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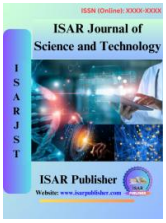

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DEVELOPMENT AND ACCEPTABILITY EVALUATION OF MOBILE INSTRUCTIONAL WORKBENCH

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Abstract: A versatile workbench is essential in carpentry, as it transforms tasks into meaningful, engaging work that fosters both efficiency and a deeper passion for the craft. This study developed a Mobile Instructional Workbench to address the need for a flexible and instruction-oriented workshop facility in technical and vocational education. The workbench was designed to enhance instructional delivery and hands-on workshop activities through features such as a detachable whiteboard, power tool mounting board, waste collector, safety mechanisms, and instructional components, all aimed at improving teaching effectiveness and learner engagement. A developmental–descriptive research design was used. The developmental phase included planning, design, fabrication, assembly, testing, revision, and final evaluation, while the descriptive phase assessed functionality and acceptability. The respondents consisted of thirty experts, including ten woodworking teachers, ten TVET trainers, and ten industry practitioners. Data were gathered using a validated researcher-made questionnaire and analyzed using mean and standard deviation. Results showed that the workbench had fast and efficient setup and an effective waste collection system that promoted a clean and safe working environment. It was rated highly acceptable in terms of design, durability, stability and safety, and maintainability, indicating that it is structurally reliable, safe, and easy to maintain. A user manual was also developed, covering assembly, operation, safety, maintenance, and troubleshooting. Overall, the Mobile Instructional Workbench is a functional, safe, and highly acceptable instructional tool for technical-vocational education.

Keywords: *Mobile Instructional Workbench, Technical-Vocational Education, Instructional Equipment, Functionality, Acceptability, Developmental and Descriptive Research*.

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Introduction

Workbenches are essential components in woodworking activities, serving as stable work surfaces that support various operations such as sawing, planing, chiseling, and assembly. A well-designed workbench not only provides a solid and ergonomic platform for executing precise tasks but also promotes organization, tool accessibility, and overall safety in the workshop. The fundamental role of workbenches in woodworking has been recognized in studies emphasizing their contribution to workflow efficiency, tool management, and ergonomic support in craft and technical practices (Riley, 2013). As foundational elements in both professional and educational woodworking environments, workbenches facilitate skill development and help maintain consistent teaching outcomes (Johnson & Forsyth, 2018).

Despite their importance, several challenges persist in woodworking education and practice, particularly within constrained workshop environments. Research in technical and vocational education indicates that limitations in physical space, inadequate availability of tools and power equipment, and insufficient infrastructure can significantly hinder hands-on learning (Ajayi & Adebiyi, 2021). Additionally, woodworking environments often pose occupational health hazards, such as wood dust exposure and unsafe working conditions, which

necessitate effective dust collection systems and strict safety practices to protect learners and instructors (Göransson, 2020). These gaps not only constrain the learning experience but also undermine efforts to provide quality vocational training. Addressing these issues aligns with broader global objectives such as Sustainable Development Goal (SDG) 4, which emphasizes inclusive and equitable quality education, and SDG 8, which promotes safe, productive employment and decent work environments (UN, 2015).

In response to these challenges, this study was conducted to develop a Mobile Instructional Workbench as an alternative tool to enhance the mastery of woodworking competencies and provide convenience in teaching practical woodworking skills. By integrating features that address space limitations, improve tool accessibility, and enhance safety through waste collection capabilities, the study aims to contribute to more effective and engaging hands-on learning experiences. The development of this instructional support seeks to help vocational learners and educators achieve better skill acquisition outcomes and safer workshop practices.

Objectives of the Study

The main objective of this study was the development of a Mobile Instructional Workbench.

Specifically, this study aimed to:

1. design and fabricate a Mobile Instructional Workbench with the following technical features:

    a. detachable board,

    b. power tool with mounting board,

    c. waste collector,

    d. safe to use, and

    e. instructional capabilities;

2. test the functionality of the Mobile Instructional Workbench in terms of:

    a. set-up time, and

    b. efficiency of the waste collection;

3. evaluate the acceptability of the Mobile Instructional Workbench in terms of:

    a. design,

    b. durability,

    c. stability and safety, and

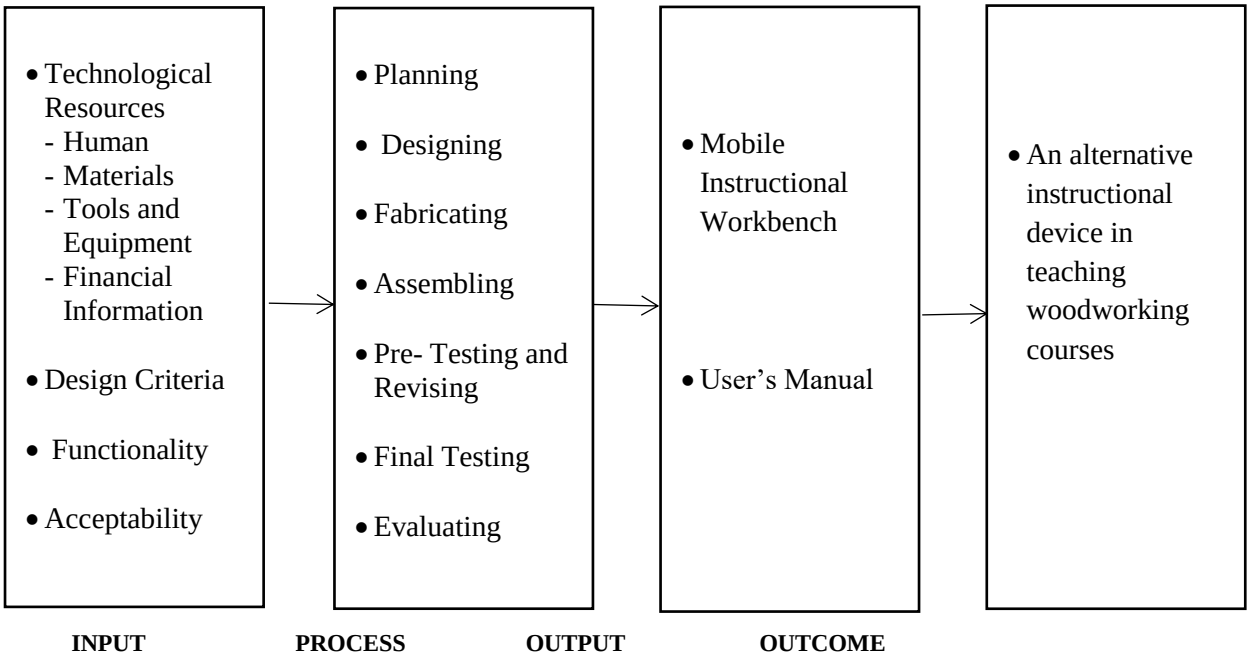
    d. maintainability;

4. develop a user's manual.

Framework of the Study

The fabrication of the Mobile Instructional Workbench followed a framework involving several phases from its conceptualization until its completion. These phases consisted of input, process, output, and outcome, as shown in Figure 1.

Figure 1: *Schematic Diagram Illustrating the Framework of the Study*



As shown in Figure 1, the development of the Mobile Instructional Workbench followed the input, process, output, and outcome (IPOO) phases.

The input phase included all technological resources and criteria needed for the effective design and use of the workbench. These inputs consisted of human resources such as TVL/TLE teachers, trainers, industry practitioners and experts who contributed to planning, fabrication, and operation; materials, tools, and equipment that provided the physical structure and functional capability of the workbench; financial resources to support procurement, safety, and maintenance; and information resources such as design plans, safety manuals, and curriculum standards that guided proper development and use. Design criteria included detachable board, power tool with mounting board, waste collection, safe to use and instructional capabilities were defined to ensure that the workbench met instructional and safety requirements. The intended functionality, such as set-up time and efficiency of waste collection ensured that the workbench can support various hands-on learning activities, while acceptability reflected the evaluation of teachers, trainers, industry practitioners and experts regarding the design, durability, stability and safety and maintainability.

The process phase of the study focused on the systematic development of the instructional workbench through a series of sequential and iterative stages. It began with planning and design, followed by fabrication and assembly of the components. This was succeeded by pre-testing and revision to address identified issues, and culminated in final testing and evaluation to ensure that the workbench met both structural requirements and instructional effectiveness.

The output phase focused on the results produced after design, fabrication, and evaluation. This included the fully assembled and functional workbench, accompanied by a user manual that provided instructions for safe operation, maintenance, and instructional use, ensuring that teachers and students can utilize the workbench effectively.

The outcome phase emphasized the workbench as an alternative instructional device in woodworking courses, offering a practical, hands-on learning environment that enhanced student competencies, improved skill acquisition, and supported curriculum objectives. By providing both a tangible instructional tool and comprehensive guidance through the user manual and pedagogical impact, contributing to improve teaching and learning outcomes in technical vocational education.

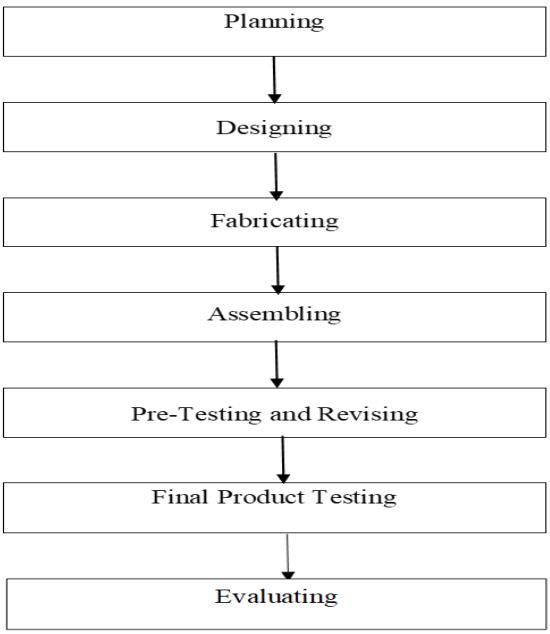
Method

This study adopted the developmental and descriptive methods of research. According to Catane (2000), developmental research refers to the systematic work drawn on existing knowledge gained from practical experiences that are directed to produce new materials, products, and devices, install new processes, systems, and services, and substantially improve those already produced or installed. In this study, the researcher developed a Mobile Instructional Workbench utilizing different processes like planning, designing, lay-outing, constructing, assembling, pre-testing and revising, final device testing and evaluating.

The study of the Mobile Instructional Workbench employed a developmental research approach, which was widely used in educational and technical research to design, develop, and evaluate instructional tools and learning devices systematically (Richey & Klein, 2023). In this approach, the researchers followed a structured process of planning, designing, fabricating, testing, and revising the workbench, ensuring that each iteration addressed both functional and instructional needs (Zabala et al., 2024). Developmental research allows the integration of practical application with theoretical foundations, enabling the creation of tools that are both effective and relevant to the target users—in this case, instructors and students in woodworking or technical education (Valencia-Arias et al., 2023). Specifically, the method facilitated the evaluation of the workbench's instructional capabilities, safety features, waste collection efficiency, and tool integration, allowing iterative improvements based on feedback and testing outcomes (Deligero, 2025). By using developmental research, the study ensured that the Mobile Instructional Workbench was not only functional as a practical workstation but also pedagogically effective, thereby bridging the gap between instructional theory and hands-on vocational practice (Phan Chei Wei et al., 2024).

Meanwhile, the descriptive research method focused on evaluating the acceptability and effectiveness of the developed workbench in terms of design, durability, stability and safety, and maintainability. Data was gathered from woodworking teachers, industry practitioners and experts, and Technical Vocational Education Training trainers using structured evaluation forms. Descriptive research allows for a systematic and accurate description of current perceptions and assessments without manipulating variables, providing a clear understanding of how the mobile instructional workbench performs under real world conditions (McCombes, 2023). Furthermore, the study employed the PASUC VI research format, designing and evaluating an approach that focused on developing new products and processes.

Figure 2: *Production Flow in the Development of Mobile Instructional Workbench*



As shown in Figure 1, the workflow in the development of the Mobile Instructional Workbench follows a systematic and iterative process that begins with planning, where the project requirements, objectives, and necessary resources are identified. This is followed by the designing phase, which involves creating detailed plans and specifications of the workbench. The process then proceeds to fabrication and assembly, where the design is translated into a physical prototype. After construction, the workbench undergoes testing to evaluate its functionality, safety, and performance. Based on the results, revisions are made to address any identified issues, leading to the final evaluation phase where the overall acceptability and effectiveness of the workbench are assessed. This structured workflow ensures that the developed instructional tool meets the required standards for usability, safety, and instructional support.

Design Criteria

The Mobile Instructional Workbench was designed to serve as an alternative device for teaching woodworking. As an instructional support tool, its development incorporated the following technical features:

a. Detachable Board. This feature was achieved by utilizing lightweight yet durable materials combined with a foldable hinge mechanism to allow easy attachment and removal. The board was designed with a smooth, flat surface suitable for writing and display purposes, while reinforced locking components ensured stability during use and ease of detachment when needed.

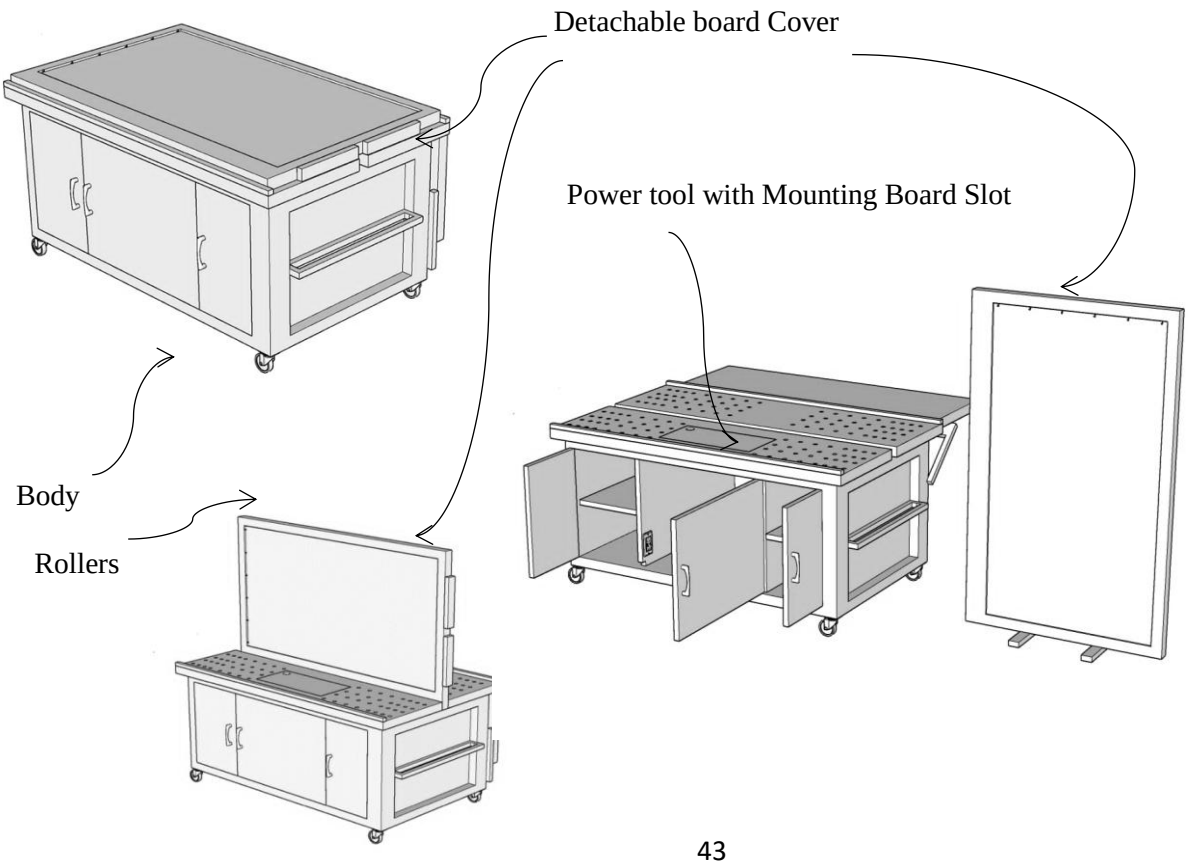
b. Power Tool Mounting Board. This was achieved through the integration of a grid-based or slotted panel system equipped with secure brackets and clamping mechanisms. The mounting board was fabricated with slot-compatible fittings, allowing precise alignment and firm engagement with the panel system. This design ensured proper load distribution, stability, and safety while enabling quick installation, removal, and repositioning of power tools during instructional activities.

c. Waste Collector. The waste collection system was achieved by incorporating a compact vacuum mechanism or cyclone separator connected to tool ports through sealed tubing. This configuration allowed efficient capture of fine particles such as sawdust and wood shavings, while the system was designed for easy cleaning and maintenance to ensure continuous functionality.

d. Safety and Mobility Features. Safe and convenient operation was achieved by installing heavy-duty swivel casters with locking mechanisms, allowing smooth mobility and secure positioning during use. The structural base was engineered to maintain stability, while carefully selected materials reduced overall weight without compromising strength and load-bearing capacity.

e. Instructional Capabilities. These capabilities were achieved by integrating hangable instructional boards using magnetic strips and sliding track systems, allowing flexible attachment and removal of teaching materials. Additionally, multi-sized drawers, shelves, and compartments were incorporated using a space-efficient layout to ensure organized storage, secure tool placement, and easy accessibility, thereby enhancing instructional efficiency.

Figure 3: *Pictorial Drawing with Major Parts of the Mobile Instructional Workbench*



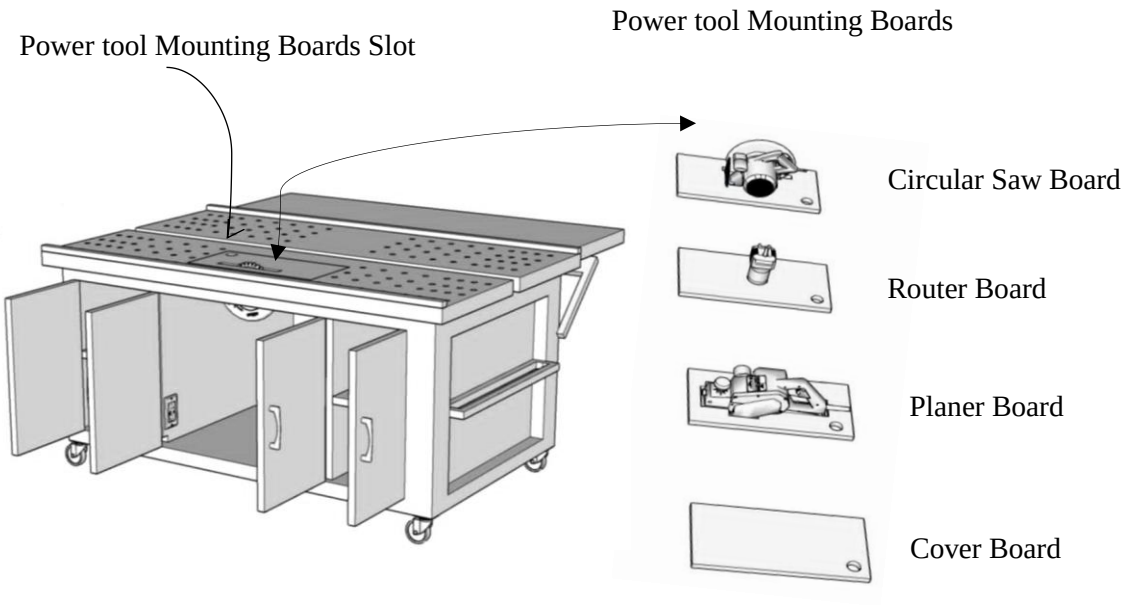
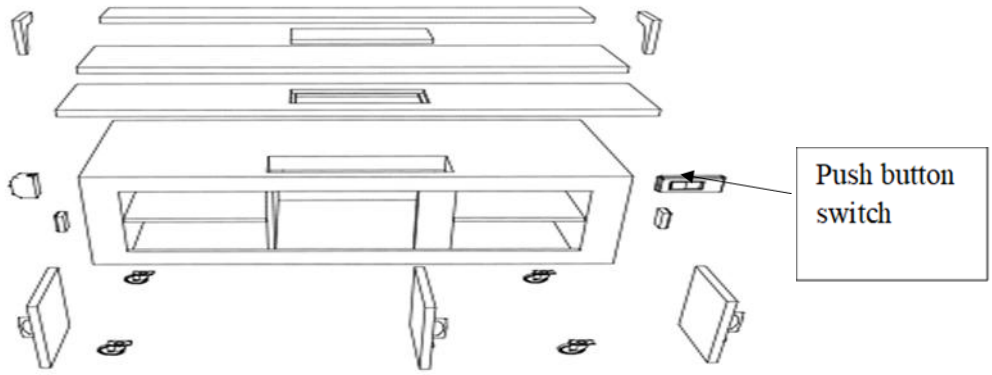


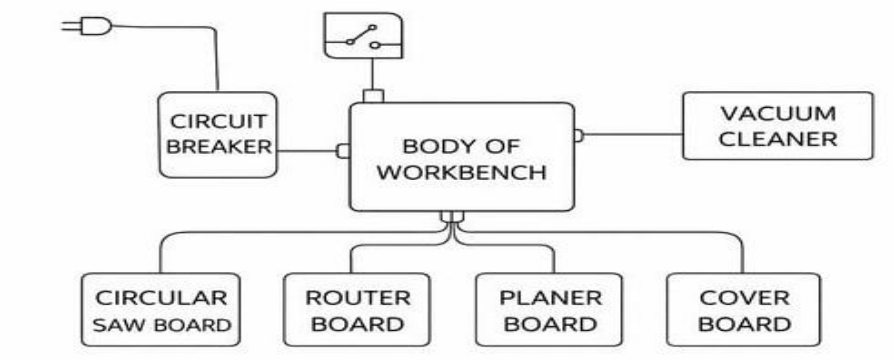
Figure 3 presented the pictorial drawing with major parts of the Mobile Instructional Workbench, highlighting its major components and their functional integration. The body served as the main structural framework, accommodating the power tool mounting board, rollers for mobility, the push button for operation, and the waste collector, ensuring both usability and safety during instructional activities. The detachable board cover enhanced the workbench's instructional capability, featuring a two-sided writing surface chalkboard and whiteboard supported by swivel legs for adjustable positioning and stability. The power tool mounting boards were designed to securely hold essential tools such as the circular saw, planer, and router, each with protective covers to ensure safe handling. Collectively, these components illustrated a well-coordinated design that integrated teaching facilitation and practical workshop functionality into a single, mobile platform, demonstrating the workbench's dual purpose as both an educational and operational too.

Figure 4: *Exploded Drawing of Mobile Instructional Workbench*



As shown in Figure 4 is the exploded view of the Mobile Instructional Workbench, illustrating its individual components and systematic arrangement prior to assembly. The components included the main frame, caster wheels for mobility, power tool mounting boards, waste collection system, detachable dual-sided instructional board, and a push button switch for controlling electrical power to the integrated tools. This diagram showed how each part was properly positioned and assembled to achieve a functional, mobile, and safe instructional workstation. The design emphasized modularity, allowing each component to be independently fabricated, maintained, or replaced when necessary. In particular, the inclusion of the push button switch enhanced operational safety by providing a convenient and immediate means of controlling power supply, thereby minimizing risks during hands-on activities. Overall, the Mobile Instructional Workbench was designed to integrate practicality, safety, and instructional efficiency, making it suitable for technical and vocational education settings.

Figure 5: *The Block Diagram Showing the Interrelationship of Parts of the Mobile Instructional Workbench*



As shown in Figure 5, the block diagram illustrated the configuration of the mobile instructional workbench. The operation of the workbench began by plugging it into an AC outlet, with the power supply passing through a circuit breaker for protection. The circuit breaker served as a safety device to regulate and protect the system from electrical overload. From the circuit breaker, electrical power was distributed to the body of the workbench, which functioned as the main control unit. Integrated within the body of the workbench was a push-button switch that allowed the user to power up and control the system during woodworking operations. The workbench provided power to various attachments, including a vacuum cleaner and interchangeable board modules. These board attachments were designed to accommodate different power tools fitted into the designated workbench slot. The modules included the circular saw board, router board, planer board, and cover board. Each attachment operated using the regulated power supplies through the main system, enabling the workbench to perform various woodworking activities efficiently and safely.

Ethical Considerations

This study upheld ethical research practices to ensure the safety, dignity, and rights of all involved. The participation of woodworking teachers, industry practitioners and experts and Technical Vocational Education Training trainers in the evaluation process was strictly voluntary. Before participation, informed consent was obtained by clearly explaining the purpose, procedures, and expected outcomes of the study. Participants were also informed that they may withdraw from the study at any time without any consequence. Confidentiality and privacy were prioritized. All data collected through questionnaires or interviews were handled with care and stored securely. No names or identifying information were disclosed in any part of the research report. Responses were used solely for academic and developmental purposes and were not shared outside the scope of the study. The development and testing of the Mobile Instructional Workbench followed proper safety protocols to avoid harm. Tools and materials used in fabrication were handled responsibly, ensuring the safety of both the developers and end users. The design did not infringe on existing intellectual property, and proper citations were provided for any ideas or references used from prior art or literatures. Finally, the study respected honesty and integrity by reporting findings truthfully, acknowledging contributions, and avoiding any form of data manipulation or plagiarism. These ethical measures ensured that the research was conducted responsibly and contributed meaningfully to the advancement of technical-vocational education.

Result and Discussions

Design and Fabrication of the Mobile Instructional Board

The first objective of the study was to design and fabricate Mobile Instructional Workbench with the following technical features: Detachable Board, Power Tool with Mounting Board, Waste Collector, Safe to Use, and Instructional Capabilities.

a. Detachable Board.

The detachable board feature of the Mobile Instructional Workbench was achieved through a modular design with a secure yet easily releasable mounting mechanism, enabling it to function both as an integrated and standalone instructional aid by providing a stable writable surface for procedures, diagrams, and safety instructions, while also allowing mobility and flexible display of materials during hands-on activities.

b. Power Tool with Mounting Board.

The power tool with mounting board feature was achieved through a modular mounting system that allowed various tools to be securely attached, interchanged, and repositioned, ensuring operational stability and safety while enhancing instructional flexibility, workspace organization, and workflow efficiency during demonstrations and student tasks.

c. Waste Collector.

The waste collector feature was achieved through the integration of a vacuum-assisted collection system connected to power tools, enabling continuous and efficient capture of sawdust and debris during operation, thereby maintaining workspace cleanliness, reducing airborne particles, and improving overall safety.

d. Safe to Use.

The safe-to-use feature was achieved through the incorporation of heavy-duty swivel caster wheels with locking mechanisms and a stable structural design, allowing secure positioning during use and easy mobility between work areas, which enhanced instructional flexibility, reduced setup time, and supported efficient hands-on learning.

e. Instructional Capabilities.

The instructional capabilities were achieved through a modular and space-efficient design incorporating configurable tool placement, a stable work surface, and organized storage components such as shelves, drawers, and pegboards, enabling the integration of

demonstrations, visual aids, and hands-on activities to improve learner engagement, accessibility of tools, and skill development.

Functionality of the Mobile Instructional Workbench

The second objective of the study was to determine the set-up time and the efficiency of waste collection of the Mobile Instructional Workbench.

a. Set up Time

The first test trial was the set-up time for circular saw, electric planer and electric router to mounting board. Test trials were conducted to evaluate its speed in setting the power tools to the mounting board through three (3) trials by three (3) trainers using a stopwatch on three types of power tools, circular saw, electric planer and electric router and a detachable board.

Table 1: *Set up time Test Result of Mobile Instructional Workbench in Board, Circular Saw, Electric Planer and Electric Router to Mounting Board. (In seconds) by the researcher*

Tool / Equipment	Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	Mean Set-Up Time (s)
Whiteboard	55.00	54.00	53.00	54.00
Circular saw	39.00	38.00	39.00	38.60
Electric planer	46.00	45.00	43.00	45.67
Electric router	41.00	40.00	39.50	40.16
Average set up time				**44.61 seconds**

As shown in Table 1, the set-up times of the Mobile Instructional Workbench were systematically measured by the researcher to assess the operational efficiency of each component. The whiteboard registered a set-up time of 54.00 seconds, while the circular saw required 38.60 seconds. The electric planer and electric router demonstrated set-up times of 45.67 seconds and 40.16 seconds, respectively. The computed overall mean set-up time of 44.61 seconds suggested that the workbench system facilitates relatively rapid assembly and preparation for instructional use, thereby supporting efficiency in technical and vocational learning environments.

Table 2: *Set up time Test Result for Mobile Instructional Workbench in Board, Circular Saw, Electric Planer and Electric Router to Mounting Board. (In seconds) by First Male Technological Livelihood Trainer:*

Tool / Equipment	**Trial 1 (s)**	**Trial 2 (s)**	**Trial 3 (s)**	**Mean Set-Up Time (s)**
Whiteboard	51.00	52.00	51.00	51.00
Circular saw	39.00	40.00	38.00	39.00
Electric planer	43.00	40.00	41.00	41.00
Electric router	39.00	38.00	39.00	38.60
Average Set up Time				**42.40 seconds**

As shown in Table 2, this summarized the mean set-up times of the Mobile Instructional Workbench components across three trials conducted by the first male Technological Livelihood to assess assembly efficiency. The whiteboard required 51.0 seconds, the circular saw 39.00 seconds, the electric planer 41.00 seconds, and the electric router 38.60 seconds. The overall mean set-up time of 44.40 seconds indicates efficient assembly and operational readiness, providing a baseline for future performance evaluation and improvement

Table 3: *Set up time Test Result for Mobile Instructional Workbench in Board, Circular Saw, Electric Planer and Electric Router to Mounting Board. (In seconds) by Second Male Technological Livelihood Trainer*

Tool / Equipment	Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	Mean Set-Up Time (s)
Whiteboard	50.00	52.00	50.00	50.60
Circular saw	39.00	37.00	36.00	37.00
Electric planer	40.00	40.00	39.00	39.70
Electric router	36.00	38.00	35.00	36.00
Average set up time				**40.82 seconds**

As shown in Table 3, the set-up times of the Mobile Instructional Workbench components measured by the second male trainer. The whiteboard required 50.60 seconds, the circular saw 37.00 seconds, the electric planer 39.70 seconds, and the electric router 36.00 seconds. The overall set-up time is 40.82 seconds indicated efficient assembly and operational readiness, providing a benchmark for future improvements

Table 4: *Average Set-up Time per Evaluator (in seconds)*

Item	Evaluator 1	Evaluator 2	Evaluator 3	Total Set Up Time (Average)
Whiteboard	54.00	51.00	50.60	52.87
Circular saw	38.60	39.00	37.00	38.20
Electric planer	45.67	41.00	39.70	42.12
Electric router	40.16	38.00	36.00	38.05
Overall set-up time				**42.81 seconds**

As shown in Table 4, the total average set-up time across the three trials of the Mobile Instructional Workbench was calculated to be 42.81 seconds, indicating a consistent and efficient assembly process for all components. This value provided a benchmark for evaluating the operational readiness and practicality of the workbench in instructional settings.

b. Waste Collector.

In this study, trial collected, referred to the quantity of dust captured by the waste collection system, representing the dust effectively contained during tool operation. Air dust denoted the amount of dust that escaped into the surrounding environment, indicating particulate matter not captured by the system. The trial net value represented the actual dust collected, calculated by adding the airborne dust from the dust collected. This metric provided a measure of the efficiency of the dust collection system in containing particulate emissions. While airborne wood dust posed health and safety risks in woodworking, the use of a vacuum dust collection system captured the majority of waste, minimizing exposure to fine particles. This was supported by research showing that most sanding dust was effectively collected, and the finest particle fractions can be further reduced with efficient collection systems (Majka et al., 2023).

Table 5: *Circular Saw Waste Collection Result (in grams)*

Evaluator	Trial 1 (Collected)	Trial 1 (Air Dust)	Trial 1 (Net)	Trial 2 (Collected)	Trial 2 (Air Dust)	Trial 2 (Net)	Trial 3 (Collected)	Trial 3 (Air Dust)	Trial 3 (Net)	Average
Evaluator 1	78.00	1.50	79.50	80.00	1.20	81.20	79.00	1.00	80.00	80.23
Evaluator 2	81.00	1,60	82.60	79.00	1.40	80.40	80.00	0.90	80.90	84.00
Evaluator 3	79.00	1.30	80.30	80.00	1.00	81.00	78.00	1.00	79.00	78.59
Total Average		**1.46 g**			**1.20 g**			**0.96g**		**80.10 g**

As shown in Table 5, the waste collection efficiency of the circular saw was evaluated across three trials by three evaluators, measuring collected waste, airborne dust, and net waste (collected minus air dust). The results showed that most of the material was effectively captured, with net averages ranging from 78.59 g to 84.00 g, while airborne dust remained minimal, decreasing slightly across trials from 1.46 g to 0.96 g. These findings indicated that the Mobile Instructional Workbench provided consistent and efficient dust collection, minimizing material loss and ensuring reliable performance across different users.

Table 6: *Electric Planer Waste Collection Result (in grams)*

Evaluator	Trial 1 (Collected)	Trial 1 (Air Dust)	Trial 1 (Net)	Trial 2 (Collected)	Trial 2 (Air Dust)	Trial 2 (Net)	Trial 3 (Collected)	Trial 3 (Air Dust)	Trial 3 (Net)	Average
Evaluator 1	65.00	1.70	66.70	67.00	1.60	68.60	66.00	1,30	67.30	67.53
Evaluator 2	68.00	1.30	69.30	67.00	1.40	68.40	67.00	1.20	68.20	68.23
Evaluator 3	66.00	1.00	67.00	65.00	0.90	65.90	66.00	1.10	67.10	66.67
Total Average		**1.33 g**			**1.30 g**			**1.20 g**		**67.48g**

As shown in Table 6, the electric planer demonstrated effective waste collection, with net waste ranging from 65.90 g to 68.60 g across three trials and evaluators. Airborne dust remained minimal, averaging 1.33 g in Trial 1, 1.30 g in Trial 2, and 1.20 g in Trial 3. These results indicated that the Mobile Instructional Workbench provided consistent and efficient dust control, ensuring most of the material was captured while minimizing air contamination.

Table 7: *Electric Router Waste Collection Result (in grams*

Evaluator	Trial 1 (Collected)	Trial 1 (Air Dust)	Trial 1 (Net)	Trial 2 (Collected)	Trial 2 (Air Dust)	Trial 2 (Net)	Trial 3 (Collected)	Trial 3 (Air Dust)	Trial 3 (Net)	Average
Evaluator 1	45.00	1.30	46.30	43.00	1.20	44.20	40.00	1.40	41.40	43.97
Evaluator 2	44.00	1.20	45.20	42.00	1.20	43.20	39.00	1.00	40.00	42.80
Evaluator 3	40.00	1.00	41.00	38.00	0.38	38.38	30.00	0.36	30.36	36.58
Total Average		**1.17 g**			**0.93 g**			**0.92 g**		**41.12 g**

As shown in Table 7, the electric router demonstrated effective waste collection, with net waste ranging from 30.36 g to 46.30 g across three trials and evaluators. Airborne dust was minimal, with average values of 1.17 g in Trial 1, 0.93 g in Trial 2, and 0.92 g in Trial 3, indicating a slight decrease over repeated use. Overall, the total average net waste of 41.12 g suggests that the Mobile Instructional Workbench provides consistent and efficient dust collection performance, capturing most of the generated material while minimizing airborne contamination.

Table 8: *Summary of Mean Waste Collection*

Power Tool	Mean Average (dust collected)	Mean Average (Air Dust)
Circular Saw	80.10 g	1.21 g
Electric planer	67.48 g	1.31 g
Electric Router	41.12 g	1.00 g
Overall mean Average	**62.29 g**	**1.17 g**

As shown in Table 8, the results showed that the Mobile Instructional Workbench effectively collected dust across all power tools. The circular saw recorded the highest mean net waste at 80.10 grams with minimal airborne dust (1.21 grams), followed by the electric planer at 67.48 grams (1.31 grams) and the electric router at 41.12 grams (1.00 grams). The overall mean net waste across all tools was 62.29 grams, with an average airborne dust of 1.17 grams, indicating that the workbench provides consistent and efficient dust collection while minimizing air contamination during operation

Acceptability Evaluation of the Mobile Instructional Workbench

The third objective of the study was to evaluate the acceptability of the Mobile Instructional Workbench in terms of design, durability, stability and safety and maintainability. A discussion on the acceptability evaluation of the Mobile Instructional Workbench was presented in Table 16 to 20 respectively,

Table 9: *Acceptability Evaluation of Workbench in terms of Design*

Mobile Instructional Workbench….	Mean	SD	Interpretation
1. shows a well-organized layout suitable for woodworking instruction.	4.73	0.45	Very Highly Acceptable
2.provides convenient placement of tools and components.	4.67	0.55	Very Highly Acceptable
3. incorporates user-friendly features for both instructors and students.	4.73	0.45	Very Highly Acceptable
4. reflects innovative design concepts that support instructional activities.	4.70	0.47	Very Highly Acceptable
5. accommodates various woodworking operations efficiently.	4.80	0.48	Very Highly Acceptable
Overall Mean	**4.73**	**0.34**	Very Highly Acceptable

Note: (4.20 - 5.00 Very Highly Acceptable, 3.40 - 4.19 Highly Acceptable, 2.60 - 3.39 Acceptable, 1.80 - 2.59 Moderately Acceptable, 1.00 - 1.80 Unacceptable)

As presented in Table 9, the Mobile Instructional Workbench was rated Very Highly Acceptable in terms of design, with mean scores ranging from 4.67 to 4.80 and an overall mean of 4.73 (SD = 0.34). These findings indicated a strong consensus among respondents that the workbench's design effectively supports woodworking instruction. Woodworking trainers and Technical–Vocational Livelihood (TVL) teachers provided the highest evaluations, suggesting that the design is well-aligned with both instructional and practical workshop requirements. Similarly, the favorable ratings from industry practitioners imply that the workbench met professional standards in terms of layout, dimensions, and functionality. Among the indicators, accommodating various woodworking operations efficiently received the highest rating (M = 4.80, SD = 0.48), highlighting the adaptability of the workbench to diverse instructional tasks. Conversely, providing convenient placement of tools and components obtained the lowest mean (M = 4.67, SD = 0.55), although it remained within the Very Highly Acceptable range. A tie in ratings (both M = 4.73, SD = 0.45) suggests that several design features were equally valued, indicating that no aspect of the design was perceived as weak. The indicator on innovative design (M = 4.70, SD = 0.47) further reflected respondents' recognition of the workbench's functional and modern features. The relatively low standard deviations across items indicate consistent responses and a high level of agreement among evaluators.

Overall, the results affirmed that the Mobile Instructional Workbench conforms to established principles of effective instructional design, making it highly suitable for woodworking and technical education contexts.

Table 10: *Acceptability Evaluation of Workbench in terms of Durability*

Mobile Instructional Workbench….	Mean	SD	Interpretation
1. is made of high-quality materials resistant to wear and tear.	4.80	0.41	Very Highly Acceptable
2. withstands continuous use during woodworking sessions.	4.83	0.38	Very Highly Acceptable
3. maintains structural integrity even under heavy workloads.	4.80	0.41	Very Highly Acceptable
4. resists corrosion, dents or other physical damage	4.83	0.38	Very Highly Acceptable
5. retains its functional quality over extended periods of use.	4.90	0.31	Very Highly Acceptable
Overall Mean	**4.83**	**0.22**	**Very Highly Acceptable**

Note: 4.20 - 5.00 Very Highly Acceptable, 3.40 - 4.19 Highly Acceptable, 2.60 - 3.39 Acceptable, 1.80 - 2.59 Moderately Acceptable, 1.00 - 1.80 Unacceptable)

Table 10, presented the acceptability evaluation of the Mobile Instructional Workbench in terms of durability, yielding an overall mean of 4.83 (SD = 0.22), interpreted as Very Highly Acceptable. This indicated that respondents strongly agreed on the workbench's durability and structural reliability. Among the indicators, the highest mean was obtained for retaining its functional quality over extended periods of use (M = 4.90, SD = 0.31), suggesting that the workbench is perceived as highly dependable for long-term instructional use. A tie in mean ratings (both M = 4.83, SD = 0.38) was observed among selected indicators, while the lowest means were recorded for use of high-quality materials resistant to wear and tear *and* maintenance of structural integrity under heavy workloads (both M = 4.80, SD = 0.41), although still within the Very Highly Acceptable range. The consistently low standard deviations reflected minimal variation in responses, indicating strong agreement among evaluators. These findings were supported by literature emphasizing that durable instructional workbenches must withstand heavy-duty and repetitive use while maintaining stability, safety, and functionality. Studies further highlight that the use of high-quality materials and reinforced structures enhanced longevity, reduced maintenance requirements, and improves reliability in technical-vocational settings. Overall, the results confirmed that the Mobile Instructional Workbench possessed the durability required for sustained use in woodworking and technical education environments.

Table 11: *Acceptability Evaluation of Workbench in terms of Stability and Safety*

Mobile Instructional Workbench….	Mean	SD	Interpretation
1. remains steady and secure during carpentry operations.	4.73	0.45	Very Highly Acceptable
2. distributes weight evenly to prevent tipping or imbalance.	4.69	0.62	Very Highly Acceptable
3, provides firm support for tools and instructional materials.	4.70	0.47	Very Highly Acceptable
4. ensures safe tool handling without wobbling or shaking.	4.67	0.61	Very Highly Acceptable
5. supports multiple activities without compromising balance.	4.53	0.68	Very Highly Acceptable
Overall Mean	**4.65**	**0.39**	**Very Highly Acceptable**

Note: (4.20 - 5.00 Very Highly Acceptable, 3.40 - 4.19 Highly Acceptable, 2.60 - 3.39 Acceptable, 1.80 - 2.59 Moderately Acceptable, 1.00 - 1.80 Unacceptable)

Table 11, presented the acceptability evaluation of the Mobile Instructional Workbench in terms of stability and safety, yielding an overall mean of 4.65 (SD = 0.39), interpreted as Very Highly Acceptable. This indicated that respondents generally agreed that the workbench provided a stable and safe platform for woodworking instruction. Among the indicators, the highest mean was obtained by remains steady and secure during carpentry operations (M = 4.73, SD = 0.45), followed by provided firm support for tools and instructional materials (M = 4.70, SD = 0.47) and distributed weight evenly to prevent tipping or imbalance (M = 4.69, SD = 0.62). These results suggested strong agreement on the workbench's stability and load handling capacity. Meanwhile, ensured safe tool handling without wobbling or shaking (M = 4.67, SD = 0.61) and supports multiple activities without compromising balance (M = 4.53, SD = 0.68) also received very high ratings, although the latter was the lowest among the indicators.

The standard deviations, ranging from 0.45 to 0.68, indicated generally consistent responses with slight variation, particularly in multi-activity support. Overall, the findings implied that the workbench was perceived as stable and safe for instructional use in woodworking activities.

Table 12: *Acceptability Evaluation of Workbench in terms of Maintainability*

Mobile Instructional Workbench	Mean	SD	Interpretation
1. is easy to clean and maintain after use.	4.70	0.53	Very Highly Acceptable
2. can be maintained with basic tools and simple procedures.	4.60	0.56	Very Highly Acceptable
3. accessible components that allow quick inspection and routine upkeep	4.77	0.43	Very Highly Acceptable
4. promotes long term usability through a low maintenance and practical design.	4.80	0.48	Very Highly Acceptable
5. ensures ease of maintenance and sustained performance through durable construction	4.77	0.50	Very Highly Acceptable
Overall Mean	**4.73**	**0.30**	**Very Highly Acceptable**

Note: (4.20 - 5.00 Very Highly Acceptable, 3.40 - 4.19 Highly Acceptable, 2.60 - 3.39 Acceptable, 1.80 - 2.59 Moderately Acceptable, 1.00 - 1.80 Unacceptable)

Table 12, presented the acceptability evaluation of the Mobile Instructional Workbench in terms of maintainability, yielding an overall mean of 4.73 **(**SD = 0.30), interpreted as Very Highly Acceptable. This indicated that respondents strongly agreed that the workbench was easy to maintain and supports long term usability through practical design features.

Among the indicators, the highest mean was obtained by promoted long-term usability through a low-maintenance and practical design (M = 4.80, SD = 0.48), followed by accessible components that allow quick inspection and routine upkeep (M = 4.77, SD = 0.43) and *e*nsured ease of maintenance and sustained performance through durable construction M = 4.77, SD = 0.50), indicating strong agreement on the workbench's efficient design for maintenance and inspection. Meanwhile, ease to clean and maintain after use also received a very high rating (M = 4.70, SD = 0.53), while can be maintained with basic tools and simple procedures obtained the lowest mean (M = 4.60, SD = 0.56), though still within the Very Highly Acceptable range.

The standard deviations, ranging from 0.43 to 0.56**,** reflect minimal variability in responses, suggested consistent evaluations among respondents. Overall, the findings implied that the Mobile Instructional Workbench is highly maintainable, with features that support ease of upkeep, accessibility of components, and sustained functional performance over time.

Table 13: *Overall Average Acceptability Evaluation of Mobile Instructional Workbench*

Aspects	**Mean**	**SD**	**Interpretation**
Design	4.73	0.34	Very Highly Acceptability
Durability	4.83	0.22	Very Highly Acceptability
Stability and Safety	4.65	0.39	Very Highly Acceptability
Maintainability	4.73	0.30	Very Highly Acceptability
Overall Mean	**4.74**	**0.31**	**Very Highly Acceptability**

As shown in Table 13, in overall, the Mobile Instructional Workbench achieved overall mean ratings ranging from 4.65 to 4.83, all interpreted as Very Highly Acceptable. The relatively low standard deviation values further indicated a strong consensus among the respondents regarding the workbench's acceptability across all evaluated criteria.

In summary, the findings demonstrated that the Mobile Instructional Workbench was very highly acceptable with the overall average of (M= 4.74, SD = 0.31) in terms of design, durability, stability and Safety, and maintainability. These results affirmed that the workbench was a well-designed, durable, stable, and easy-to-maintain instructional support tool, making it highly suitable for use in woodworking instruction, TVL programs, and industry-based training setting

The User's Manual of Mobile Instructional Workbench

The fourth objective was to develop a user's manual of the Mobile Instructional Workbench which is composed of various parts namely: the introduction, parts and leading features of the instructional Utility Cart. It is also included in the user's manual the testing procedures, care and safety instruction, caution, troubleshooting, warning, and specifications.

Summary of Findings

The following were the summary of findings of the study:

1.The Mobile Instructional Workbench was successfully designed and fabricated with the intended features, including a detachable board, power tool with mounting board, waste collector, safe to use, and instructional capabilities. These features enhanced both teaching functionality and practical workshop use.

2. Functionality testing revealed that the workbench could be assembled quickly and efficiently. The total average set-up time was found to be efficient, demonstrating that the workbench was convenient to deploy in various instructional or workshop settings. The workbench's waste collector functioned effectively, ensuring proper collection and disposal of workshop debris. This contributed to cleaner, safer, and more organized work environments during use.

3. The Mobile Instructional Workbench was rated very highly acceptable in terms of design, durability, stability and safety, and maintainability. This indicates that the system is structurally reliable, safe to operate, compliant with specifications, and easy to maintain.

4. A comprehensive user manual was successfully developed, covering assembly instructions, operating procedures, safety guidelines, maintenance tips, and troubleshooting. This ensures that users can operate the workbench effectively, safely, and efficiently.

Conclusions

The following conclusions were drawn:

1. The Mobile Instructional Workbench included essential technical features such as a detachable board, power tool with mounting board, waste collector, safety mechanisms, and instructional capabilities.

2. The functionality of the Mobile Instructional Workbench in terms of set-up time was found to be very satisfactory. This indicated that the workbench can be quickly assembled and deployed, allowing efficient use in instructional and practical workshop setting. The workbench's waste collection system functioned efficiently. Proper collection and management of workshop waste contributed to a cleaner, safer, and more organized working environment, making the workbench suitable for continuous practical use.

3. The Mobile Instructional Workbench was rated very highly acceptable in terms of design, durability, stability and safety, and maintainability. Very high ratings in these dimensions suggested that the system is structurally reliable, compliant with design specifications, equipped with useful features, safe to operate, and easy to maintain and repair.

4. A comprehensive user manual was developed to guide users in operating the Mobile Instructional Workbench effectively.

Recommendations

Based on the findings and conclusions of the study, the following recommendations were formulated:

1. Continuous improvement of the Mobile Instructional Workbench was recommended by further enhancing its core technical features, such as the detachable board, power tool with mounting board, waste collector, safety mechanisms, and instructional capabilities. Future developments may focus on improving material quality, ergonomic design, and integration of additional instructional or workshop functionalities to further increase efficiency, reliability, and adaptability.

2. The Mobile Instructional Workbench may be deployed in classrooms, laboratories, and practical workshop settings where flexible teaching and hands-on activities were required. Given its satisfactory functionality in set-up time and waste collection efficiency, proper operational practices are recommended to ensure smooth assembly, effective workflow, and safe usage.

3. It was recommended to adopt the Mobile Instructional Workbench as a long-term instructional and practical tool due to its very high quality in design, durability, stability and safety, and maintainability. Institutions should ensure compliance with safety and design standards and provide appropriate storage and workspace conditions to maximize the workbench's lifespan and usability.

4. The use of the developed user' manual was strongly recommended to support proper operation, maintenance, and instructional integration of the Mobile Instructional Workbench. These materials should guide users in understanding technical features, assembly and operating procedures, safety precautions, maintenance, and troubleshooting techniques.

5. Further studies were recommended to expand and enhance the Mobile Instructional Workbench by exploring additional features such as modular components, advanced tool integration, smart safety mechanisms, or digital instructional aids. Future researchers may also conduct comparative studies to evaluate system performance under different workshop activities, user loads, and educational settings.

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