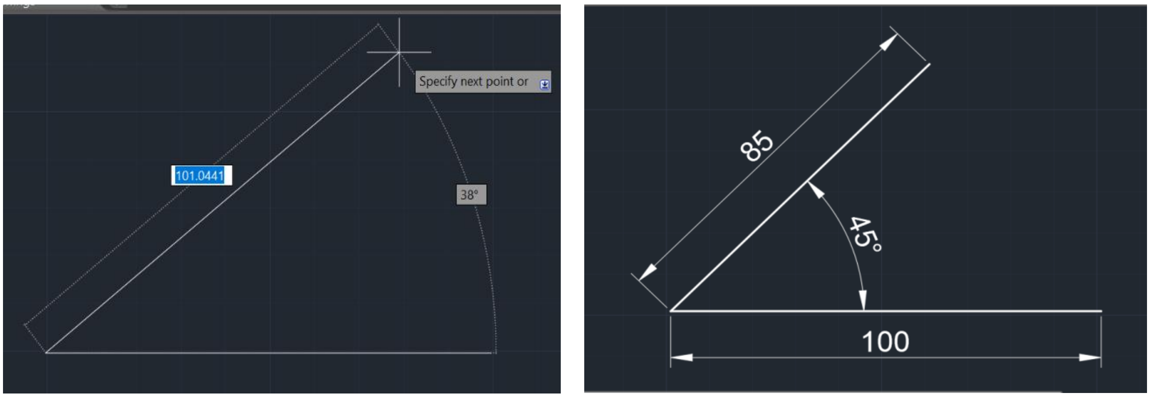


Workspace of AutoCAD software *Display for unit selection on the work space*

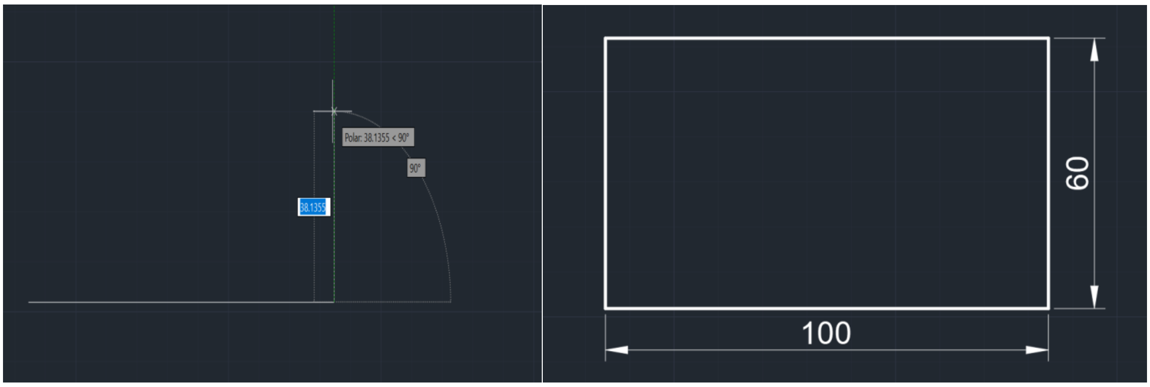
Source: Primary Data 2022

Appendix 17: Trainees practicing drawing angles and rectangles



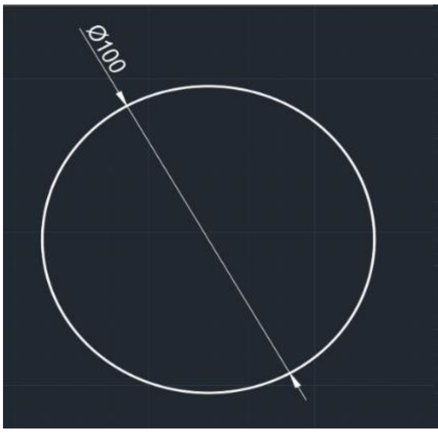


Angle construted at 45^{0}



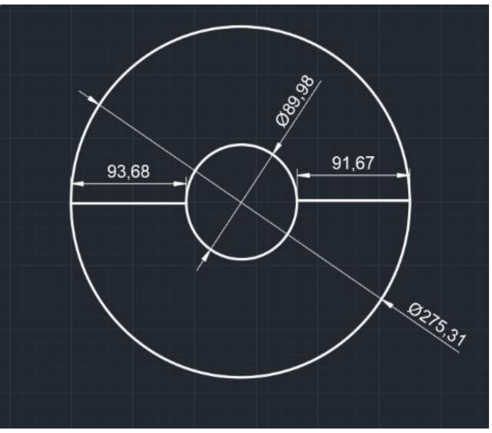
Constructing a rectangle using modern tool. **Source: Primary Data 2022**

Appendix 18: Trainees constructing circles. Tangents, triangle and polygons



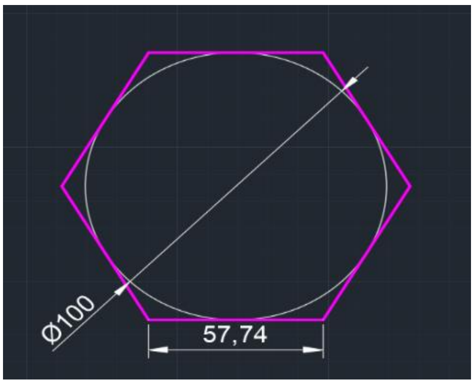
Constructing circle using

(Center diameter method)

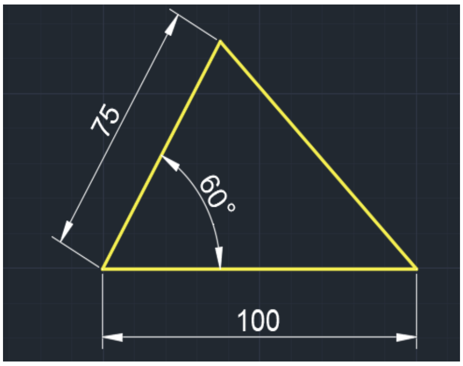


Constructing circles

(Pointmethod)



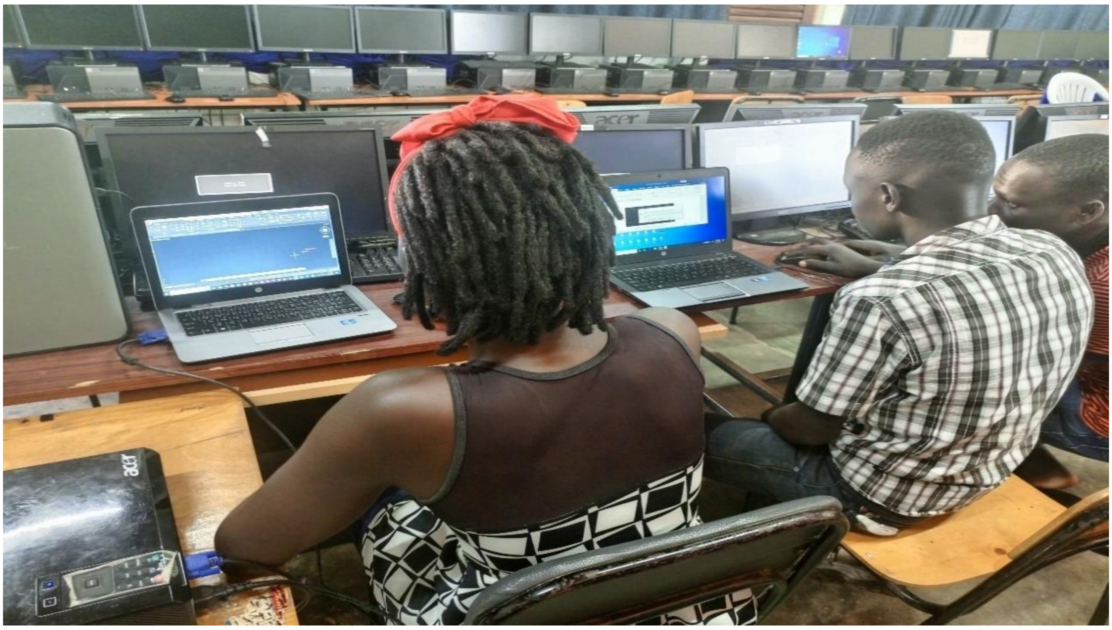
Regular hexagon circumscribed using AutoCAD.



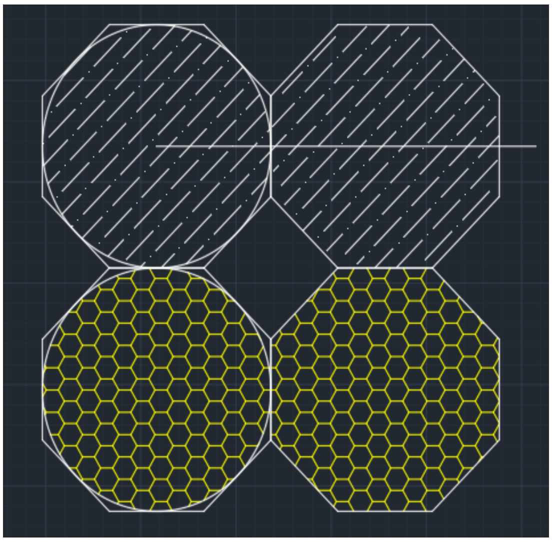
Triangle drawn using angular method

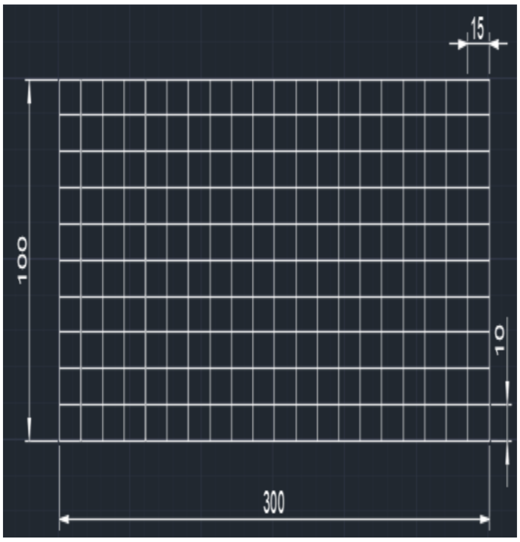
Source: Primary Data 2022

Appendix 19: Students practicing construction of grids and shapes mirroring one another



Source: Primary Data 2022

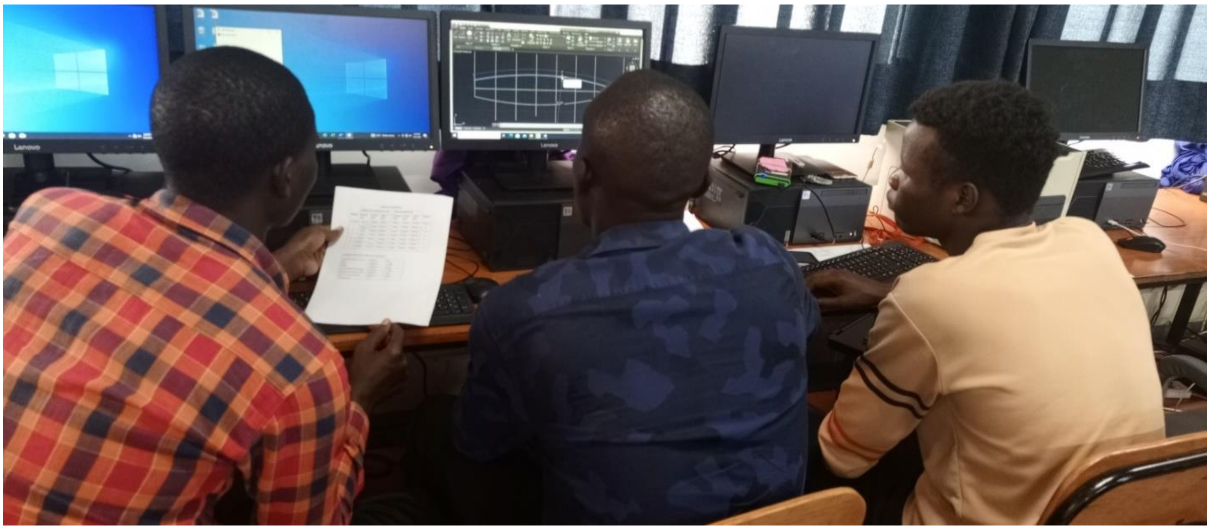




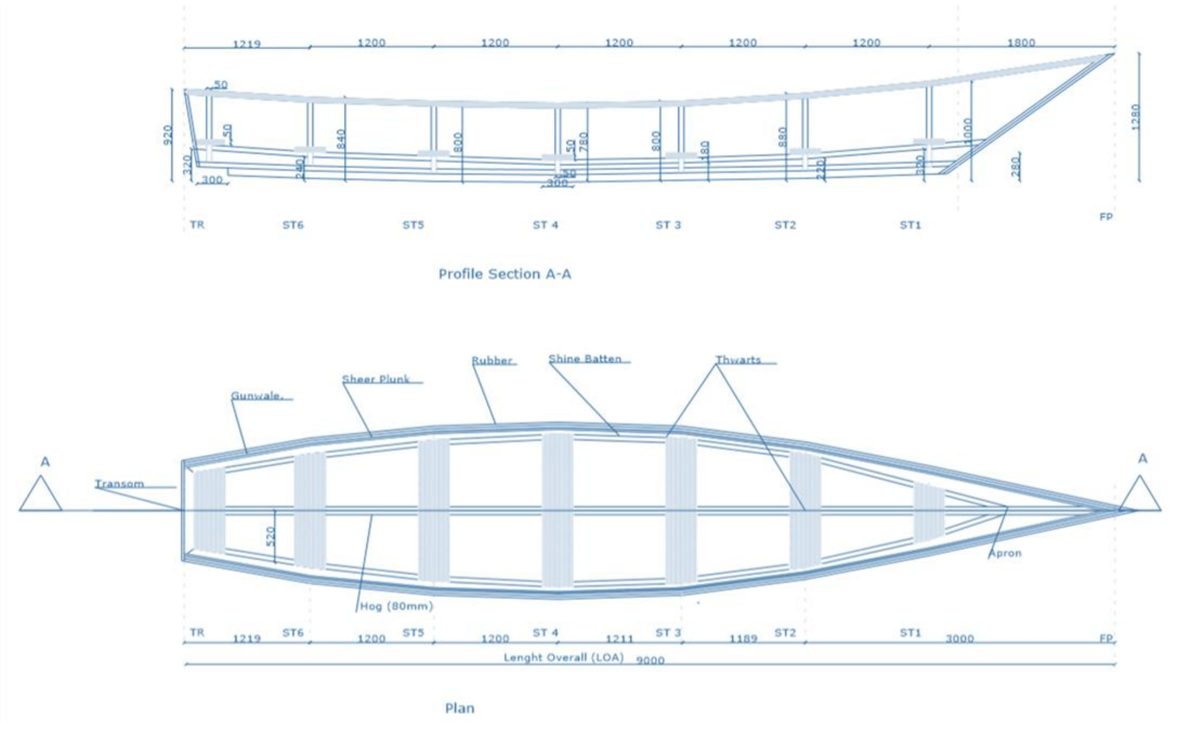
Polygons drawn mirroring one another ***Grids constructed by the trainees***

Source: Primary Data 2022

Appendix 20: Trainees practicing producing (lines drawing) plan of a boas using AutoCAD



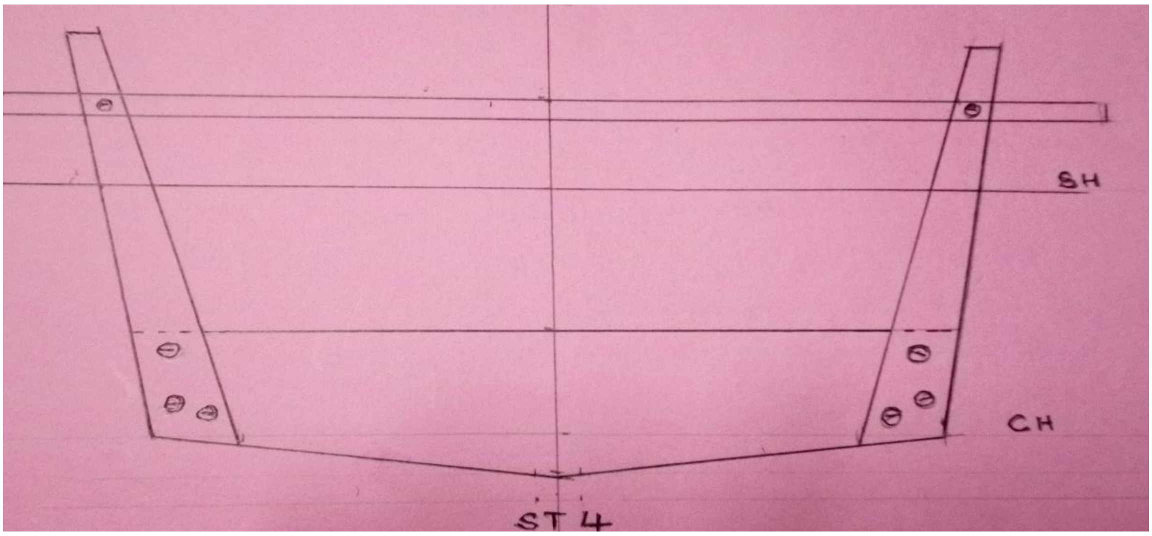
Source: Primary Data 2022



Construction details of a boat plan **Source: Primary Data 2022**

Appendix21: Trainee lofting to obtain frames for constructing a scale model boat (Prototype) on manila papers.

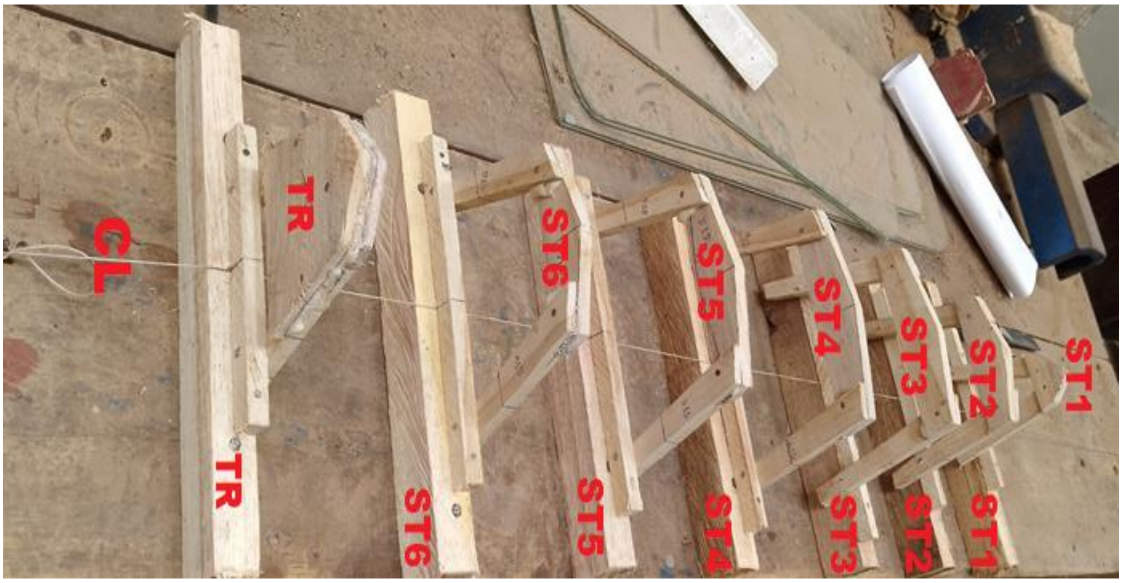
Source: Primary Data 2022



Frame number 4 lofted on manila paper **Source: Primary Data 2022**

Appendix 22: Setting frames on a building jig

A building jig prepared to receive frames **Source: Primary Data 2022**



Frames assembled on a building jig **Source: Primary Data 2022**

Appendix 23: Planking of the prototype and the produced prototype

Scale model (prototype) at planking stage **Source: Primary Data 2022**

Profile of a constructed prototype **Source: Primary Data 2022**

Appendix 24: Stake-holders on summative evaluation meeting on 28th August, 2022

Source: Primary Data 2022

Appendix 25: A questionnaire used during summative evaluation of the incorporated method of drawing boat plans

	Responses	**Strongly Agree**	**Agree**	**Undecided**	**Disagree**	**Strongly Disagree**
1	AutoCAD produces better clearer drawings which are smarter than hand tools.					
2	Two dimensional (2D) drawings are easier to produce using AutoCAD than hand tools.					
3	AutoCAD contributes positively and beneficially in the learning Environment of technical drawing in general.					
4	My usual output in AutoCAD is more accurate than the manual drawing output.					
5	I apply the knowledge of AutoCAD in planning and designing.					
6	AutoCAD has simplified drawings.					
7	AutoCAD can be used by only one person to produce a drawing of a component.					
8	Work in progress can be stored within the computer; when using AutoCAD.					
9	AutoCAD uses inbuilt scales and dimensions and there is no need for hand tools for the measurements.					
10	The administration of FTI should embrace the use of AutoCAD to improve drawing of boat plans.					

Source: Primary Data