THE DEVELOPMENT OF A *DUALFUNCTION RULER* PROTOTYPE AS A TEACHING AID TOOL FOR TECHNICAL DRAWING SUBJECT IN SCHOOL

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ABSTRACT

This research is about the development of a Dualfunction Ruler (DR) prototype as a Teaching Aid Tool for the Technical Drawing subject in secondary school. The objective of this research is to develop a prototype innovated from the existing technical drawing tool in school and it's expected to facilitate student to draw corner and sphere. This prototype is developed via the Oshuga`s methodology where the aspect of modification, analysis and evaluation is running inside of each phase. To measure the efficiency of the prototype, two kinds of test have been conducted. The instrument for the first test is a checklist where it was used by the researcher to measure the prototype from the aspect of pertinence when drawing corner and sphere. The second test involved questionnaires which were distributed among Computer-Aided Design students. The questionnaire contain 12 items which covered 7 items that are related to the usage of the prototype and 5 items that are related to the design of the prototype. In order to fill in the questionnaire, the respondents have to use the prototype at first. The data collected has been analyzed with SPSS V16.0. From the result, it shows that this prototype can draws perfect sphere and corner where the min score is 4.06. In addition, the design of the tool is also suitable for the usage of the school students where the min score is 4.17. The result for the test conducted by the researcher himself also shown the positive result which means the prototype can draw the accurate corner and sphere.

Keywords: Technical Drawing subject; teaching aid tool, Dualfunction Ruler

INTRODUCTION

The changes of the world view towards the importance of industry have giving a new dimension to Malaysian government in looking up the importance of the technical and vocational subject in school. Based on the *Pelan Induk Pembangunan Pendidikan (PPIP) 2006-2010*, the government had allocated RM577 for the technical and vocational education purposes in the 9th Malaysian Planning (RMK-9). According to the PIPP in addition, there are 90 Technical Secondary School in 2005 where the increment of the student number is 42.1%, from 30,691 on 1990 to the 72,838 on 2005.

According to Dato Aishah Abu Sanah (1994), the Technical Drawing subject is a new elective subject in the group II of the Vocational and Technical Subjects for form four and five students. This subject has been legislated with consideration on continuity of the *Kemahiran Manipulatif Tambahan* and Mathematics subjects since form 1 to form 3. Most of the students who are taking this subject have mathematical and visual intelligence ability. This subject can enhance the student's intellectual, helps them in making decision, understand the latest technology and as a basis for them to further their study in the technical drawing field. So that the purpose of this subject is to expose the students who are interested, to the basic of technical drawing techniques in order to manure and expand their interest and tendency before they can get involve or select this field as their career or study line in the university or college.

During form 4, the students will learnt about the basic concepts which are the introduction of the technical drawing tools, line/lining understanding, geometry concept, orthographic and oblique principles. When they are in form 5, the students will learnt about mechanical drawing, electrical and electronic drawing, piping drawing and civil engineering drawing.

In school, students are exposed to the manual method of technical drawing techniques where the A3 drawing paper and technical drawing tools are taking its place. The rational of using the

manual method is to give the drawing experience to the students in learning the basic and the concept of technical drawing before the complex AutoCAD software application playing its role.

The teaching and learning process that commonly implemented by the school teacher in teaching this subject is through the inductive method. This method is implemented because the content of this subject is focused on the techniques of drawing so the teacher's guidance is very crucial in the teaching and learning process. The demonstration does by teacher using the large scale of technical drawing equipment could facilitate students to see the technique of drawing clearly.

RESEARCH QUESTIONS

1. Can DR play it function to draw accurate corner?
2. Can DR play it function to draw accurate sphere?
3. Is the design of DR suitable to be used by school students?

RESEARCH METHODOLOGY

Checklist
The first research instrument is a checklist. The checklist is used by the researcher to test the ability of DR to draw a perfect corner and sphere.

Research Procedure
During the test, the aspects of accuracy while drawing corner and sphere will be tested. The checklist is divided into two parts. The first part involves the accuracy in order to draw a corner using selected degree and the later part involves the accuracy in order to draw a sphere using selected radius. The checklist implements the nominal scales where the value is either accurate or inaccurate.

Data Analysis
The collected data will be analyzed based on the selected degree and radius that have been listed and tested through the checklist.

Questionnaire
The second research instrument is questionnaire which is developed using Likert`s scale. The questionnaire consists of a part related to the respondent details and two parts related to the product evaluation from the aspects of design and usability.

Research Sample
The research sample is 10 students of Computer Aided Design Program from Universiti Pendidikan Sultan Idris (UPSI) who had experienced and education background in the Technical Drawing subject either in primary school or higher education institution.

Research Procedure
The respondents have to use the prototype before they can response to the questions listed in the questionnaire.

Data Analysis
The collected data is analyzed through quantitative and descriptive types by using *SSPS Data Editor*. Each of the answer is analyzed according to its category.

ANALYSIS AND DISCUSSION

Checklist Instrument Analysis

The accuracy of DR to draw Corner

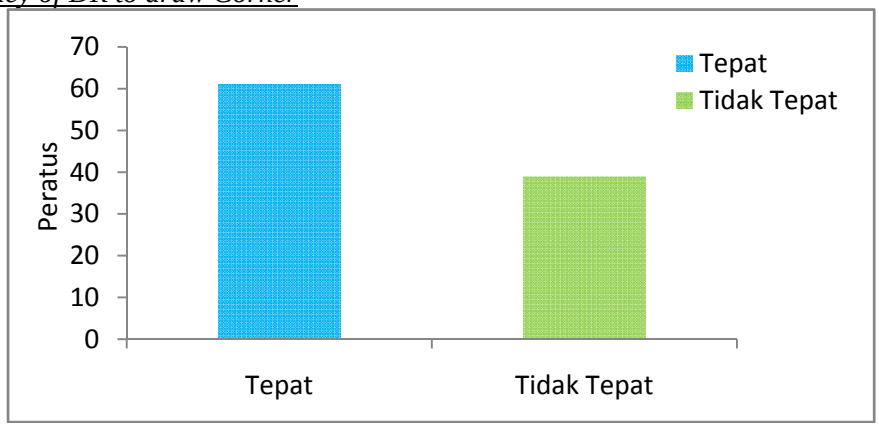

Figure 1 The overall test result represented by the percentage of accuracy while testing the left side of protractor.

Three tests have been conducted for each of the selected degree. Figure 1 shows that 61% of the corner that has been sketched using the left-side of DR is accurate while the rest is inaccurate. The result is narrowed down via Figure 2 below.

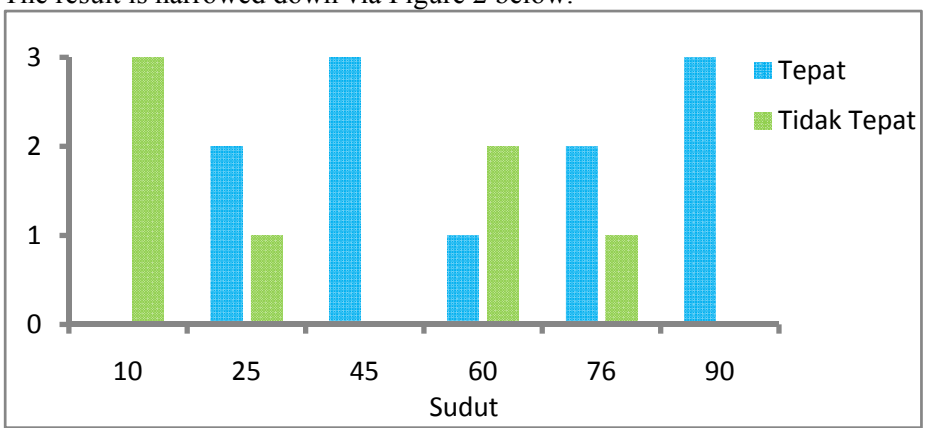

Figure 2 The accuracy score via three time of tests using selected corner degree (left-side).

Figure 2 shows that 10° corner that has been sketched is inaccurate for the related three tests. For 60°, two out of three tests that have been conducted show the inaccurate result. The 25° and 76° corners that have been sketched show the accuracy in two of the test. The 45° and 90° show the accurate results for all of the three tests. The conclusion that can be made for this test is only two corners can be drawn accurately out of six corners that have been tested for three times.

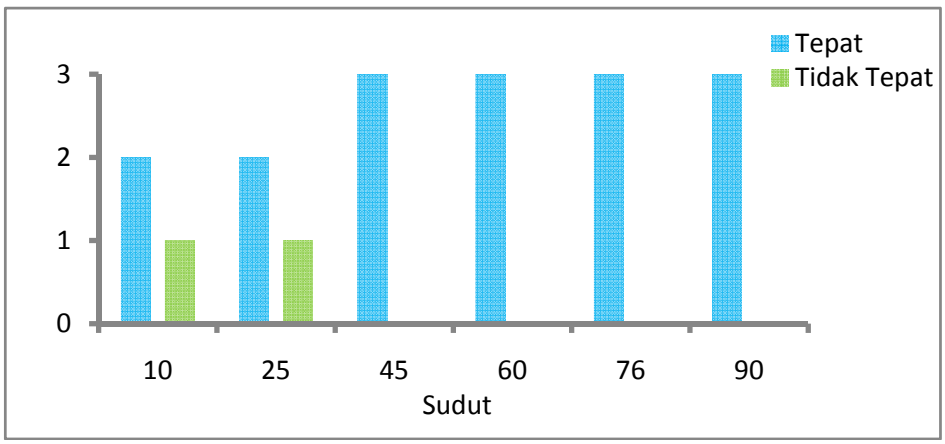

Figure 3 The accuracy score via three time of tests using selected corner degree (right-side).

Regarding to Figure 3 above, the test result for 10° and 25° corners show the similar result where two out of three tests are accurate. While the result of 45°, 60°, 76° and 90° corners show the accuracy for all of the three tests. It means 89% of the test shows the accuracy while drawing corner using DR as compare to 11% for the inaccurate test result as showing in Figure 4 below.

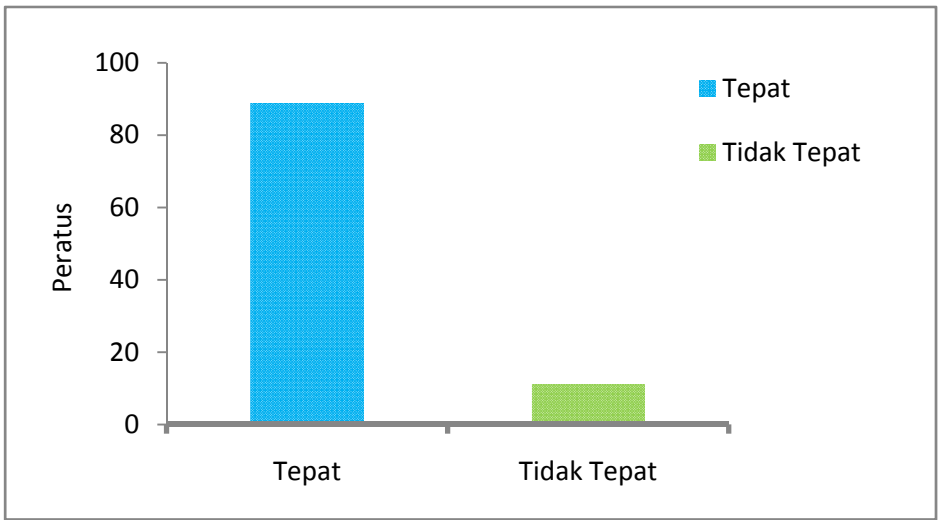

Figure 4 The overall test result represented by the percentage of accuracy while testing the right side of protractor.

The accuracy of DR to draw Sphere

Figure 5 below shows the result regarding to the accuracy of the DR to draw 6 kind of sphere radiuses that have been tested three times each. According to the figure, the test of 13 cm radius shows the inaccurate result for two out of three tests that have been conducted while the 5.5, 8 and 9 cm radiuses show the accurate result for two out of three tests that have been conducted. The result for 6.7 and 8 cm of radiuses show the accuracy for all of the three tests.

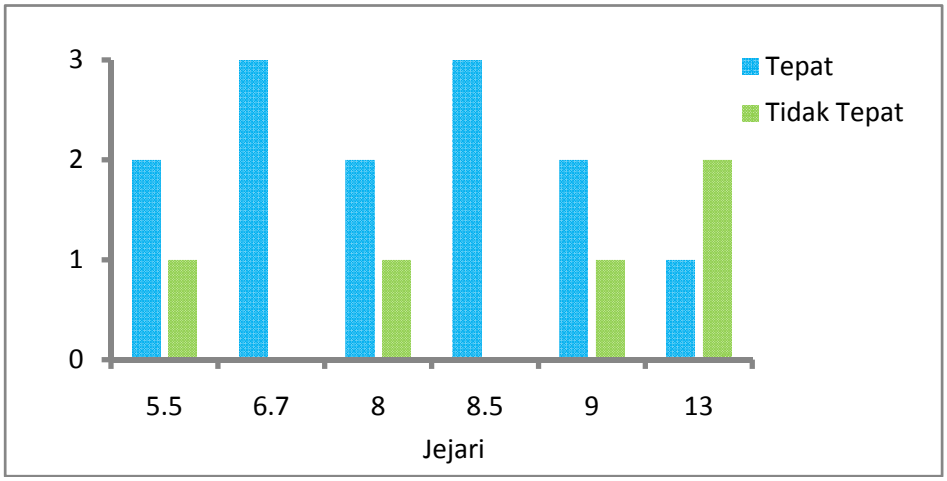

Figure 5 The accuracy score via three time of tests using selected sphere radius.

Figure 6 below represents the percentage of the sphere that has been drawn accurately in all of the three tests and the result is 72%. The result analysis is in conjunction with the objective of the research where the DR can be used to draw sphere accurately.

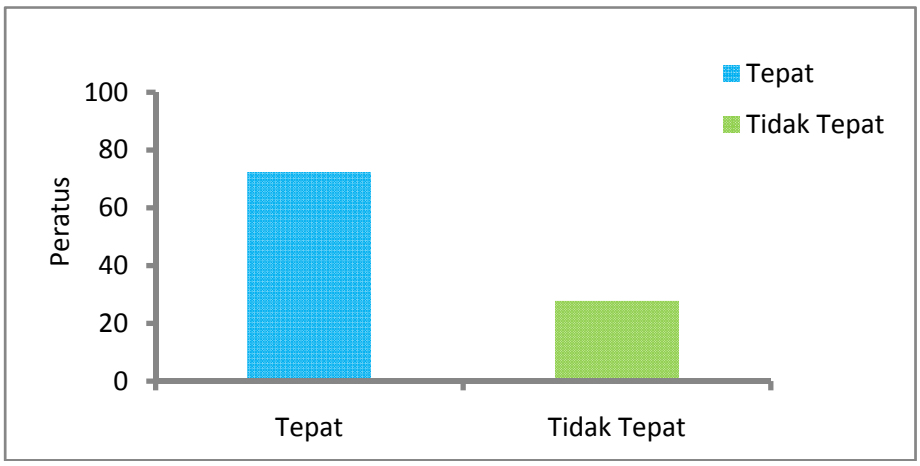

Figure 6 The overall test result represented by the percentage of accuracy via three time of tests using selected sphere radius.

QUESTIONNAIRES ANALYSIS AND DISCUSSION

The Analysis on the DR Prototype Usability

Table 1 The analysis on the DR usability in a form of percentage and mean.

Evaluated Item	**Respondent (%) N=7**					**Mean**
	5	**4**	**3**	**2**	**1**	
The prototype can be used to draw corner accurately.	28.6	28.6	42.9			3.86
The prototype can be used to draw sphere accurately.	42.9	28.6	28.6			4.14
The prototype facilitates me to draw corner	42.9	14.3	14.3	28.6		3.71
The prototype facilitates me to draw sphere	28.6	42.9	28.6			4.00
This prototype is easier to use as compare to *set square* in order to draw corner.	28.6	71.4				4.29
This prototype is easier to use as compare to compasses to draw sphere.	28.6	71.4				4.29
I love to use this prototype to draw the technical drawing.	42.9	28.6	28.6			4.14
Average	**34.7**	**40.8**	**20.42**	**4.1**		**4.06**

The first section consists of seven items relate to the respondent's perception towards DR usability. Table 1 shows the descriptive statistic of the respondent's perception towards DR prototype usage in order to draw corner and sphere. The result of the analysis shows the mean score for this section is 4.06 which mean majority of the respondent Agreed that the usage of DR could facilitate them to draw corner and sphere.

The first item is related to the accuracy of the prototype in order to draw corner. The result of the analysis shows that 3.86 is Agreed. The percentage of the Very Agreed respondent and Agreed respondent is similar where the total is 57.2% while 42.9% respondent is Disagreed as shown in Table 1. This result analysis is in conjunction with the objective of the DR development where it can be used to draw corner accurately.

The second item is related to the accuracy of the prototype in order to draw sphere. The result shows the mean score of 4.14 is Agreed that DR can be used to draw sphere accurately. The percentage of the Very Agreed respondent is 42.9%, Agreed is 28.6% and Disagreed is 28.6% as shown in Table 1. The analysis of the result also indicates that the objective of the research is in hand where the DR can draw sphere accurately.

As a conclusion, the result of the analysis for this section shows that the majority of respondents are Agreed that DR can be used to draw corner and sphere. In another hand, the respondents also Agreed that the usage of the DR is better as compare to the existing tools used in the school.

The Analysis on the DR Prototype Design

Table 2 The analysis on the prototype design in a form of percentage and mean.

Evaluated Item	**Respondent (%) N=7**					**Mean**
	5	**4**	**3**	**2**	**1**	
The prototype is easy-mobile	42.9	28.6	28.6			4.14
The prototype easy to be kept inside bag.	42.9	42.9	14.3			4.29
I won't ever forget to bring this tool to the school/working place.	28.6	42.9	28.6			4.00
I don't need to purchase other tools (compasses, square set) if I use this prototype.	42.9	28.6	28.6			4.14
The prototype can replace the existing tools used in the school.	42.9	42.9	14.3			4.29
Average	**40**	**37**	**23**			**4.17**

The second section consists of five items relate to the respondent's perception towards the design of DR. Table 2 shows the descriptive statistic of respondent's perception towards the DR design. The analysis of the result shows that the mean score for this section is 4.17 Agreed that the DR design is suitable for the usage of the school's students.

The first item which is related to the DR design is about mobility. The result shows that the score mean of 4.14 is Agreed that the prototype is mobile. According to Table 2, the percentage of Very Agreed is 42.9%, Agreed is 28.6% and the rest is Disagreed. Via the analyzed score mean and percentage, it can be said that the design of DR is mobility.

The second item which is related to the design of the prototype is about the easiness to keep it inside the bag. The result shows that the score mean of 4.29 is Agreed. Table 2 above shows the percentage of Very Agreed and Agreed is similar where the total is 85.8% while the Disagreed respondent is 14.3%. This result indicates the prototype size is suitable to be kept by student inside the school bag.

As a conclusion, the result of the analysis shows that the research objective which is the design of DR is suitable for the school student is achieved.

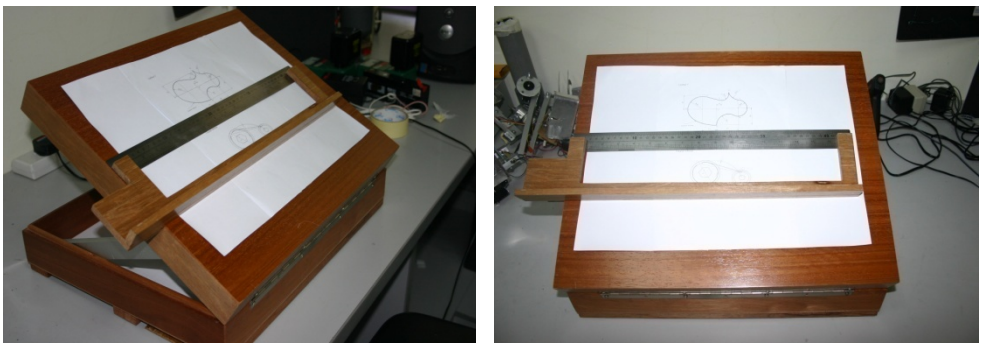

Figure 7 The Dual-Function Ruler

RECOMMENDATION AND FUTURE WORK

There are numbers of recommendations to enhance the tools is listed below so that the usage can be upgraded in the future:

i. using suitable material to built DR so that its lighter than the existing product which has been developed using iron.
ii. enhancing the ability of the protractor to draw sphere where the radius is less than 5 cm.

CONCLUSION

The prototype that has been developed through this research can be used to draw corner and sphere. It's very helpful for the process of teaching and learning for the Technical Drawing subject. However, bit of work should be done to enhance the tool so that the error percentage can be decreased. This is very crucial part because in the Technical Drawing principle, the accuracy and precision is always at the first place. Hopefully with the development of DR, it can be the mechanism to open up the new dimension for the teaching and learning process of Technical Drawing subject in school parallel with the openness of the student's mindset towards the technology innovation, not only focused on the Computer Aided Learning or just keep implementing the old school technology.

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