

## TEXTILE TECHNOLOGY STUDENTS' PERCEPTION TOWARDS THE APPLICATION OF VECTOR RULER AS A TEACHING TOOL IN LEARNING INTRODUCTORY PHYSICS

Amin Aadenan<sup>1\*</sup>, Nor Fadhlin Jaafar<sup>1</sup>, Nurulizzati Makhtar<sup>1</sup>, Siti Zaubidah Abdullah<sup>1</sup>

<sup>1</sup>*School of Physics and Materials Science, Faculty of Applied Sciences, Universiti Teknologi MARA Negeri Sembilan, Kuala Pilah Campus, 72000 Kuala Pilah, Malaysia*

\*Corresponding author: [amin7606@uitm.edu.my](mailto:amin7606@uitm.edu.my)

### Abstract

This paper presents the application of a teaching tool called “Vector Ruler (VR)” on the Textile Technology students’ perception in learning Introductory Physics. The main objective of this study is to identify the effectiveness of utilizing Vector Ruler in teaching and learning Introductory Physics on non-major students based on their perspectives and learning preferences. The purpose is to overcome their difficulties in understanding the fundamental physics concepts and to provide an insight to educators on the importance of teaching and learning strategies to be developed and employed by them. The study was conducted using ADDIE model as a main framework on the first year students enrolled into the Diploma in Textile Technology at Universiti Teknologi MARA (UiTM) Negeri Sembilan, Kuala Pilah Campus for the Academic Year of 2019-2020. Based on the results obtained, majority of the students agreed with the utilization of Vector Ruler as a teaching tool is considerably useful in teaching and learning Introductory Physics where all the responses are above the average. In addition, the majority of the students strongly agreed that their desire to learn Introductory Physics is high if lecturers integrate the use of teaching tool during lecture. This concludes that most students agreed that the combination of using a teaching tool with the traditional teaching methods is an alternative way to improve their motivation, understanding and visualization. Thus, offers an insight for educators to diversify their teaching methods based on the non-major students’ preferences.

**Keyword:** Student’s perception, non-major, introductory physics, teaching tool, vector ruler

### Introduction

Introductory Physics is one of the foundation courses offered by universities in Malaysia for the first year students elected into the science, technology and engineering faculties as a general requirement for graduation. The course is designed to prepare the students with fundamental knowledge of science and to give an opportunity to explore the cutting-edge science, technology and engineering topics in depth (Larkin-Hein, 2000). Universiti Teknologi MARA (UiTM), for instance, is one of the public universities in Malaysia that offers an Introductory Physics course for non-majors to be completed in one-semester duration. One program that is currently offered the Introductory Physics course in UiTM is Diploma in Textile Technology (AS118). The aim of this program is to provide the students with fundamental knowledge of textile science, technology and engineering. The first year students who enrolled into this program will have to complete the introductory course as the requirement for graduation. Learning Introductory Physics is important for non-major students under science, technology and engineering faculties in the hope that students can fully understand and explain the natural and physical phenomena based on the Physics’ perspective (Hookway et al., 2013) in relation

with the field of their studies. A lack of understanding and knowledge in fundamental Physics can lead to the downfall in students' academic achievement and future work uptakes. This happens when the non-major in Physics students encountered difficulties in understanding Physics concepts in real terms without proper teaching strategies and engagement between them and the instructors. Many Introductory Physics courses are still taught in the traditional method of teaching such as lecture-based in which all facts and information is presented through passive teaching method (Shah et al., 2013) where lecturers use visual aids in the form of presentation slides and illustrates figures on the whiteboard as a visualizer (Shaharane et al., 2016). As a result, students might face difficulties in learning fundamental Physics such as lack of understanding, the ability to solve the problems, lose interest in learning Physics (Hookway et al., 2013) and the ability of visualization on the Physics concepts if the traditional teaching approach remain practiced by most educators. In order to overcome this situation, the integration between the lecture and the application of teaching tools in teaching and learning is one of the solutions to improve the students' perceptions through their perceive of use, attitudes and motivation in understanding Physics concepts with the aid of teaching tool.

The students' perceptions towards the use of educational tools have been extensively studied due to its promising information in providing a good and better quality of teaching and learning based on the students' expectations, requirements and responses (Nirmalya et al., 2015). A number of researchers found that the combination of teaching tools together with lecture in the classroom can help the students to improve their focus, attitudes, motivation and visualization skills on the topics that they found difficult to understand (Linden & Joolingen, 2016). By incorporating the traditional-based teaching method with the aid of teaching tool, it offers students a fun way to learn Introductory Physics through interactive manner and visualization, which allow them to engage in the learning process and trigger their interest to learn (Mulop et al., 2012; Shah et al., 2013; Jian-hua & Hong, 2012; Turkan et al., 2017; Hookway et al., 2013; Arbain & Shukor, 2015). Therefore, the utilization of teaching tools provides the potential to develop better understanding in learning fundamental Physics among non-major students and to change the mindset that Physics is a tough and difficult course to learn.

In this paper, the study on the Textile Technology students' perceptions by applying Vector Ruler in learning Introductory Physics is organized as follows: The next section provides information on the methodology used to conduct this study through four stages, followed by results and findings. Finally, the conclusion for the entire research is explained and summarized.

### **Methodology**

The research procedure was developed using ADDIE model as a framework. ADDIE model contains five stages; A-analysis, D-design, D-develop, I-implementation, and E-evaluation that provides an organized process for developing instructional instruments (Arkün & Akkoyunlu, 2008). By adopting from this frame of reference, this study is divided into four main stages as follows.

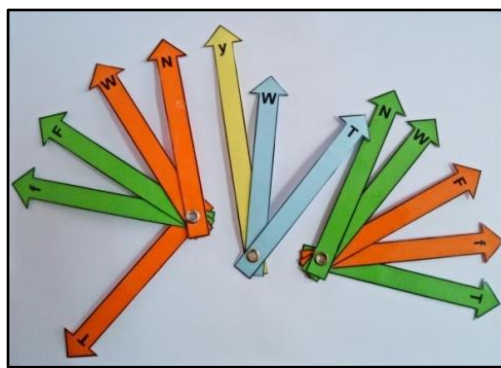
#### **Stage 1: Learners Screening**

Before the study is conducted, the target population for this research was identified. They were the students who enrolled in Fundamental in Physics (PHY130) course at UiTM Negeri Sembilan, Kuala Pilah campus for the Academic Year 2019-2020. The study was implemented on the total number of 56 students from the Diploma in Textile Technology program using a simple random sampling method (Shaharane et al., 2016). The provided data will be served to identify the students' demographic trend covering the gender, the school background,

previous Sijil Pelajaran Malaysia (SPM) results, perceptions and attitudes towards the purpose of this study.

**Stage 2: Designing and Development of the Tool**

The tool used to conduct this study was adopted from the existing tool entitled “Free Body Diagram (FBD) Ruler” (Aadenan et al., 2017) as shown in **Figure 1**. In order to further extend its application and usefulness, the tool was reconstructed for the multi-purpose use and it was named as “Vector Ruler”. The tool demonstrates the principle direction of vectors which can be used in visualizing and illustrating the direction of vector and force in the topic such as Vector, Newton’s laws and Work as shown in **Figure 2**. This ruler was made from wood and it was labelled with an arbitrary alphabet of A, B, C, D and E based on the application to be used. **Figure 3** shows one of the applications of vector ruler for a given problem and how the ruler is used to identify the direction of vectors.



Where:  
 T = Tensional force  
 f = Frictional force  
 F = Applied force  
 W = Weight  
 N = Normal force

**Figure 1** The prototype of Free Body Diagram (FBD) Ruler adopted by Vector Ruler (Aadenan et al., 2017)



**Figure 2** Vector Ruler with arbitrary indicators of A, B, C, D and E

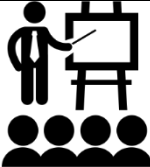




Where:  
 A = Weight  
 B = Normal force  
 C = Applied force  
 D = Frictional force

**Figure 3** The application of Vector Ruler on a given situation

**Stage 3: Implementation**

The demonstration of the tool was carried out by a total number of 4 instructors, who were appointed to teach the course in the Academic Year of 2019-2020. The implementation procedure was initially commenced with the explanation on the purpose of using the Vector Ruler, the principle operation of the ruler and how to apply the ruler based on the given problems with the aid of vector directions illustrated by the ruler. Later, students were requested to practice using the vector ruler by providing the students with some sample questions in order to test their understanding on the application of Vector Ruler on the given problems. Finally, a questionnaire was disseminated to all respondents. The questionnaire was systematically developed based on the modification from the Attitude/Motivation Test Battery model developed by (Gardner, 2005). **Figure 4** shows a summary of the whole implementation procedure to conduct the study.

<p>Step 1: Demonstration</p>	 <p>Lecturer explains the use of the vector ruler to students.</p>
<p>Step 2: Hands-on</p>	 <p>Students practice using the tool.</p>
<p>Step 3: Response</p>	 <p>Students answer the questionnaire</p>

**Figure 4** A summary of the implementation procedure

#### Stage 4: Evaluation on Perceptions

In order to measure the perceptions and attitudes of students on the application of the vector ruler, there are three main items were categorized in the questionnaire where each section focuses on the ease of use of the Vector Ruler, its effectiveness and students' motivation towards the use of Vector Ruler as a teaching tool in learning fundamental Physics. All the items were measured through five Likert scale of '1-Strongly Disagree, 2-Disagree, 3-Average, 4-Agree, 5-Strongly Agree'. This questionnaire contains statement that reflects the students' perceptions of the use of Vector Ruler as an aid tool in teaching and learning process.

#### Results and Discussion

From the preliminary data obtained through learners screening, it is observed that the respondents were dominated by female students. This can be shown clearly in **Table 1** based on the high percentage (84%) of female respondents compared to only (16%) male respondents which in turn reflects the gender ratio between male and female for the study. The table also revealed that from the total of 56 students, (51.78%) respondents were science students and the other (48.22%) respondents were non-science background students from the response on the SPM background. This provides the general overview regarding on the selection process made by the university to enter this program is extensively offered to either science or non-science SPM background students.

**Table 1** Respondents' demographic

Category	Description	Total Number	Percentage
<b>Gender</b>	Male	9	16%
	Female	47	84%
<b>SPM Background</b>	Pure Science	29	51.78%
	Art (Economy, Accountancy, Islamic Studies, Social Science)	24	42.86%
	Others	3	5.36%

Next, to further analyze on the students' perception, the empirical data obtained from the questionnaire were analyzed systematically in order to study the application of Vector Ruler as a teaching tool towards the perceptions and acceptance.

#### Students' Responses on the Perceived of using VR

**Table 2** shows the score obtained from the students' responses on the perceived of use of Vector Ruler as a teaching tool. Overall, all scores from the three statements are above the average with the highest mean value is 3.75. This indicates the respondents were agreed with the statement that VR is easy to use. The lowest mean score goes to the statement of learning to use VR is easy for respondents with the score value of 3.54. This was due to the limitation of the tool while conducting the study whereby the students need to share the tool with the other respondents. However, respondents likely agreed that VR was easy to use and handle with the mean score of 3.73.

**Table 2** Mean value of the perceive use of Vector Ruler

Factor	Statements	Mean
Ease of use	1. VR is easy to use and handle.	3.73
	2. Learning to use VR is easy for me.	3.54
	3. Overall, VR is easy to use.	3.75

### Students' Attitudes towards the Application of VR in Learning Fundamental Physics

From **Table 3**, the mean value of each statement shows above the average agreement with the highest mean is the usefulness of applying Vector Ruler in teaching and learning with the mean score of 3.70. This indicates that students agreed that the use of VR is very useful in teaching and learning. In addition, the use of Vector Ruler enabled the students to enhance their visualization skills. This is supported by the statement that the use of Vector Ruler enhanced visualization skills with the mean score of 3.68. Besides, most students likely agreed with the statement of the use of Vector Ruler makes students easy to identify the direction of vector and using Vector Ruler improved students' understanding in determining the vector with the mean score for both statements is 3.59. It is learned that with the aid of teaching tool during learning process, students were able to improve the understanding and visualization through drawing and illustration. Next, the lowest mean score value goes to the statement of using Vector Ruler enables to figure out the vector direction with mean value of 3.52. The students fairly agreed to this statement perhaps almost the half of the population (48.22%, **Table 1**) coming from a non-science SPM background. Therefore, lecturers should pay more attention in helping these students with necessary materials and teaching technique in order to enhance students' visualization skills and interest to learn fundamental Physics.

**Table 3** Mean value for effectiveness of using VR

Factor	Statements	Mean
Effectiveness	1. Using VR makes me easy to identify the direction of vector.	3.59
	2. Using VR enhances my understanding of vector.	3.59
	3. Using VR enables me to figure out the vector direction.	3.52
	4. Using VR alleviates my visualization skills.	3.68
	5. Using VR is useful in teaching and learning.	3.70

### Students' Motivation towards the Application of VR in Learning Fundamental Physics

Based on **Table 4**, the overall score for the students' motivation towards the application of Vector Ruler shows above the average for all the statements with the highest score of 3.95 are the statements indicating that VR helps to improve understanding in learning Physics and the students' desire to study Physics is higher if lecturers use teaching tool in teaching during lecture. This shows that the use of Vector Ruler in the classroom has received positive responses by the majority of the students. In addition, the respondents considerably agreed that using teaching tool makes them confident to learn Physics with the mean value of 3.88. Next, to summarize on the motivation of students towards the use of Vector Ruler, the mean of 3.77

shows that using VR has improved the students' motivation to learn fundamental Physics with the aid of hands-on teaching tool.

**Table 4** Mean value for students' motivation

<b>Factor</b>	<b>Statements</b>	<b>Mean</b>
Students' Motivation	1. Using VR helps me improve my understanding in learning Physics.	3.95
	2. Using VR makes me confident to learn.	3.88
	3. Using VR improves my motivation to learn fundamental Physics.	3.77
	4. My desire to study Physics _____ if teachers using tools.	3.95

### Conclusion

From the above results, the study concludes that most students considerably agreed with the effectiveness of the application of Vector Ruler as a teaching tool in learning Introductory Physics as an alternative to integrate the learning with the traditional lecture-based methods. In fact, the majority of the students were satisfied with the use of Vector Ruler was helpful in the learning process. This teaching tool enhances their understanding and visualization on the Physics concepts, which they find difficult to relate in real terms. Students also believed that the use of Vector Ruler can improve their motivation to learn Introductory Physics which in turn provides an insight to educators to diversify their teaching and learning strategies based on the perspectives and learning preferences of non-major students.

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### Conflict of interest

Authors hereby declare that there is no conflict of interest with any organization or financial body for supporting this research.

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