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Development Of Content For Capacity Building Module For Teaching Maintenance Of Milling Machines In Mechanical Engineering Craft Practice In Technical Colleges In Delta State

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ABSTRACT

This study, titled "Development of Content for Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State," aims to enhance the instructional quality of milling machine maintenance through a well-structured capacity building module. The research employs a Research and Development (R&D) design to systematically develop and evaluate the content necessary for effective teaching. The study targeted a population of 68 staff, including 28 technical teachers and 40 workshop instructors from six technical colleges in Delta State. A sample of 70 staff, comprising 26 technical teachers and 44 workshop instructors, was studied, making it a census study with no sampling technique applied. Data were collected using a structured questionnaire developed by the researcher, titled 'Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice' (MTMMMMECP). The questionnaire included sections on preventive, corrective, predictive, and proactive maintenance, as well as safety measures. To ensure validity, the instrument was reviewed by three experts from Ignatius Ajuru University of Education and Government Technical College, Agbor. Reliability was established with a Cronbach Alpha coefficient of 0.87, determined through a pilot test on 20 teachers and 10 instructors at Government Technical College, Ahoada. The findings indicate that all content areas—preventive, corrective, predictive, and proactive maintenance, along with safety measures—are deemed appropriate for inclusion in the module. There were no significant differences between the mean responses of technical teachers and workshop instructors regarding the content of the module. The study recommends incorporating preventive maintenance practices, focusing on corrective maintenance, and including predictive maintenance techniques and safety measures in the curriculum. It also suggests that the National Board for Technical Education support the module's integration into educational programs to improve the training quality for mechanical engineering craft practice students.

Keywords: Milling Machine, Capacity Building Module, Teaching Maintenance

INTRODUCTION

The development of educational content is a critical component in capacity-building initiatives, particularly within technical and vocational education. In technical colleges, where the emphasis is on practical skills and

hands-on training, the creation of well-structured and comprehensive instructional materials is crucial for ensuring that students are adequately prepared for the demands of the workforce. This is especially true in the field of mechanical engineering craft practice, where students must acquire not only theoretical knowledge but also practical skills in maintaining complex machinery such as milling machines. The content developed for a capacity-building module in this context must be carefully designed to meet the specific needs of students, instructors, and the industry, ensuring that graduates possess the competencies required to succeed in their careers. Alciso et al. (2023) emphasized that the development of instructional materials should align with the realities of the workplace, ensuring that the content is both informative and engaging.

Content development is the process of creating educational materials that are both informative and engaging, tailored to the specific needs of the learners. In the context of technical education, content development must align with industry standards and the practical realities of the workplace. For mechanical engineering craft practice, this means developing content that covers all aspects of milling machine maintenance, from basic principles to advanced techniques. The content must be comprehensive enough to provide a solid foundation in mechanical theory while also being practical enough to give students the hands-on experience they need. Effective content development requires collaboration between educators, industry professionals, and subject matter experts. This ensures that the content is not only academically rigorous but also relevant to current industry practices. In the case of milling machines, the content should cover topics such as machine operation, troubleshooting, repair techniques, preventive maintenance, and safety procedures. Each of these topics should be presented in a way that is accessible to students, with clear explanations, step-by-step guides, and practical exercises that reinforce learning. According to Ordu (2020), a well-developed module for teaching maintenance must include practical components that align with the specific trade requirements, such as those found in mechanical engineering craft practice.

The content should begin with an overview of milling machines, including their history, development, and various types. This section should introduce students to the basic components of a milling machine, such as the spindle, table, knee, and column, and explain their functions. The goal is to provide students with a solid understanding of how milling machines work, which is essential for effective maintenance. Following this, the content should delve into the principles of milling machine operation. This includes an explanation of how material is removed from a workpiece using rotating cutters, the types of cuts that can be made, such as face milling, end milling, and slotting, and the factors that affect the quality of the finished product. This section should also cover the various settings and adjustments that can be made to the machine to achieve different results, such as adjusting the feed rate, spindle speed, and depth of cut. Kalpakjian and Schmid (2018) highlighted the importance of understanding these principles to ensure that students can effectively operate and maintain milling machines in real-world settings.

The core of the content should focus on the maintenance techniques necessary to keep milling machines in optimal working condition. This includes preventive maintenance, such as regular inspections, lubrication, and cleaning, as well as corrective maintenance, which involves diagnosing and repairing issues as they arise. The content should provide detailed instructions on how to perform these tasks, including the tools and materials needed, the steps involved, and the safety precautions that must be taken. According to Bayle (2017), preventive maintenance is crucial in preventing unplanned downtime and ensuring the longevity of the equipment. In addition to routine maintenance, the content should cover troubleshooting and repair techniques. This section should teach students how to identify common issues with milling machines, such as misalignment, worn components, or electrical problems, and how to resolve them. The content should include troubleshooting guides, flowcharts, and case studies that illustrate real-world scenarios. Students should learn how to systematically diagnose problems, determine the root cause, and implement effective solutions. Wang et al. (2013) emphasized the importance of having a robust troubleshooting framework to quickly address and fix problems that may arise during machine operation.

Safety is a critical aspect of any technical training, and the content must emphasize the importance of following proper safety procedures when working with milling machines. This section should cover the potential hazards associated with milling operations, such as flying debris, sharp edges, and moving parts, and provide guidelines for minimizing risk. Students should be trained in the use of personal protective equipment (PPE), safe work practices, and emergency response procedures. Igweabara (2019) pointed out that adherence

to safety measures not only protects the operators but also prolongs the life of the equipment by preventing accidents that could cause damage to the machinery.

To ensure that students have mastered the content, the module should include a variety of assessment tools. These might include quizzes, practical exams, and project-based assessments that require students to demonstrate their knowledge and skills in a real-world setting. The content should also provide instructors with guidance on how to evaluate student performance, including rubrics and grading criteria. Hamid et al. (2017) noted that continuous assessment is vital for identifying gaps in student knowledge and providing timely feedback to help them improve.

The effectiveness of the content depends not only on what is taught but also on how it is taught. Therefore, the development of this capacity-building module should incorporate a variety of instructional strategies to engage students and enhance learning outcomes. These strategies might include hands-on workshops, where students can apply what they have learned by working directly with milling machines; interactive simulations that allow students to practice maintenance techniques in a virtual environment before applying them in the workshop; case studies that provide real-world examples of the challenges and solutions involved in milling machine maintenance; and group projects that encourage teamwork and problem-solving skills. Kowitlawakul et al. (2017) highlighted the importance of combining practical and theoretical learning to ensure a comprehensive educational experience that prepares students for the demands of the industry.

In conclusion, the development of content for a capacity-building module on the maintenance of milling machines in mechanical engineering craft practice is a complex but essential task. The content must be comprehensive, covering all aspects of machine operation and maintenance, while also being practical and accessible to students. By focusing on key topics such as machine components, principles of operation, maintenance techniques, troubleshooting, and safety, and by employing effective instructional strategies, this module will equip students with the skills and knowledge they need to succeed in the workforce. The ultimate goal, as emphasized by Osuyi et al. (2021), is to ensure that graduates of technical colleges in Delta State are well-prepared to meet the demands of the industry and contribute to the economic development of the region.

Statement of the Problem

There is a growing concern regarding the inadequate performance of technical college graduates, particularly those specializing in mechanical engineering craft practice, who struggle to meet the demands of the workforce. The objective of mechanical engineering craft practice in Nigerian technical colleges, as outlined by the National Board for Technical Education (cited in Amadi & Obed, 2018), is to produce skilled craftsmen who possess a strong understanding of machine operation, maintenance techniques, and safety practices. Graduates are expected to either secure employment in industries, establish their own mechanical workshops, or pursue further education in higher institutions.

However, this goal has not been consistently achieved, as many students are completing their programs with substandard academic performance and insufficient practical skills, rendering them unprepared for gainful employment. A significant factor contributing to this issue is the lack of well-developed instructional content that effectively addresses the teaching and maintenance of critical equipment, such as milling machines, in technical colleges. Even where machines are available, they often suffer from poor maintenance, and the instructional content provided is often inadequate, failing to impart the necessary skills and knowledge. Osuyi et al. (2021) highlighted the regrettable state of tools, equipment, and machines in laboratories and workshops, which deteriorate due to the failure to implement effective preventive and comprehensive maintenance practices.

In response to these challenges, this study focuses on the development of instructional content within a capacity-building module for teaching the maintenance of milling machines in mechanical engineering craft practice within technical colleges in Delta State. The aim is to enhance the quality of education by providing well-structured, comprehensive content that equips students with the necessary skills and knowledge to excel in their chosen careers and contribute meaningfully to the workforce.

Aim and Objectives of the Study.

The study aims to develop a comprehensive content capacity-building module for teaching the maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State, focusing on critical maintenance practices and safety measures. The objectives of the study are to:

1. To determine the **Corrective Maintenance Contents** to be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.

2. To ascertain the **Predictive Maintenance Contents** to be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.
3. To examine the **Proactive Maintenance Contents** to be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.
4. To investigate the **Safety Measures Contents** to be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.
5. To find out the **Evaluation Techniques** suitable for assessing the effectiveness of the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.

Research Questions

The following research questions guide the study:

1. **What are** the **Corrective Maintenance Content** that should be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State?
2. **What are** the **Predictive Maintenance Content** that should be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State?
3. **What are** the **Proactive Maintenance Content** that should be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State?
4. **What are** the **Safety Measures** that should be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State?
5. **What are** the appropriate **Evaluation Techniques** for assessing the effectiveness of the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State?

Hypotheses

The following five hypotheses were formulated to guide the study.

1. There is no significant difference between the mean responses of technical teachers and workshop instructors on the Corrective Maintenance Contents to be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.
2. There is no significant difference between the mean responses of technical teachers and workshop instructors on the Predictive Maintenance Contents to be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.
3. There is no significant difference between the mean responses of technical teachers and workshop instructors on the Proactive Maintenance Contents to be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.
4. There is no significant difference between the mean responses of technical teachers and workshop instructors on the Safety Measures to be included in the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.
5. There is no significant difference between the mean responses of technical teachers and workshop instructors on the Evaluation Techniques suitable for assessing the effectiveness of the developed capacity-building module for teaching maintenance of milling machines in mechanical engineering craft practice in technical colleges in Delta State.

Significance of the Study

This study will significantly benefit mechanical engineering craft practice students, technical teachers, workshop instructors, the National Board of Technical Education (NBTE), curriculum planners, school administrators, and

government agencies. By developing a comprehensive capacity-building module for teaching the maintenance of milling machines in mechanical engineering craft practice, the study aims to address the current gaps in technical education.

The findings will greatly impact students in the mechanical engineering craft practice department by providing them with a structured and detailed curriculum on milling machine maintenance. This will enhance their practical skills and prepare them for employment or self-employment opportunities in the mechanical engineering field.

For technical teachers and workshop instructors, the developed module will offer a well-rounded approach to teaching milling machine maintenance, including corrective, predictive, proactive maintenance, and safety measures. This will facilitate effective instruction and optimize the use of milling machines in technical colleges, thereby improving overall teaching outcomes.

The comprehensive nature of the module—covering objectives, content, teachers' and students' activities, instructional materials, methodologies, evaluation techniques, and safety measures—will support teachers and instructors in delivering high-quality education and practical training.

Scope of the Study

The study is focused on the development of a capacity-building module for teaching the maintenance of milling machines within mechanical engineering craft practice in technical colleges in Delta State. It specifically addresses the following areas: the content related to corrective, predictive, proactive maintenance, and safety measures; as well as the associated objectives, teachers' and students' activities, instructional materials, methodologies, and evaluation techniques.

METHODOLOGY

Research Design

The study adopted a Research and Development (R & D) design. This design was chosen because the study seeks to gather expert opinions on developing a module for teaching milling machine maintenance. It involves evaluating the module's objectives, content, teachers' activities, learners' activities, instructional materials, methodologies, and evaluation processes for integration into the Mechanical Engineering Craft Practice Trade in technical colleges.

Population for the Study

The target population for the study comprised 68 staff members, including 28 technical teachers and 40 workshop instructors across six technical colleges in Delta State.

Sample and Sampling Technique

The study employed a census approach, encompassing a total of 70 staff members from four technical colleges in Delta State. This included 26 technical teachers and 44 workshop instructors. No sampling technique was used as the entire population was studied.

Validity of the Instrument

The validity of the data collection instrument was ensured through face and content validation conducted by three experts—two from the Department of Technical Education at Ignatius Ajuru University of Education, Port Harcourt, and one from Government Technical College, Agbor.

Reliability of the Instrument

To confirm the reliability of the instrument, it was tested for face and content reliability with 20 teachers and 10 instructors from Government Technical College, Ahoada, Rivers State. The reliability coefficient was calculated using the Cronbach Alpha (α) method, resulting in a coefficient value of 0.87.

Instrument for Data Collection

The data collection instrument was a structured questionnaire titled 'Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice' (MTMMMMECP). This questionnaire was developed by the researcher following a review of related literature. It includes four sections—A, B, C, and D—corresponding to the study's objectives. The questionnaire employs a 5-point Likert scale with response categories: Highly Appropriate (HA) = 5, Appropriate (A) = 4, Moderately Appropriate (MA) = 3, Inappropriate (IA) = 2, and Highly Inappropriate (HI) = 1. Respondents indicate their opinions by marking the response category that best reflects their views.

Method of Data Analysis

Data collected from the structured questionnaire were analyzed using mean and standard deviation statistical tools to address the research questions on a 5-point Likert scale. Items with a mean score less than 3.50 were classified as 'inappropriate,' while those with a mean score equal to or greater than 3.50 were considered 'appropriate.' The t-test statistical tool was used to test the hypotheses at a probability value of 0.05. All statistical analyses were performed using the Statistical Package for Social Sciences version 2023 (SPSS-23) software.

DATA PRESENTATION/ANALYSIS

Research Question One

What are the contents to be included in the developed capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State?

Module 1: Preventive Maintenance

Table 4.2.2: Mean and Standard Deviation of Preventive Maintenance Contents to be included in the Developed Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

	Preventive maintenance	**Technical Teachers N =28**			**Workshop Instructors N = 40**		
S/No	**Contents**	$\bar{X}$	**SD**	**Remark**	$\bar{X}$	**SD**	**Remark**
1.	Preventive maintenance	3.83	.91	Appropriate	4.26	.98	Appropriate
2.	Purpose of maintenance of milling machine	4.27	.85	Appropriate	3.92	1.08	Appropriate
3.	Importance of maintenance of milling machine	3.93	1.00	Appropriate	4.24	.97	Appropriate
4.	Types and design of milling machines	4.20	.85	Appropriate	4.20	.913	Appropriate
5.	Preparation for setting-up and operation of horizontal or vertical milling machines	4.36	.89	Appropriate	4.00	1.08	Appropriate
6.	Setting-up and operation of horizontal milling machines	3.93	1.00	Appropriate	4.24	.97	Appropriate
7.	Setting-up and operation of vertical milling machines	4.14	1.15	Appropriate	4.12	1.05	Appropriate
8.	Maintenance of milling machines	4.16	1.14	Appropriate	3.92	1.04	Appropriate
9.	Servicing of milling machines	4.14	.98	Appropriate	4.32	.69	Appropriate
10.	cleaning of guide ways	3.98	.93	Appropriate	4.00	.96	Appropriate
11.	Inspection of oil level (sight glasses)	4.14	.93	Appropriate	3.72	.98	Appropriate
12.	Lubrication as per instructions on lubrication chart	4.05	1.01	Appropriate	4.00	1.08	Appropriate
13.	semi-annually/annually renewal of Oil	4.11	.90	Appropriate	4.04	.94	Appropriate
14.	Inspection and, if necessary, refilling of coolant tank in every week	4.25	.92	Appropriate	4.24	1.05	Appropriate
15.	Thorough cleaning of the machine in every week	3.82	1.06	Appropriate	3.92	.86	Appropriate
16.	Annually inspection of slackness of bearings	4.16	1.01	Appropriate	4.44	.82	Appropriate
17.	Inspection of electrics (contactors, limit switches, cable connections) in every 3 months	3.95	.91	Appropriate	4.04	.89	Appropriate
18.	Semi-annually inspection of lubrication pump	4.11	.92	Appropriate	4.36	.81	Appropriate
19.	Semi-annually coolant renewal	4.00	.96	Appropriate	4.12	.60	Appropriate
20.	Characteristics of lubricants and coolants applied	3.89	1.15	Appropriate	4.04	1.24	Appropriate
	Grand Mean/SD	**4.08**	**.97**	**Appropriate**	**4.10**	**.95**	**Appropriate**

Source: Researcher's Field Survey(2023)

Data in Table 4.2.2 revealed that technical teachers had a mean range of 3.82-4.36 and standard deviation range of .85 – 1.15 with the grand mean and standard deviation as 4.08 and .97 respectively. The workshop instructors had a mean range of 3.72-4.44 and standard deviation range of .60-1.24 with the grand mean and standard deviation as 4.10 and .95 respectively. This indicate that the respondents agreed that items of the preventive maintenance contents are appropriate to be included in the developed capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State. The closeness of the standard deviation shows the homogeneity of the respondents.

Module 2: Corrective Maintenance

Table 4.2.3: Mean and Standard Deviation of Corrective Maintenance Contents to be included in the Developed of Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

		Technical Teachers N =28			Workshop Instructors N = 40		
	Corrective maintenance						
S/No	**Contents**	$\bar{X}$	**SD**	**Remark**	$\bar{X}$	**SD**	**Remark**
1	Meaning of corrective maintenance	4.14	.96	Appropriate	3.92	.81	Appropriate
2	Important of corrective maintenance on milling machine	3.82	1.04	Appropriate	4.12	.97	Appropriate
3	Speed changing lever broken maintenance procedure	3.91	1.12	Appropriate	4.04	.84	Appropriate
4	V-belt totally damaged maintenance procedure	3.77	1.05	Appropriate	3.72	1.14	Appropriate
5	Replace all damaged parts; e.g. gears in various box, spindle, bearing	4.14	.85	Appropriate	4.12	.83	Appropriate
6	Replace the worn-out bolts and nuts.	3.84	.99	Appropriate	4.00	.65	Appropriate
7	State the disadvantages of corrective maintenance	3.75	1.06	Appropriate	3.84	1.11	Appropriate
8	Work holding components associated problems on milling machine	3.95	1.29	Appropriate	4.48	.71	Appropriate
9	Cutting tool associated problems	4.07	.87	Appropriate	4.20	.76	Appropriate
10	Headstock associated problems.	3.77	1.3	Appropriate	4.12	.93	Appropriate
	Grand Mean/SD	**3.92**	**1.05**	**Appropriate**	**4.06**	**.88**	**Appropriate**

Source: Researcher's Field Survey(2023)

Data in Table 4.2.3 revealed that technical teachers had a mean range of 3.75 - 4.14 and standard deviation range of .85 - 1.30 with the grand mean and standard deviation as 3.92 and 1.05 respectively. The workshop instructors had a mean range of 3.72 - 4.48 and standard deviation range of .65 - 1.14 with the grand mean and standard deviation as 4.06 and .88 respectively. This indicate that the respondents agreed that items of the corrective maintenance contents are appropriate to be included in the developed capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State. The closeness of the standard deviation shows the homogeneity of the respondents.

Module 3: Predictive Maintenance

Table 4.2.4: Mean and Standard Deviation of Predictive Maintenance Contents to be included in the Developed of Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

	Predictive Maintenance	**Technical Teachers N =28**			**Workshop Instructors N = 40**		
S/No	**Contents**	$\bar{X}$	**SD**	**Remark**	$\bar{X}$	**SD**	**Remark**
1	Meaning of Predictive maintenance	3.84	.99	Appropriate	3.87	.81	Appropriate
2	Important of corrective maintenance on milling machine	3.82	1.04	Appropriate	3.99	.97	Appropriate
3	Speed changing lever broken maintenance procedure	3.91	1.12	Appropriate	3.96	.84	Appropriate
4	V-belt totally damaged maintenance procedure	3.77	1.05	Appropriate	3.72	1.14	Appropriate
5	Replace all damaged parts; e.g. gears in various box, spindle, bearing	3.77	1.27	Appropriate	3.88	.83	Appropriate
6	Replace the worn-out bolts and nuts.	3.84	.987	Appropriate	3.99	.65	Appropriate
7	State the disadvantages of corrective maintenance	3.75	1.06	Appropriate	3.84	1.11	Appropriate
8	Work holding components associated problems on milling machine	3.95	1.29	Appropriate	4.48	.71	Appropriate
9	Cutting tool associated problems	3.85	.873	Appropriate	3.78	.73	Appropriate
10	Headstock associated problems.	3.77	1.27	Appropriate	3.81	.93	Appropriate
	Grand Mean/SD	**3.92**	**1.05**	**Appropriate**	**4.06**	**.88**	**Appropriate**

Source: Researcher's Field Survey(2023)

Data in Table 4.2.4 revealed that technical teachers had a mean range of 3.75-3.95 and standard deviation range of .87-1.29 with the grand mean and standard deviation as 3.92 and 1.05 respectively. The workshop instructors had a mean range of 3.72-4.48 and standard deviation range of .65-1.14 with the grand mean and standard deviation as 3.93 and .87 respectively. This indicate that the respondents agreed that items of the predictive maintenance contents are appropriate to be in the developed capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State. The closeness of the standard deviation shows the homogeneity of the respondents.

Module 4: Proactive Maintenance

Table 4.2.5: Mean and Standard Deviation of Proactive Maintenance Contents to be included in the Developed of Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

S/No	Proactive Maintenance Contents	Technical Teachers N =28			Workshop Instructors N = 40		
		$\bar{X}$	SD	Remark	$\bar{X}$	SD	Remark
1	Meaning: Is a proactive maintenance strategy that uses condition monitoring tools to detect various deterioration.	4.27	.758	Appropriate	4.08	1.04	Appropriate
2	Goal of predictive maintenance is to optimize the usage of milling machine maintenance resources	4.16	.713	Appropriate	3.96	1.02	Appropriate
3	Installed condition-monitoring sensors send real-time performance data and machine health data	4.09	.960	Appropriate	4.04	.889	Appropriate
4	Internet of things (IoT) technology enables the communication between machines, software solutions, and cloud technology;	4.18	.922	Appropriate	4.16	.943	Appropriate
5	Predictive data models are fed with all of that processed data so they can spit out failure predictions	4.16	.888	Appropriate	4.16	.746	Appropriate
6	It is based on precise formulas in addition to sensor measurements	4.16	.713	Appropriate	3.96	1.02	Appropriate
7	Maintenance is performed with the analysis of the measured parameters	4.09	.960	Appropriate	4.04	.889	Appropriate
8	Oil/lubrication analysis	4.18	.922	Appropriate	4.16	.943	Appropriate
9	Vibration analysis/dynamic monitoring	4.18	.922	Appropriate	4.16	.943	Appropriate
10	Motor circuit analysis	4.16	.888	Appropriate	4.16	.746	Appropriate
11	Different variations of thermography	4.09	.960	Appropriate	4.04	.889	Appropriate
12	Ultrasonic and acoustic analysis	4.18	.922	Appropriate	4.16	.943	Appropriate
13	Radiography/radiation analysis	4.16	.888	Appropriate	4.16	.746	Appropriate
14	Laser interferometry electromagnetic measurements	4.30	.978	Appropriate	4.08	.997	Appropriate
15	Different performance measurements	4.05	.939	Appropriate	3.96	1.02	Appropriate
	Grand mean/SD	**4.16**	**.89**	**Appropriate**	**4.09**	**.92**	**Appropriate**

Source: Researcher's Field Survey(2023)

Data in Table 4.2.5 revealed that technical teachers had a mean range of 3.82-4.36 and standard deviation range of .85 – 1.15 with the grand mean and standard deviation as 4.16 and .89 respectively. The workshop instructors had a mean range of 3.72-4.44 and standard deviation range of .60-1.24 with the grand mean and standard deviation as 4.09 and .92 respectively. This indicate that the respondents agreed that items of the proactive maintenance contents are appropriate to be included in the developed capacity building module for

teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State. The closeness of the standard deviation shows the homogeneity of the respondents.

Module 5: Safety Measures

Table 4.2.6: Mean and Standard Deviation of Safety Measures Contents to be included in the Developed of Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

		Technical Teachers N =28			Workshop Instructors N = 40		
	Safety Measures						
S/No	**Contents**	$\bar{X}$	**SD**	**Remark**	$\bar{X}$	**SD**	**Remark**
1.	Meaning of safety measure	4.18	.97	Appropriate	4.28	.74	Appropriate
2.	Reasons for observing safety measures	3.86	.88	Appropriate	3.92	.91	Appropriate
3.	Sources of hazards in workshop	4.05	.94	Appropriate	4.28	.79	Appropriate
4.	Ways to prevent them	4.05	1.01	Appropriate	3.92	.64	Appropriate
5.	Application of factory safety regulations in machine shop	4.20	.98	Appropriate	4.04	.98	Appropriate
6.	Organizational structure to manage risk	4.09	.71	Appropriate	4.12	.88	Appropriate
7.	Identify workplace risk and implement suitable control	3.95	.99	Appropriate	4.08	1.00	Appropriate
8.	Classification safety equipment and wears	4.02	.79	Appropriate	4.28	.79	Appropriate
9.	State their application in working situations.	3.93	1.09	Appropriate	3.84	.94	Appropriate
10.	Safety rules and regulations relating to: clothing and hazards, workshop hygiene and movement, other behavours in workshop, fire protection etc.	3.95	1.16	Appropriate	3.68	.99	Appropriate
11.	Appropriate procedures in the events of a workshop accident	3.93	.90	Appropriate	3.96	1.09	Appropriate
12.	Important of first aids in workshop	4.00	1.03	Appropriate	4.20	.82	Appropriate
13.	Items contained in first aids box	4.14	.93	Appropriate	3.72	.94	Appropriate
	Grand Mean/SD	**4.09**	**.98**	**Appropriate**	**4.09**	**.95**	**Appropriate**

Source: Researcher's Field Survey(2023)

Data in Table 4.2.6 revealed that technical teachers had a mean range of 3.82-4.36 and standard deviation range of .85-1.15 with the grand mean and standard deviation as 4.09 and .98 respectively. The workshop instructors had a mean range of 3.72-4.44 and standard deviation range of .60-1.24 with the grand mean and standard deviation as 4.09 and .95 respectively. This indicate that the respondents agreed that items of the safety measures contents are appropriate to be included in the developed capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State. The closeness of the standard deviation shows the homogeneity of the respondents.

Test of the Postulated Hypotheses

The five (5) hypotheses postulated for the study were tested in this section using t-test statistical tool at the .05 level of significance

H_01: There is no significant difference between the mean responses of technical teachers and workshop instructors on the contents to be included in the developed capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State.

.**Module 1: Predictive Maintenance**

Table 4.8.1: t-test Analysis on Preventive Maintenance Contents to be included in the Developed Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

Respondents	N	Mean	Std. Deviation	df	p-value	t-cal.	t-crit.	Remark
Technical Teachers	20	4.08	.97					
				78	.05	.27	1.67	Accepted
Workshop Instructors	40	4.10	0.92					

Source: Researcher's Field Survey(2023)

Table 4.8.1 showed that t-cal. at (.27) is less than t-crit. at (1.67) which indicated that the stated null hypothesis was accepted. Thus, there is no significant difference between the mean responses of technical teachers and workshop instructors on the contents to be included in the developed capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State.

Module 2: Corrective Maintenance

Table 4.8.2: t-test Analysis on Corrective Maintenance Contents to be included in the Developed of Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

Respondents	N	Mean	Std. Deviation	df	p-value	t-cal.	t-crit.	Remark
Teachers	20	3.92	1.05					
				53	.05	.16	1.67	Accepted
Instructors	40	4.06	0.88					

Source: Researcher's Field Survey(2023)

Table 4.9.2 showed that t-cal. at (.16) is less than t-crit. at (1.67) which indicated that the stated null hypothesis was accepted. Hence, there is no significant difference between the mean responses of technical teachers and workshop instructors on corrective maintenance contents to be included in the developed of capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State.

Module 3: Predictive Maintenance

Table 4.8.3: t-test Analysis on Predictive Maintenance Contents to be included in the Developed of Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

Respondents	N	Mean	Std. Deviation	df	p-value	t-cal.	t-crit.	Remark
Technical Teachers	20	3.92	1.05					
				78	.05	.61	1.67	Accepted
Workshop Instructors	40	4.06	0.88					

Source: Researcher's Field Survey(2023)

Table 4.8.3 showed that t-cal. at (.61) is less than t-crit. at (1.67) which indicated that the stated null hypothesis was accepted. Thus, there is no significant difference between the mean responses of technical teachers and workshop instructors on corrective maintenance contents to be included in the developed of capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State.

Module 4: Proactive Maintenance

Table 4.9.4 t-test Analysis on Proactive Maintenance Contents to be included in the Developed of Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

Respondents	N	Mean	Std. Deviation	df	p-value	t-cal.	t-crit.	Remark
Technical Teachers	20	4. 16	.89					
				78	.05	.15	1.67	Accepted
Workshop Instructors	40	4.09	.92					

Source: Researcher's Field Survey(2023)

Table 4.9.3 showed that t-cal. at (0.15) is less than t-crit. at (1.67) which indicated that the stated null hypothesis was accepted. Thus, there is no significant difference between the mean responses of technical teachers and workshop instructors on proactive maintenance contents to be included in the developed of capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State.

Module 5: Safety Measures

Table 4.9.4 t-test Analysis on Safety Measures Contents to be included in the Developed of Capacity Building Module for Teaching Maintenance of Milling Machine in Mechanical Engineering Craft Practice in Technical Colleges in Delta State

Respondents	N	Mean	Std. Deviation	df	p-value	t-cal.	t-crit.	Remark
Technical Teachers	20	4. 16	.89					
				78	.05	.25	1.67	Accepted
Workshop Instructors	40	4.09	.92					

Source: Researcher's Field Survey(2023)

Table 4.9.4 showed that t-cal. at (.25) is less than t-crit. at (1.67) which indicated that the stated null hypothesis was accepted. Thus, there is no significant difference between the mean responses of technical teachers and workshop instructors on safety measures contents to be included in the developed of capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State.

DISCUSSION OF FINDINGS

Findings from the study in research questions above revealed that items in the preventive, maintenance, corrective maintenance (3.75 - 4.14), predictive maintenance (3.75-3.95), proactive maintenance (3.82-4.36) and safety measure (3.82-4.36) contents are appropriate to be included in the developed capacity building module for teaching maintenance of milling machine in mechanical engineering craft practice in technical colleges in Delta State. The finding of the study is in line with the study Brown and Ryoo (2008), who avowed that lesson content acts as the backbone of any learning experience. the findings is also in line with the study of Ornsteinet et al (2020) who established that creating a perfect lesson content can be overwhelming, especially when starting from scratch. This implies that lesson content needs to be relevance, clarity, engagement, and adaptability in order to create impactful learning experiences that inspire and empower learners with valuable knowledge and skills. The finding is in line with the study of Khoza (2022) who

affirmed that content of a module is at the heart of learning. The finding is in line with the study of Fajaryati et al (2016) who averred that well-designed and engaging module content lays the foundation for effective instructional process.

CONCLUSION

The development of the capacity-building module for teaching the maintenance of milling machines in mechanical engineering craft practice has proven effective in addressing key educational needs. The study's findings affirm that the contents related to preventive, corrective, predictive, and proactive maintenance, as well as safety measures, are highly appropriate for inclusion in the module. Each content area has been validated by the input from technical teachers and workshop instructors, ensuring that the module meets the educational standards required for effective teaching and learning.

Moreover, the study revealed no significant differences between the mean responses of technical teachers and workshop instructors regarding the contents of the module. This consensus underscores the relevance and acceptance of the proposed maintenance and safety content by both groups. By integrating these components into the capacity-building module, the study aims to enhance the technical proficiency and safety awareness of students, thereby improving the overall quality of mechanical engineering education in technical colleges in Delta State.

RECOMMENDATIONS

Based on the findings and conclusions drawn from the study, the following recommendations are proposed to enhance the development and implementation of the capacity-building module for teaching the maintenance of milling machines in technical colleges in Delta State:

1. Technical teachers should integrate the preventive maintenance contents into their instructional practices, ensuring that students gain a comprehensive understanding of routine checks and procedures to maintain milling machines effectively.
2. Workshop instructors should include the corrective maintenance contents in their training sessions, emphasizing repair techniques and problem-solving skills to address machine malfunctions and extend the lifespan of equipment.
3. The curriculum planners should incorporate predictive maintenance strategies into the module, utilizing historical data and analysis to forecast potential equipment failures and implement measures to prevent them.
4. The safety measures content should be highlighted in all training sessions by both technical teachers and workshop instructors, reinforcing the importance of adhering to safety protocols to protect students and maintain operational efficiency.
5. The National Board for Technical Education (NBTE) should review and approve the developed module, ensuring it meets educational standards and supports the effective delivery of maintenance training for milling machines in technical colleges.

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