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Acceptability testing and development of a novel wood lathe balanced rest

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ABSTRACT

The utility model discussed in this study discloses a wood lathe balancing rest that is advantageous in terms of design, ergonomics, and functions. The study aimed to fabricate a safety device for the wood lathe machine to prevent kickback and slow down vibration from the workpiece attached to the lathe machine to avoid the vibration of the workpiece and to avoid an accident to the operator and to avoid damage of the materials. The utility model is planned not exclusively to spare time yet also for the wellbeing of the laborers amid activity. It is designed to hold the workpiece when turning and control the vibration, it can be mounted on the bed of the lathe near the center of the turning planetary.

1. INTRODUCTION

The usefulness of the wood lathe machine has been widely recognized in the current literature (see [15],[16]). Making a set of the balustrade is among the process that enables the machine to derive various designs. However, turning a long slender spindle on a wood lathe can be a real trial. It flexes, vibrates and generally puts the operator in danger as it spins. In this regard, the improvement of such is warranted to enhance the usability of the device.

The importance of material quality as used in woodworking has received significant attention in the literature (see [17], [18]). A particular machine to invest in is a woodworking lathe machine. These machines help in cutting, knurling and shaping wooden materials into precise objects that can be used for creating various products.

Over the years, the technologies that are used to create these wooden lathe machines have significantly evolved(see [19]). The main purpose of developing such a machine is to lessen work and complete things rapidly; however, due to inefficiencies in design, improvements are executed for machines, particularly wood lathes. This has made it possible to create a state-of-the-art that offers precise wood cutting results. In antiquated occasions, offering shapes to metal is a repetitive employment and tedious procedure. The development of the machine made the activity of metal molding a lot simpler. It is utilized to expel the annoying part from the metals to give it another shape. The material is turned against the apparatus, which trims down the material into shape.

The mechanical changes to the wood lathe over the years conveyed numerous adaptable changes. This had made the generation of every several items possible which has impacted various industries. Apart from that, the machine can be used to form metal-based products. To fabricate any metal item, the necessity is to shape it. In this regard, the wood lathe can be used to perform that.

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This Innovated Wood Lathe Balanced Rest is designed for local companies. It is developed herewith to save operators time and for the safety purposes. It was designed to control the vibration of the machine, and it can be mounted on the bed of the lathe near the center of the turning planetary. Three mechanical bearings will provide and support the stability of the workpiece when turning. It will stabilize the most uncontrollable spindle without damaging the surface. The attached three mechanical bearings are positioned to the inner part of the device. The primary function of this bearing is to control the vibration of the wooden spindle during the operation. Another feature of this device is the laser pointer, used to establish the end line of the wood spindle to prevent an accident of the users.

This paper aims to contribute to the current literature within the domains of mechanical technology in terms of:

a. The provision of empirical analysis in regards to a novel development of a wood lathe,
b. Design and specification of the novel parts that are innovated from the conventional machine,
c. Empirical testing of its applicability to intended adopters.

2. REVIEW OF RELATED LITERATURE

2.1. The wooden lathe machine

In comparison with several machines, the wooden lathe is relatively simpler. However, it is considered to be an important tool [20]. A wooden lathe is probably the oldest machine tool, stemming from the early tree lathe, which was turned by a rope passed around the work a few times and attached to a sparingly branch overhead. The work was supported by two dowels struck in adjacent trees. The operator's foot supplied the motion, which was intermittent and fluctuating. The tool was held in the operator's hand. A strip of wood called a "lathe" was used to support the rope and hence named as lathe.

A lathe is a machine that spins a block in order to perform a certain manipulation to it such as cutting and sanding with the help of tools to form of symmetry based on its axis of rotation. The end goal is to smooth and shape the block into a new form. Moreover, it seems that wood turning is making a bit of resurgence and is gaining in popularity in woodworker's shops. Although gaining in popularity, this form of wood working is nothing new. The first wood lathe was patented by Thomas Blanchard way back in 1820. The first version of the lathe was very different than what we see today. They were manually operated and the rotation of the spindle was very slow. By the mid-1900s there were introductions of wood lathes that represent more closely to the conventional one today.

2.2. Wooden lathe and education

Innovation has affected pretty much every part of life today, and instruction is no particular case. It has significantly changed the instruction. For one, innovation has incredibly extended access to instruction. Access to learning openings today is phenomenal in extension on account of technology. Opportunities for correspondence and cooperation have likewise been extended by innovation. Generally, study halls have been moderately segregated, and coordinated effort has been constrained to different understudies in a similar study hall or building.

Today, innovation empowers types of correspondence and cooperation undreamt of before. The dividers of the homerooms are never again an obstruction as innovation empowers better approaches for picking up, conveying, and working cooperatively. Innovation has likewise started to change the jobs of educators and students. Regardless, because of the entrance to data and instructive open door that innovation has empowered, in numerous study halls today we see the instructor's job moving to the guide as an afterthought as understudies assume greater liability for their very own getting the hang of utilizing innovation to assemble significant data.

Schools and colleges across the country are starting to overhaul learning spaces to empower this new model of training, cultivate more association and little gathering work, and use innovation as an empowering agent. As per Prater et al. [12] that to pull in exchange and mechanical educators and to enable them to perform effectively in the homeroom, the nation must settle on showing an appealing decision for talented experts and offer them sufficiently and open preparing to smooth the change from industry to instruction.

Education and teaching formation is an important and arduous task in entire higher education. New teaching contents for mechanical manufacturing technology are systematically constructed to satisfy the new talent-training plan. On the other hand, some possible teaching methods are discussed to understand efficiently mechanical manufacturing technology [13].

Competency-based education focuses on measuring learning rather than time. The student's progress is assessed in how they will perform their skills based on competencies regardless of how long it takes to master them. It is the learning process through practice, measure, harnesses the student's skills, knowledge and attitude and computer-based instruction gives them individualized learning [7]. Understudies learn at various pace, customarily staff fill in as instructors, holding booked classes for an endorsed number of weeks, the guidance happens at the speakers' pace while in competency-based training, understudies move the job of the workforce and work with the understudies, managing getting the hang of, addressing questions, show and helping understudies make and apply information, abilities and create down to earth, robust evaluations [11].

According to Etcuban et al. [4] some students learn by watching, listening, and inquiring; others learn best by a group or social interactions, and still, others need special personal attention to learn. Again, it is emphasized that the more teaching skills and strategies a teacher has at his command, the higher is the chance for more students to achieve the desired learning outcomes.

According to Denaud et al. [3] in the course of most wood machining processes, administrators are typically ready to identify different issues by just hearing the sound produced by the procedure. This is particularly valid for wood stripping. Machine checks development has been distinguished as one of the runs of the mill circumstances that a tested peeler can recognize. Poplar and beech facade tests have been delivered on a research center smaller-scale machine, utilizing working conditions purposely great to checking.

Manos et al. [9] exhibited a technique for machining complex three-dimensional surfaces utilizing just a single pivot of controlled movement for situating a cutting apparatus on an uncommonly planned numerically controlled machine. This single controlled hub machine is designed like a machine however is utilized to deliver complex formed surfaces out of wood. This is practiced by precisely connecting two tomahawks of movement to create a fixed helical impression of a device way with a consistent advance over the separation. As the connected tomahawks are turned, their area is estimated by an encoder and passed straightforwardly to a (PC). Programming running on the PC decides the profundity of the PC controlled pivot. The profundity data is utilized to control the profundity pivot. A few test pieces have been machined out of cedar for assessing the strategy.

The study of Fang et al. [5] revealed that the densified veneers showed markedly reduced hygroscopicity: the higher the densification temperature, the lower the wood hygroscopicity. The hardness of densified veneer was about two to three times that of control for both aspen and hybrid poplar. Tensile and bending strength also increased significantly after densification. However, the mechanical properties of densified veneers decreased slightly with increased densification temperature. The modulus of elasticity in tension and bending increased after densification, especially at high temperatures. A very high compression set recovery was found for veneers densified at low temperatures.

The findings of the study of Tomppo et al. [14] revealed that the lathe checks in birch veneer were examined with contact ultrasound, and a preliminary study for the measurement with air-coupled ultrasound from green birch veneer (moisture content 60–75%) was carried out. The contact measurements were conducted from dry veneer and then from the moistened veneer. Several ultrasound parameters measured from dry veneers were related to lathe check depth, e.g., the correlation between ultrasound transit time and lathe check depth was 0.63 when measuring perpendicular to grain from unchecked face of the veneer. The same correlation for moistened veneers was 0.74. Furthermore, air-coupled reflection and through-transmission measurements were carried out with green veneer samples.

In air-coupled through-transmission measurements, it seemed that moisture content dominated the measurement when measuring parallel to checks. There was also a positive correlation between energy-related parameters in through-transmission and reflection measurement, which could be utilized to measure the properties of veneer with transducers on one side.

In the study of Darmawan et al. [2] on the impacts of wood immaturity and facade thickness on machine checks of rotational cut, the sengon facade was assessed. Machine checks of the facade were estimated on the loosed side under an optical video magnifying lens, and their recurrence, profundity, and length were portrayed. Results demonstrated that wood adolescence and facade thickness decided the recurrence, profundity, and length of machine checks for the sengon turning cut facade. As a rule, the recurrence of machine checks of the facade increments with expanding facade thickness, and increments from substance to bark. The recurrence of machine check influences the paste bond and bowing quality, in which the paste bond, modulus of versatility, and modulus of break decline as the recurrence of machine checks increment fundamentally.

As per McGavin et al. [10] that straightforward spindle-less machine innovation was utilized to process industrially essential hardwood species. The investigation has shown that the creation of a turning stripped facade is a compelling strategy for changing over manor hardwood trees. Recuperation rates altogether higher than those announced for increasingly conventional preparing methods were accomplished. Facade outwardly reviewed to industry norms showed good recuperations reasonable for the assembling of auxiliary items.

In response to this situation, the researchers constructed an Innovated Wood Lathe Balanced Rest for Instruction that provides a healthy and comfortable environment inside the workshop. The functions of Innovated Wood Lathe Balanced Rest for Instruction were partly answered. This could be used as a project for the students providing the necessary skills in civil technology.

3. OBJECTIVES OF THE STUDY

This study aimed to fabricate an Innovated Wood Lathe Balanced Rest for Instruction for Technology Instruction at Cebu Technological University, Cebu City, Philippines. The discoveries of the investigation filled in as the reason for the proposed instructional guide. It answered the: 1) Technical requirements for the construction of an Innovated Wood Lathe Balanced Rest as to its design, ergonomics, and construction; 2) Extent of acceptability of the fabricated Wood Lathe Machine, and Effectiveness of the Wood Lathe in terms of Straight pole making, Chair Leg Making, Baluster making, and Making Handles; and 3) Significant difference between the perceptions of the respondent groups on the acceptability of the fabricated Innovated Wood Lathe Balanced Rest.

4. METHODOLOGY

This study used the quasi-experimental method of research to gather facts relevant in achieving the discussion details in planning, designing, and fabricating the Innovated Wood Lathe Balanced Rest. A normative survey is a mode of acquiring data that uses the questionnaire as the main instrument. The study was conducted at Cebu Technological University-Main Campus, Cebu City, Philippines. The University is a government-owned institution, which offers technology and professional and technical instruction courses for special purposes, advanced studies, technical trade.

The researchers utilized researcher-made questionnaires to 10 faculty members and 18 College students who are the first year and second-year Bachelor of Science in Industrial Technology (BSIT) major in Civil Technology. These respondents are determined using universal purposive sampling. The selected second-year BSIT students who are considered skillful in their field were chosen to validate the acceptability of the Device. There are two arrangements of the questionnaire; one for the faculty members, and one for the BSIT students. The questionnaires for both respondent groups have the proximity of content. It asked responses only on the acceptability of the tool from its design,

construction, function ability, effectiveness, and aesthetics. The gathered data were statistically treated using frequency, weighted mean, and t-test.

5. RESULTS AND DISCUSSIONS

5.1 Technical Requirements of Wood Lathe

This area displays the specific prerequisites of the Innovated Balanced Rest for Wood Lathe Machine Tool as an instructional device for BSIT major in Civil and Interior Design Technology (IDT).

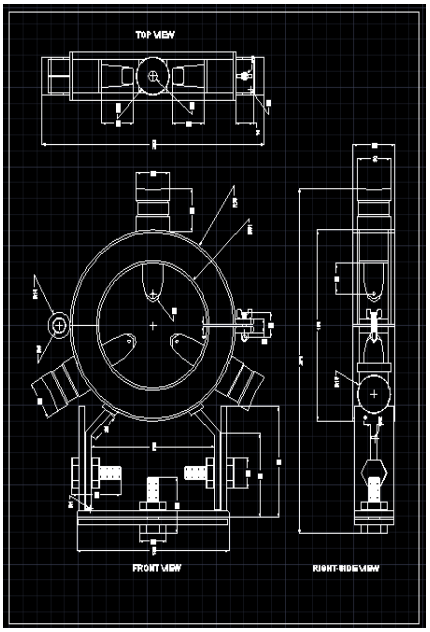

Fig. 1. The orthographic view

Design. The technical requirements for the drawing produced to show the functions or workings of an object before it is built or made (Carlile, [1]; Jennings, [6]; Kitch, [8]). It includes the Orthographic Views, Exploded Drawing and Perspective, List of Materials, List of Supplies, and List of Tools and Equipment.

The Orthographic view is composed of the three views of an innovated wood lathe balanced rest for instructions to give more detail and understanding of the unit; on the topmost is the top view of the device and below the top is the Front View of the unit, beside the Front View is the right side view of the device.

Ergonomics. The technical requirements for ergonomics in terms of Innovated Wood Lathe Balanced Rest for Instruction in the workplace lessen the risk of injury to the worker like forceful elbow movements, vibration, extreme temperature and awkward postures that arise from improper work methods and improperly designed workstations and work implements.

The users of the device should be positioned in front of the Wood Lathe Machine. Then proceed as follows: lay down the base plate of the device and tighten bolts and nuts on top of the wood lathe machine. Then set the device by mounting the sliding lever for the leg heights. Insert the wood spindle inside the device and lock the wing nut. Picture inset located lower right portion; manually turn the workpiece spindle to check the alignment materials, the machine and the Innovated Wood Lathe Balanced Rest.

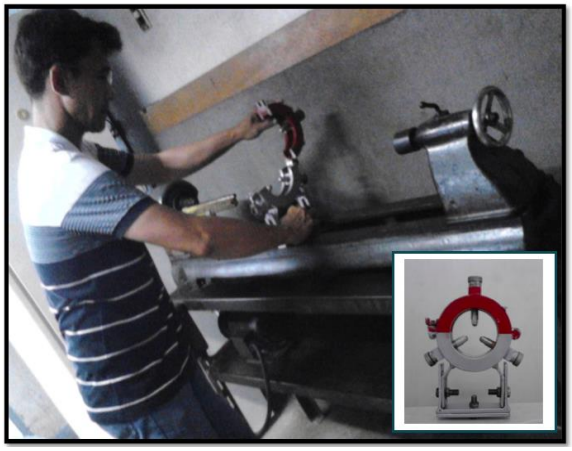

Fig. 4. Setting up the device on top of the wood lathe balanced rest

Construction. The technical requirements for ergonomics in terms of Innovated Wood Lathe Balanced Rest for Instruction in the workplace include the proper movements/ postures in the workplace by using specific materials, tools, and equipment.

Table 1. List of materials and supplies

Qnty	Unit	Description	Disposition	Price
1	Length	6mm x 50mm Flat Bar	Base Plate Frames	250
2	Pieces	200mm x 200mmx 12mm	Main Circular Frame	400
		Steel Plate		
3	Pieces	25mmx25mm 30mm	Bearing Housing	450
		Square Bar		
3	Pieces	12mm Dia. 80mm	Bearing shaft Controller	300
		Plane Round Ba		
6	Pieces	25mm Dia.x 80mm PRB	Bearing shaft controller	300
			levers	
3	Pieces	12mm Dia.	Bearing Roller Vibration	450
		Mechanical Bearing	Controller	
3	sets	12mm	Hex high Tensile Bolt and Nuts	150
		Bolt with Nuts with PW		
1	set	6mm Dia x 50mm bolt	High tensile Bolt	120
		w/wing nut and washers	with Wing Nuts	
			Cost of the Materials;	2,420

The materials stated in Table 1 were in the vicinity available. These are scrapped materials such as steel plates, block iron steel, and steel plates. These items were recycled for the maximization of materials. This implies that the fabrication of Innovated Wood Lathe Balanced Rest can be made with minimal cost and fully utilized by the students for making their practical shop exercises. The design of the Innovated Wood Lathe Balanced Rest can be prototype while the materials and supplies are locally found.

5.2 Acceptability of the Constructed Wood Lathe

Acceptability of the constructed wood lathe balanced rest was validated according to the three aspects: design, ergonomics, and construction.

Design. In the aspect of design, acceptability is broken down into three categories: Orthographic Drawing; Perspective View, Exploded Drawing.

Table 2 displays the acceptability of the constructed Wood Lathe Balanced Rest's Design in terms of Working Drawing as rated by the faculty members and students. It composed of six indicators such as American National Standard Institute (ANSI) standards which are strictly followed in the drawing; Clarity of placing dimensions on different views for direct measuring; Clarity of drawing details needed for construction; Correct usage of surface symbol and specifications; and Clarity of pictorial views.

Table 2. Acceptability of the constructed wood lathe as to design

		Faculty Member		
		(N1=10)		
Criteria	Weighted Mean			Weighted Mean
1. ANSI Strictly Followed in the Drawing	4.8		Highly Accepta	4.44
2. Clarity of Placing Dimention on	4.8		Highly Accepta	4.33
Different view for direction measuring.				
3. Clarity on Drawing Details	4.6		Highly Accepta	4.33
needed for the construction				
4. Correct usage of line and	4.9		Highly Accepta	4.83
symbol				
5. Correct usage of surface	4.6		Highly Accepta	4.56
symbols and specifications				
6. Clarity of the Picturial View	4.6		Highly Accepta	4.44
Average Weited Mean	4.72		Highly Accepta	4.49
StDev	0.13			0.19

The table shows that the Innovated Wood Lathe Balanced Rest's design in terms of Working Drawing was Highly Acceptable by both faculty members and students.

Ergonomics. In the aspect of ergonomics, acceptability is broken down into four categories: Hinge Angle, Rotating and Retractable Top Table Surface, Sole Glider Adjuster, and Retractable Platform.

Table 3. Acceptability of the constructed wood lathe as to ergonomics

		Faculty Members		Students
		(N1=10)		(N2=18)
	Weighted	Verbal Description	Weighted	Verbal Description
Criteria	Mean		Mean	
1. The rigidity of the Device	4.6	Highly Acceptable	4.5	Highly Acceptable
2. The utility of the Device	4.7	Highly Acceptable	4.56	Highly Acceptable
3.Safety in using the Device	4.5	Highly Acceptable	4.83	Highly Acceptable
4.The Durability of the Device	4.7	Highly Acceptable	4.67	Highly Acceptable
Average Weited Mean	4.63	Highly Acceptable	4.64	Highly Acceptable
StDev	0.1		0.15	

The table shows that the developed wood lathe was highly acceptable based on its ergonomic as a working drawing. This means that the Innovated Wood Lathe Balanced Rest's design as to ergonomics is proven useful, safe, durable, and time-saving. For the duration of corroboration, assembly drawing was attached.

Construction. In the category of construction, the Wood Lathe Balanced Rest was validated based on the considerations of time upon the Wood Lathe Balanced Rest was made, the usage of tools and machines, ventilation of the workplace, safety, housekeeping, and the quality of the finished Innovated Wood Lathe Balanced Rest.

Table 4 shows how the faculty members and students validated the acceptability of the Wood Lathe Balanced Rest in terms of construction.

Table 4. Acceptability of constructed wood lathe as to the construction

		Faculty Members		Students
		(N1=10)		(N2=18)
	Weighted	Verbal Description	Weighted	Verbal Description
Criteria	Mean		Mean	
1. Construction Time Frame	4.8	Highly Acceptable	4.33	Highly Acceptable
2. Proper usage of tools and Machines	4.6	Highly Acceptable	4.78	Highly Acceptable
3. Adequate Ventilation	4.4	Highly Acceptable	4.61	Highly Acceptable
4. Safety Habits	4.7	Highly Acceptable	4.67	Highly Acceptable
5. Proper Housekeeping	4.3	Highly Acceptable	4.67	Highly Acceptable
6. Quality of Finished Device	4.8	Highly Acceptable	4.67	Highly Acceptable
7. Feasible of steps of operations	4.8	Highly Acceptable	4.33	Highly Acceptable
8. Machine Scheduling	4.6	Highly Acceptable	4.78	Highly Acceptable
9. Prepararation of machines and accessories	4.7	Highly Acceptable	4.67	Highly Acceptable
10. Availability of tools	4.7	Highly Acceptable	4.67	Highly Acceptable
Average Weited Mean	4.64	Highly Acceptable	4.62	
StDev	0.21		0.51	

The table that the acceptability of the constructed Wood Lathe Balanced Rest in terms of Construction is summed up and described as Highly Acceptable by both faculty members and students as manifested in the average weighted mean of 4.64 and 4.62 with a standard deviation of 0.21 and 0.15. It means that the constructed Wood Lathe Balanced Rest is appropriately constructed with safety and proper ventilation of the working areas and the Wood Lathe Balanced Rest is in sound quality.

Table 5. Summary table on the acceptability of the constructed wood lathe

		Faculty Members		Students
		(N1=10)		(N2=18)
	Weighted	StDev	Weighted	StDev
Criteria	Mean		Mean	
Design	4.72	0.13	4.49	0.19
Ergonomics	4.63	0.1	4.64	0.15
Construction	4.64	0.26	4.62	0.15
Average	4.66	0.16	4.53	0.16
Verbal Description		Highly Acceptable		Highly Acceptable

To have an objective validation of the constructed Wood Lathe Balanced Rest based on a questionnaire, assembly drawings with parts list were given to faculty members and students and ocular inspection was done.

The overall on the acceptability of the Innovated Wood Lathe Balanced Rest's Design by both the faculty members and students indicate that it is Highly Acceptable as manifested in the average weighted mean of 4.66 and 4.53 with a standard deviation of 0.16 and 0.16 respectively. The summary of the acceptability of the constructed wood lathe balanced rest proves that the design of the device met the required standards for planning and designing. It can be the basis for the construction of the Innovated Wood Lathe Balanced Rest. It is proven that the Innovated Wood Lathe Balanced Rest for Instruction follows the standards in design, ergonomics, and construction.

5.3 Test of Significant Difference

Table 6. The significant mean difference as rated by Faculty and Students

	Wood Lathe Balance Rest		Computed T-Value	Critical Value @df =26 a= 0.05 two-tailed test	Significance	Decisi
Respondents	X1	D1				
Faculty Member (n=10)	4.79	0.12	12.68	2.056	Significant	Ho Rejec
Students (n=10)	4.68	0.09	6.15	2.056	Significant	Ho Rejec

The table shows that there is a significant mean difference between an Innovated Wood Lathe Balanced Rest when rated by faculty members and students since the computed t-values are more significant than their respective critical values.

Table 7. Effectiveness of wood lathe

		Faculty Members (N1=10)		Students (N2=18)	
Machine Operation Exercises	Criteria	Weighted Mean	StDev	Weighted Mean	StDev
Chair Leg Making	Design	4.72	0.13	4.49	0.19
Baluster Making	Ergonomic	4.63	0.1	4.64	0.15
Making Handle	Construction	4.64	0.26	4.62	0.15
	Average	4.66	0.16	4.53	0.16
Verbal Description		Highly Effective		Highly Effective	

The summary of the effectiveness of the constructed wood lathe balanced rest proves that the design of the device met the required standards for planning and designing. It can be the basis for the construction of the Innovated Wood Lathe Balanced Rest for Instruction. It is proven that the Innovated Wood Lathe Balanced Rest for Instruction follows the standards in design, ergonomics, and construction. In the category of construction, the Wood Lathe Balanced Rest was validated based on the considerations of time upon the Wood Lathe Balanced Rest for Instruction was made, Chair Leg Making; Baluster making, and Making Handles of the finished Innovated Wood Lathe Balanced Rest.

6. CONCLUSIONS

This study has analyzed the specific characteristics of the conventional wood lathe and developed improvements for the purpose of instruction. In this regard, a balance rest was made and applied to the device to increase its usability and safety. The innovation of the device is of vital importance particularly to instruction primarily because among the adopters of the device are students which would require it to safe and usable.

The innovated wood lathe was tested for acceptability and it was found that the intended adopters of the device significantly found it highly acceptable for instruction. In this regard, it can be concluded that the Innovated Wood Lathe Balanced Rest meets the standards and precise function in performing each function for Civil and Interior Design Technology instructions.

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