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THE DESIGN OF THE SMART GAUGE

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Abstract

The project is implemented according to the concept of multipurpose tools with the easiest way to complete practical work for the subject of Mechanical Workshop Practice (machining) in Malaysian polytechnics. In the current situation, each student needs to complete the order assignment based on the lab sheet given. In this process, students should use several types of testing and measurement tools such as size measurement, angle determination, thread, and tool grinding. Due to the small size of the tool, it becomes difficult in movement control besides often losing. With a variety of tools used, it thus increases the use of time in completing a task. Therefore, the objective of this project is to complement several types of testing tools and measurements in one tool. In addition, the project can save students time to complete the task. In the manufacturing process, the project started by obtaining testing and measurement tools to be used to complete the task. Next, follow by sketching process and designing using AutoCAD software. For the cutting process, The Metal Laser Die Cut machine is used and the process will be done by using a laser marking machine. In conclusion, this smart gauge which consists of a variety of gauge testers and measurers in one plate can make work easier and more enjoyable. This project can build students' confidence and make their self-assessment in Mechanical Workshop Practice course. Thus, references to lecturers can be reduced. The processing work carried out by students is more effective and results in a more precise measurement of work materials. For lecturers, the using of Smart Gauge can reduce the time to measure and mark student's workpiece and in turn can increase productivity.

Keywords: *Smart gauge, machining, self-assessment*

1.0 Introduction

In education, innovation can appear as a new pedagogic theory, methodological approach, teaching technique, instructional tool, learning process, or institutional structure that, when implemented, produces a significant change in teaching and learning, which leads to better student learning (Serdyukov, 2017).OECD (2016) emphasized that innovation in education is vital to bring improvement in education. Innovation will improve the nation's efficiency and also outcomes in learning quality and equity.

Thus, the effectiveness of teaching and learning is not just relied on the syllabus but the skills of lecturers in adapting the methodology and developing teaching materials. Technical, vocational, and technical education lecturers (TVET) always face the challenge of developing self-esteem for students with low academic grade that need for extra teaching effort in applying the theories learned to practical work (Khuzainey Ismail, 2018), especially for workshop courses such as machining and rushing skills.

Grinding tool skill is one of the topics that need to be completed before the process of the lathe. Normally, students will be given a worksheet that shows diagrams and dimensions that are required to set up the tool. Also, lecturers will demonstrate the steps necessary for grinding tools. Based on previous practice, students face problems producing an accurate tool and often apply it to the faculty to assess the results of their work so that the tool is ready to grind.

Besides taking a long time to complete the process, students are seen to be less self-conscious and often make mistakes when performing the tool grinding process. Students also often refer to lecturer determination of complete workpiece size measurement. Determination of the angle of the drill bit size is also a problem for students. It can cause binding, wear, and eventual catastrophic failure of the tool (Dhanraj Patel, 2015).

Smart Gauge has been created to realize our commitment to improving student achievement and effective learning approaches and innovative learning approaches. The concept of the Smart Gauge comes from Multipurpose Tools; a combination of several tools in a single unit with eleven functions as exhibited in Figure 1(wikipedia.org, 2022).

Figure 1: Multipurpose Tool

Experience learning and studying about lathe machines in three semesters gives an idea of innovation to develop a tool that could be a gauge calibration to the activities of the tool machining (Yashraj, 2018). The use of 'Smart Gauge' not only understand but also improves students' skills in evaluating their self-assessment.

This tool indirectly embraces student-centered learning. Students will be able to practice practically grinding the tool points and making the measurement of the workpiece better. Students will practice by themselves and think critically in doing practical tool grinding, machining, and angle determining. The ability of students to evaluate their work using Smart Gauge can stimulate and attract interest and increase confidence in the performance of machine work and rush.

2.0 Methodology

A gauge is a tool used to determine the exact dimension, and as a device for measuring a physical quantity (dictionary.com, 2022), for example, to determine thickness, the gap in space, the diameter of materials, or pressure of the flow, or a device that displays the measurement of a monitored system using a needle are a pointer that moves along a calibrated scale. For the innovation of this project, it is a tool of 12 in 1 that acts as a tool to measure and test as well as 1 self-learning tool (Kevin Otto, 2016). Measuring functions are as follows:

- Tool bit gauge
- Pitch gauge (M25)
- 180° protractor
- Ruler
- Semester 1 machine gauge
- Semester 2 machine gauge
- Semester 3 machine gauge

As for the lab sheet function, QR (Quick Response) code has been used. QR codes allow students to use their smartphones to get a lab sheet according to the semester they are in. So, the lecturer does not need to give the lab sheet hardcopy to the students as well as save can save the use of paper. Mechanical Workshop practice courses are offered for Mechanical Engineering Diploma Programs and Mechanical Engineering Diploma (Packaging) programs. This course is offered for three levels at semesters 1, 2 and 3 under the course code DJJ 1032, DJJ 2032, DJJ 3032.

The development of this tool is based on the student learning process that trains students to self-evaluate their working process. Also, this gauge consume less time as compared to other measuring devices (learnmechanical.com, 2022). This tool is made of stainless steel with a thickness of 6mm because of the characteristic feature of this material that is light, durable, and easier to use as a measuring tool. The size of this tool is about 110 mm x 100 mm to make it easier to use as a measuring and testing tool. This Smart Gauge is designed using AUTOCAD and NC editor software. Next, stainless steel plate cutting process using 'Metal Laser Die Cut' according to designed drawing.

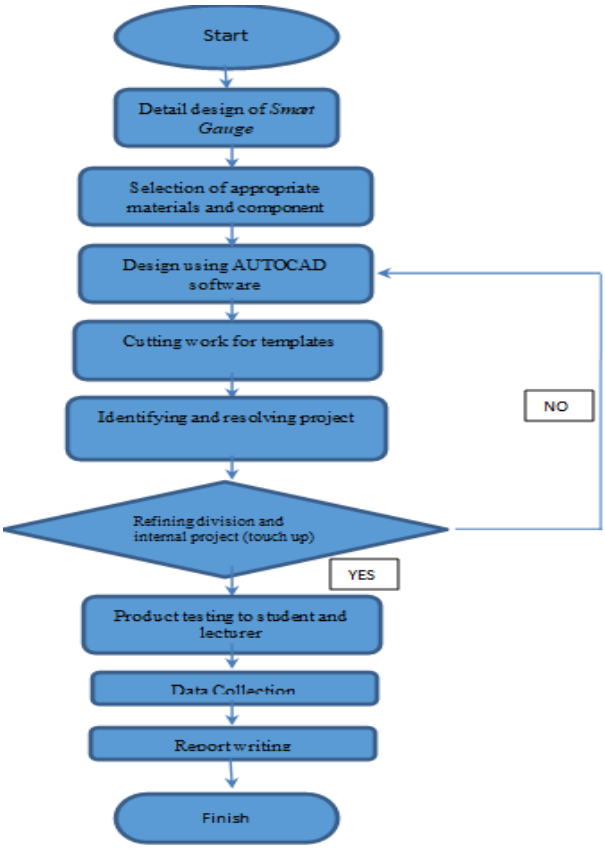

FIGURE 2: Process Flow Chart

3.0 Result & Analysis

This project design was successfully proposed and produced according to the designed material and component. The design and the function of the Smart Gauge as exhibited in Figure 3.

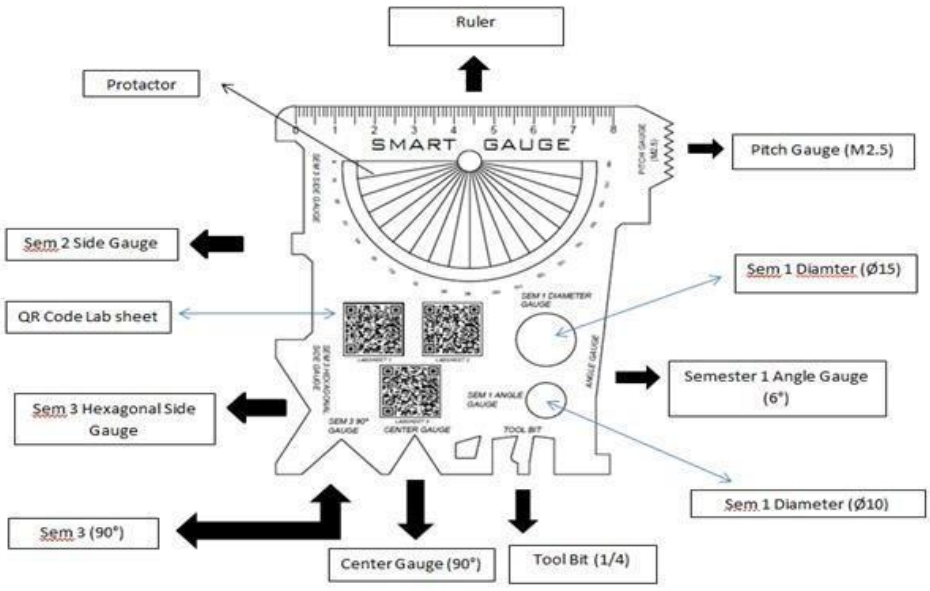

FIGURE 3: Design and Function of Smart Gauge

This project aims to overcome students' weaknesses in testing tool bits for lathe machines. It was designed to solve tool bits problem. This 'Smart Gauge' also can solve the problem of deciding the angular angle of tool bits to determine pitch angle, also determine the size, angle, and measure workpiece.

After the project was successfully produced, the observation involving 10 students and 2 lecturers were successfully conducted to prove that it can achieve the objective of the project. Six areas were identified to be considered as variables which are as follow:

Table 1: Data before and after using Smart Gauge

Observation	Before	After
Students refer to lecturer	3 times	1 time
Decent quality tool bit grinded by student	7	9
Time completion to grind tool bit by student (minutes)	21	9
Student mistake grinded tool bit	10	2
Student work piece with accurate measurement	6	10
Time evaluate student's work by lecturer (second)	30	15

3.1 Product Testing

The apparatus needed to use for testing a product is a tool bit, pitch gauge (M2.5), ruler, and a few lathes machine gauge. Example can be taken, lathe machine gauge (Semester 1 diameter gauge) was used to check the accuracy performed by student to get the actual size as in all-in-one gauge (Smart Gauge).

The second example can be taken for testing a product is pitch gauge (M2.5). This apparatus was chosen for testing to determine the thread size of the project task student. If size of the Smart Gauge (M2.5) is exactly same as the apparatus used, it shows the student has managed to get the right size thread for their project practical task.

FIGURE 4: Image of three-semester workpieces using Smart Gauge

The inaccuracies of the size when doing a practical task workshop by students can be reduced. It is because the use of Smart Gauge has shown a good impact when used while performing tasks in the workshop. Hence, a few examples of result can be seen below that may indicate the use of Smart Gauge can help students and lecturers.

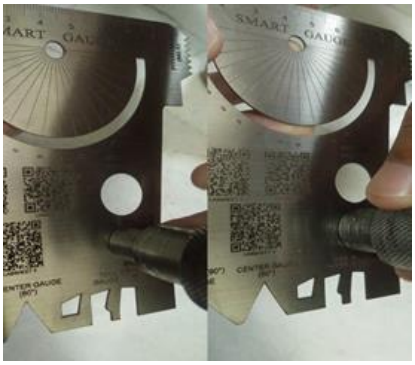

FIGURE 5: Comparison between before and after (Semester 1 Diameter Gauge)

FIGURE 6: Comparison between before and after (Semester 1 Angle Gauge)

FIGURE 7: Comparison between before and after (M2.5 pitch gauge)

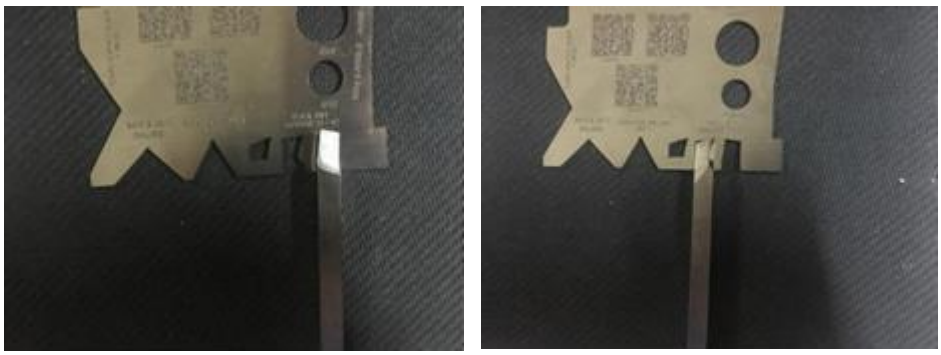

FIGURE 8: Tool bit angle gauge

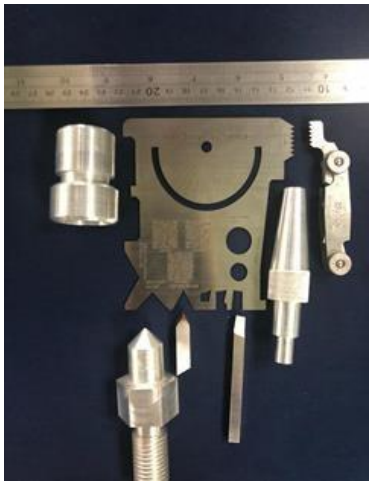

FIGURE 9: Image of the uses of Smart Gauge

From the result of testing have done, Smart Gauge shows a reduction of problems that always happen when students doing a practical task a workshop. Besides that, it shows the lecturer more ease giving marks to students, lecturer does not need to waste more time to measure every project done by students and the lecturer will not be busy because of the oversight of every student.

4.0 Conclusion

This innovation development has enabled students to better understand the concepts and methods of implementing, measuring, and testing the work of machinery, especially tool bit grinding (Rohit R. H., 2019). Hence, lecturers can also make the work review faster, easier, consistent, and accurate. Indirectly, this Smart Gauge- assisted machining process can train students to think creatively and critically, and competitively in producing quality machining and practice grinding tool points according to the correct procedure. This innovation can be practiced extensively for technical courses of processing in schools and other technical training centers. Furthermore, this tool can also help disabled students in technical programs. Smart Gauge can be used for all polytechnic in Malaysia, it will be easier for students and lecturers who take Mechanical course and workshop. It shows the creation of Smart Gauge can be more beneficial to Polytechnic's students and lecturers.

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References

Dhanraj Patel, R. V. (2015). Analysis of Drilling Tool Life-A Review. *International Journal of Mechanical Engineering and Robotics Research, ISSN 2778-0149, Vol 4, No 1*, 523-539.

dictionary.com. (2022). Récupéré sur www.dictionary.com/browse/gauge

Kevin Otto, K. W. (2016). *Product Design and Development.* Pearson Education.

Khuzainey Ismail, M. N. (2018). Challenge Faced by Vocational Teachers in Public Skills Training Institution: A Reality in Malaysia. *Journal of Technical Education and Training ISSN 2229-8932 Vol. 10, No.2*|, 13-27.

Kumar, P. D. (2016). Multi-purpose Machine Tool: A Key to Increased Productivity, Decreased Cost and Saving in Power Consumption and Floor Area Requirement. *International Journal of Emerging Engineering Research and Technology, Vol. 4, Issue 10*, 1-6.

learnmechanical.com. (2022). Récupéré sur www.learnmechanical.com/types-of-gauges

OECD. (2016). Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills. Paris: OECD Publishing.

Rohit R. H., R. S. (2019). Design and Manufacturing of Inspection Gauge. *International Journal of Advanced Engineering Research and Application, Vol. 5, Issues 01*, 29 – 33.

Serdyukov, P. (2017). Innovation in education: what works, what doesn't, and what to do about it? *Journal of Research in Innovative Teaching and Learning, Volume 10 Issue 1 ISSN: 2397-7604*, 4-33.

Siddarth, S. A. (2020). A Review of Inspection Gauge and Instruments Used in Industries. *International Research Journal of Engineering and Technology, Vol. 7, Issue 06*, 2101 – 2106.

wikipedia.org. (2022). Récupéré sur https://en.wikipedia.org/wiki/Multi-tool

Yashraj, V. P. (2018). Study of Fabrication of Multipurpose Tooling Machine. *International Research Journal of Engineering and Technology, Vol. 5, Issue 03*, 100 – 103.