Design and Development of an Attachable Sharpening Tool Bit Holder: A Utility Model

Asia Pacific Journal of Management and Sustainable Development
Vol. 10. No. 2, pp 87-91
March 2022
ISSN 2782-8557(Print)

Edgardo C. Morales[1], Ruel G. Chua [2], James M. Dumaguit [3]
Student, Graduate School, Surigao State College of Technology[1,2]
Faculty, Graduate School, Surigao State College of Technology[3]
emorales@ssct.edu.ph[1], rchua@ssct.edu.ph[2], jdumaguit1@ssct.edu.ph[3]

Abstract *–This study focused on the design and development of an Attachable Sharpening Tool Bit Holder for mechanical technology. Specifically, the study focused on determining the accuracy of the angle produced by the device when performing an operation. Moreover, perceived cost-effectiveness and device safety. This research study uses the descriptive-developmental research method with 51 respondents who were determined using the purposive sampling. The data were gathered from the respondents using the researcher-made questionnaire.*

Result revealed that the mean absolute error for the attachable tool bit holder is 0.13. Respondents of the survey rated strongly agree on the cost-effectiveness and the device safety of the Attachable Tool Bit. Meanwhile, the operational safety of the Attachable Tool Bit Holder was rated as very much safe by the respondents. There is a significant difference in the angle accuracy, duration, and operational safety between the Attachable Tool Bit Holder compared to the old design. Thus, the device is recommendable to use in mechanical shop rooms in industry and academe and to be registered as utility model.

Keywords: Attachable tool bit holder, developmental, perceptions, tool bit utility model,

INTRODUCTION

Tool bits are commonly used in the field of machine shops. Generally, the lathe machine requires a cutting apparatus called tool bits during its operations. Tool bit becomes blunt after continued use for a period of time, hence requires re-sharpening usually done manually with a grinding machine, which is not accurate in terms of shapes and angles. Practices of machine shop operations in grinding tool bits to restore its sharpness uses offhand manual operations.

Grinding or re-sharpening tools bit manually offhand using a bench or pedestal grinding machine, may not be safe for the novice practitioner such as students, especially those freshmen.3 When the tool bit touches the grinding wheel, it will produce vibration, sparks, and the tool bit temperature increases making it difficult to hold 4 [1]]. This factor may cause difficulties for the students to properly sharpen the tool bit and establish the desired shape. Moreover, the cost of buying a new tool bit is quite comparably expensive than sharpening the old one.

The previous study of the tool bit mechanisms development can't provide an accurate angle when a tool/object is attached to it for sharpening into the desired angle [2]-[4].

Design and Development of an attachable sharpening tool bit holder addressed these issues and problems. This device is attached to the grinding machine and firmly the tool bit to be ground, while controlling vibrations. The tool bit is placed on the holder and locked with the screw clamp, the holder is swiveled at the required angle and can be adjusted to its desired position during the operation. The operator holds and drives the tool bit sharpening holder safely by adjusting its angle and moving it gradually across the grinding wheel.

With this method of sharpening the students will be free from injuries or accidents due to the reason that they will no longer directly hold the tool bit by hand instead they just simply hold and drive the tool bit holder.

OBJECTIVES OF THE STUDY

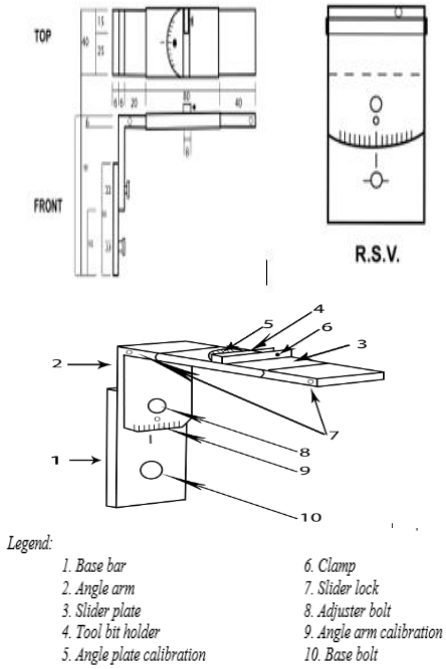
This research aimed to designed and developed an Attachable Sharpening Tool Bit Holder for mechanical technology. Specifically, this determines the Accuracy of the produced angle, Duration in Grinding Tool Bits, Extent of Cost-Effectiveness of Attachable Sharpening Tool Bit Holder, Device Safety of Attachable Sharpening Tool Bit Holder and Comparisons of Angle Accuracy, Duration, and Operational Safety between the Attachable Sharpening Tool Bit Holder and the Old Platform.

MATERIALS AND METHODS

Project Design

The Attachable sharpening tool bit holder is comprised of a base bar (1) for firm foundation, angle arm (2) that support the slider plate and can be tilted to the desired angle when grinding different forms or shapes

of the cutting tool at a definite angle with slider lock (7), slider plate (3) allowing the user to move longitudinally the tool bit holder, a tool bit holder(4) with clamp (6) for firmly hold the cutting tool, and angle plate calibration (5) allows the user to swivel the holder to the desired position. This utility model showcases adjustable due to threaded bolt (8) that can be used for tilted to the desired angle, with angle arm calibration (9), and base bolt (10) which will be mounted or held rigidly to bench grinder.



Legend:

1. Base bar
2. Angle arm
3. Slider plate
4. Tool bit holder
5. Angle plate calibration
6. Clamp
7. Slider lock
8. Adjuster bolt
9. Angle arm calibration
10. Base bolt

Fig.1 Perspective view of the device.

Design Implementation

The materials used in implementing the designed attachable tool bit holder are shown in Table 1.

Table 1. Bill of Materials

Description		Qty	Unit	Unit Cost	Amount
Bolt	3x10 mm	1	pc.	5	5
Bolt with Nut	5x30 mm	1	pc.	10	10
Bolt with Nut & Washers	10x50 mm	2	pc.	35	70
Steel Plate	3x80x80 mm	1	pc.	100	100
Flat Bar	5x40x395 mm	1	pc.	120	120
				Total Cost	**305**

After securing the needed materials, the layout was setup. The carbon steel was cut to the required shapes and sizes, and the larger length flat bar was bent with the specified dimensions with right angle (90 degrees) to produce angle arm. A 10 mm. cylindrical holes was produced by drilling both base bar and angle arm with inside thread. Using the milling machine, a slot was cut on the top of angle arm, and the plate was bent to serve as slider. Then using the welding machine, the tool bit holder was formed with 3mm. cylindrical hole on one side; then the inside thread was produced by using hand tap.

The wing side of the tool bit holder and slider plate was drilled to produce 5mm. holes. The unit was assembled by mounting the slider plate to the angle arm, then mounting the tool bit holder to the slider plate using 5mm. threaded bolt with nut, then marking degrees' calibrations both the angle arm and base bar, mounting the base bar to the angle arm with 10mm. bolt with nut.

Product Testing

The product was initially tested by grinding tool bits using the Attachable Tool Bit Holder. Upon seeing that the results are okay, it was replicated many times to test its effectiveness in terms of angle accuracy and duration of tool bit grinding or reshaping. Five tool bits were reshaped or grind to achieve a 30 degrees angle using the proposed utility model. Another 5 tool bits were reshaped with the same target angle using the old platform. Another 5 tool bits were reshaped to achieve 45 degrees angle using the proposed utility model. Again, another five tool bits were ground to achieve the same target angle using the old platform. This was done again to another five tool bits to achieve 75 degrees using the proposed utility model and another five using the old platform.

Fig.2 Attaching the device to the grinder.

Fig.3 Setting the angle of the device.

Project Evaluation

The Attachable Sharpening Tool Bit Holder was brought to the experts in mechanical technology. They are professors/instructors in mechanical technology of Surigao State College of Technology and technology and mechanical shop machinists in Surigao City. The product was presented to them so that they can evaluate if the product itself is cost-effective and safe. The video of the testing was also viewed to them so that they can evaluate the operational safety of the product when used to grind or reshape tool bits.

Research Environment

This study was conducted at Surigao State College of Technology, Surigao City Campus.

Respondents

The respondents of this study are the 43 third year students, 8 instructors and professors in the mechanical engineering technology course of Surigao State College of Technology, Surigao City campus. The participants are selected thru purposive sampling, to ensure that all perceptions are being represented. A purposive sampling is a sample selected in a deliberative and non-random way to achieve research objectives.

Research Instrument

The instrument to be used in this study is the researcher made questionnaire The questionnaire addresses analysis and evaluation by which the respondents answered and rated them accordingly.

Data Analysis

Mean Absolute Error. This was used to describe the accuracy of the produced angles after grinding tool bits using the Attachable Sharpening Tool Bit Holder and the old platform.

Mean and Standard Deviation. These were used to determine the length of time or duration of producing the angles of the tool when grinding tool bits using the Attachable Sharpening Tool Bit Holder and the old platform. These were also used to determine the extent of cost-effectiveness and device safety of the Attachable Sharpening Tool Bit Holder and the perceived operational safety.

t-test for independent samples. This was used to compare the angle accuracy and duration between the Attachable Sharpening Tool Bit Holder and old platform.

Sign Test. This was used to compare the perceived operational safety of the Attachable Sharpening Tool Bit Holder and old platform.

RESULTS AND DISCUSSION

Table 2 shows the accuracy of the produced angles using the proposed design and the old platform.

Table 2. **Accuracy of the Produced Angles**

Target Angle	Proposed Design		Old Design	
	Output	Absolute Error	Output	Absolute Error
30	30.16	0.16	30.32	0.49
45	45.13	0.13	44.87	0.38
75	75.10	0.10	75.31	0.31
Mean		**0.13**		**0.39**

The table shows that that the average angle produced is using the proposed design are 30.16 degrees for the 30 degrees target. The average angle produced is 45.13 degrees for the 45 degrees target. The angle produced is 75.10 degrees for the 75 degrees target. There is an absolute error of 0.16 degree for 30 degrees target. There is an absolute error of 0.13 degree for the 45 degrees target. There is an absolute error of 0.10 degree. The mean absolute error for all 15 tool bits is 0.13.

The table also shows that that the average angle produced is using the proposed design are 30.32 degrees for the 30 degrees target. The average angle produced is 44.87 degrees for the 45 degrees target. The angle produced is 75.31 degrees for the 75 degrees target. There is an absolute error of 0.49 degree for 30 degrees target. There is an absolute error of 0.38 degree for the 45 degrees target. There is an absolute error of 0.31 degree. The mean absolute error for all 15 tool bits is 0.39.

In table 3, the durations in grinding the tool bits are shown as results.

Table 3. **Duration in Grinding Tool Bits**

Design	Target Angle	Mean Duration (Minutes)	SD
Proposed	30	7.34	0.14
	45	6.89	0.11
	75	5.67	0.20
	Average	**6.63**	**0.75**
Old	30	8.22	1.05
	45	8.16	0.83
	75	5.97	0.52
	Average	**7.45**	**1.33**

In using the proposed Attachable Sharpening Tool Bit Holder, the mean duration is 7.34 minutes with SD=0.14 for the 30 degrees target. The mean duration is 6.89 minutes with SD=0.11 for the 45 degrees target. The mean duration is 5.67 minutes with SD=0.20 for the 75 degrees target. The average duration is 6.63 minutes with SD=0.75 for the 15 tool bits. In using the old platform, the mean duration is 8.22 minutes with SD=1.05 for the 30 degrees target. The mean duration is 8.16 minutes with

SD=0.83 for the 45 degrees target. The mean duration is 5.97 minutes with SD=0.52 for the 75 degrees target. The average duration is 7.45 minutes with SD=1.33 for the 15 tool bits.

Table 4. **Extent of Cost-Effectiveness of Attachable Sharpening Tool Bit Holder**

Item	Statement	Mean	SD	Description
1	The materials used to develop the device are affordable.	4.00	0.00	Strongly Agree
2	Transportation costs are avoided since the materials are locally available.	4.00	0.00	Strongly Agree
3	Fabrication cost is minimal as it can be locally done.	4.00	0.00	Strongly Agree
4	Maintenance cost of the device is minimal.	4.00	0.00	Strongly Agree
5	No special storage cost is needed.	3.90	0.32	Strongly Agree
	Average	**3.98**	**0.06**	**Strongly Agree**

In table 4 the extent of cost-effectiveness of Attachable Sharpening Tool Bit Holder is displayed as results.

Result revealed that the average is 3.98 with SD=0.06. This has a description of strongly agree. All items are rated as strongly agree by the experts. This means that the proposed utility model is cost-effective. Four items are rated with perfect scores of 4 and SD=0. This is Item 1 to Item 4. Item 5 is not rated a perfect score with SD=0.32. It means that the proposed utility model is made without unnecessary expenses.

Table 5. **Device Safety of Attachable Sharpening Tool Bit Holder**

Item	Statement	Mean	SD	Description
1	It has no sharp edges that can harm the user when held.	4.00	0.00	Strongly Agree
2	The parts are well-attached to each other avoiding dismantling harm.	4.00	0.00	Strongly Agree
3	The device doesn't heat-up when used.	3.40	0.52	Agree
4	The components of the device doesn't contain metals that can harm the user when in contact with the device.	3.90	0.32	Strongly Agree
5	The device is safe for relocation and movement from one place to another.	3.90	0.32	Strongly Agree
	Average	**3.84**	**0.13**	**Strongly Agree**

In table 5, we can see the extent of device safety of the Attachable Sharpening Tool Bit Holder is displayed as results. The average is 3.84 with SD=0.13. This has a description of strongly agree. Meaning that the Attachable Sharpening Tool Bit Holder is not harmful to the user. It has not harmful parts and no cause of concern for accidents. Four items are rated as strongly agree and only 1 is rated agree. Item 1 "It has no sharp edges that can harm the user when held" and Item 2 "The parts are well-attached to each other avoiding dismantling harm" are rated a perfect score of 4.00 with SD=0. Item 3 "The device doesn't heat-up when used" is getting the lowest mean 3.40 with SD=0.52 and this is under the description of agree.

Table 6. **Operational Safety in Using the Attachable Sharpening Tool Bit Holder and Old Platform**

Design	Mean	SD	Description
Old	2.90	0.57	Moderately Safe
Proposed	4.51	0.53	Very Much Safe

Legend:
5 - Very Much Safe *3 - Moderately Safe* *2 - Less Safe*
4 - Very Safe *1 - Unsafe*

The experts rated the operational safety if the proposed model and the old platform are used, and the results are presented in the table 6.

The mean for the old design is 2.90 with Sd=0.57 and this is under the description of moderately safe. The proposed design has mean 4.51 with SD=0.53 and this is under the description very much safe. So, the operational safety is good in using the proposed design because the mean is higher compared to the old design.

The significant differences or comparing of the angle accuracy, durations, and operational safety between the two designs can be seen in Table 7.

Table 7. **Comparisons of Angle Accuracy, Duration, and Operational Safety Between the Attachable Sharpening Tool Bit Holder and the Old Platform**

Variable	Design	Central Measure	Statistic	df	p	D	I
		Mean	t				
Angle Accuracy	Proposed	0.41	7.129	28	9.3E-08	R	S
	Old	0.63					
Duration	Proposed	6.63	2.084	28	.046	R	S
	Old	7.45					
		Median					
Operational Safety	Proposed	4.50	-	-	.002	R	S
	Old	3.00					
Legend:	*D - Decision on Ho*		*I - Interpretation*				
	R - Rejected		*S - Significant*				

For angle accuracy, the p=9.3E-08 and the t=7.129. This is rejected because the p is less than 0.05. This means that there is a significance difference between old and proposed design. By looking at the mean, the mean for the mean of old has 0.63 mean absolute error and the proposed has only 0.41 absolute error. This means that the proposed utility model is good than the old one. We can also see t=2.084 and p=0.046 for the duration.

This is rejected and significant interpretation. By looking at the mean, the old has 7.45 minutes but the proposed is only 6.63 minutes. Meaning that it is faster to work using

the proposed model. For the operational safety the p=0.002. This is again rejected and significant interpretation. If we look at the median, the proposed has median of 4.50 but only 3.00 for the old. Meaning that the grinding operation is safer if we use the Attachable Sharpening Tool Bit Holder.

CONCLUSION AND RECOMMENDATION

The angles produced in the tool bits using the Attachable Tool Bit Holder are very close to the target angles. The duration to finish the grinding of tool bits using the Attachable Tool Bit Holder is minimal. The Attachable Tool Bit Holder is cost-effective and not harmful. Using the Attachable Tool Bit Holder in the grinding operation is safe and The Attachable Tool Bit Holder produce more accurate angles, less time consumed, and safer than the old platform which is dangerous because the technician will hold the tool bits when grinding.

The following are being recommended based on the findings: the Attachable Tool Bit Holder should be used in grinding and sharpening tool bits. The device should be included in mechanical shop lessons. The device can be used also in shops outside the school. The device is also good for commercial plan.

REFERENCES

[1] Talibin, M. N., &Mydin, M. M. (2014). The drill bit sharpening device.80-87, 1

[2] Balasubramaniam, M., Joshi, Y., Engels, D., Sarma, S., & Shaikh, Z. (2001). Tool selection in three-axis rough machining. *International Journal of Production Research*, *39*(18), 4215-4238.

[3] Fu, L., & Guo, Q. (2010). Development of an ultra-small micro drill bit for packaging substrates. *Circuit World*.

[4] Suzumori, K., Likura, S., & Tanaka, H. (1991, January). Development of flexible microactuator and its applications to robotic mechanisms. In *Proceedings. 1991 IEEE International Conference on Robotics and Automation* (pp. 1622-1623). IEEE Computer Society.

COPYRIGHTS