VARK learning style and cooperative learning implementation on impulse and momentum

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Abstract. Individuals have various preferences in learning and processing information. These variances in individuals learning are clarified by learning styles. A recent classification of learning style associates state that individual learning styles can be categorized into Visual, Aural, Read or Write and Kinesthetics (VARK). Current learning concepts focus more on the intellectual development features through visual/verbal approach. This visual/verbal approach seems to incorporate frequent scopes from other learning style preference. This research aims to determine student achievement on impulse momentum subject using cooperative learning which instruction is based on learning style and cooperative learning which instruction is mismatched on learning style. Research was designed according to quasi experimental with non-equivalent control group pre-test post-test design. The experimental group were formed into cooperative groups which instructions is based on learning styles for each student and the control group formed into cooperative groups which instruction was mismatched with students learning styles. The result shows that there is significant difference between control group and experimental group. In addition, it was determined that students in experimental group were more successful rather than students in control group.

1. Introduction

Educators in all stages of education realize that students do not all retort correspondingly well to the identical instructional teaching approaches, and hence, educators are interested through the opportunity of furnishing several instructions adjusted to those student differences. Students, besides, have realized in themselves that deceptive variance preference for one technique of studying over another. As a result of this case, researchers in education have projected and reviewed several concepts and tools proposed to support either the educator or the student become mindful of learning preferences thus that the learning environment may adjusted to student requirements [1]. These phenomena embody important ideas along the pathway of learning styles development. According to [2] Learning style is defined as the several kinds of indications of different students that occasionally denoted to as a "lifestyle" and is occasionally understood as a form of personality, so learning style termed as a fragment of Intellectual styles. Learning style also can be distinct as the complex behaviour in which students most proficiently and most excellently perceive, develop, store and reminiscence what they are attempt to learn [3-4].

The learning process needs several theories. Many of theories been represented vital arguments during the path of the development of learning styles. One of the most widespread tools in assessing
individuals learning style is the VARK Questionnaire, developed by Fleming [5]. The VARK Questionnaires are frequently used by educators to identify the preference tendency of students, to implement certain learning methods and identify suitable learning establishment mechanisms [6]. VARK Questionnaire assesses student’s preferences to obtain and process information consuming Visual, Aural, Read/Write and kinesthetics modes. The visual learners process information best through graphs, flow charts, and pictures; the aural learner process information best by listening to lectures, attending tutorials, using tape recorders to play back learning sessions, and also like to explain information; the read/write students like to see the written words, they like to take notes and reread these over and over again, they also like to read texts; the kinesthetics learners like to acquire information through experience and practice, and prefer to learn information that has a connection to reality; the additional “multimodal” category encompasses the students who fall into more than one sensory modality of any combination [7-8]. For students knowing learning style can be useful if they take the next step, and consider how and when they learn, as part of a reflective, metacognitive process, with action to follow [6]. Thus, educators need to know the students’ learning styles for adjusting teaching instruction toward students’ preferences.

Research is able to be achieve through students’ preferences. Research outcomes have shown that learning style is one of the key factors and affect academic achievement in learning process [9,10]. A Finding showed that students which their learning style matched with the technique of material presented in online course have higher scores significantly compared to those in which their learning style were mismatched [11]. Research have been done by Bacon [12] and Miller [13] shows that students’ learning result is significantly enhanced if their learning styles are properly coordinated to the learning environment. Knowing those fact, it is important for educator to provide teaching models according to students learning style.

Learning style can become one of consideration for educator in designing teaching model. Various teaching model were developed due to pedagogical research development. Cooperative learning is one of popular teaching model. Cooperative learning is a teaching model in which students work together in small groups to help each other learn academic content [14]. Assumed students cooperate with each other in cooperative groups, it is conceivable to form learning environment in which students who have diverse learning styles interact and support each other learning by placing the assemblies heterogeneously according to student’s learning styles [15]. This assembly construction permits students who have diverse learning styles to discuss the things they acquire and understand the knowledge from each other’s viewpoints. Through this method, the appetency to learn together can be enlarged and prevent a student learning less than the other student.

Students learn physics in school, physics becoming one of compulsory subject to learn. Physics is branch of natural science that explain natural phenomena in life which describe through concept, theory, and physics law that can accepted by human. One of physics concept that usually taught in high school level is impulse and momentum. Momentum or in this case specifically ‘linear momentum’ is one of vector quantity in physics. The most fundamental definition of momentum relays to distinguishable action of a physical system consumes a resembling conservation law. In specific, momentum is the preserved quantity that resembles to invariance underneath translations motion in three-dimensional space [16]. Nevertheless, this kind of definition of momentum is basically incomprehensible intended for students and perhaps for most educators too. Technically in teaching physic, ‘momentum’ is characteristically related within Newtonian mechanics,

\[ F = m \cdot a = m \frac{dv}{dt} = \frac{d(mv)}{dt} \]  

(1)

Subsequently acceleration is the first derivative of velocity by respect to time, the formula also can be written to replicate the first derivative by respect to time (rate of change) in the quantity mv. So linear momentum (p) is can be written as

\[ p = m \cdot v \]  

(2)
Where \( m \) is mass of the object and \( v \) is velocity of object. The bold sign for \( p \) and \( v \) indicate that they are vector quantity, precising amount and direction in three-dimensional space. In this case, momentum can be defined as something that objects in motion have or contain or we can call it as mass in motion [17]. The greater the mass and the velocity of a body, the greater it’s momentum.

When a force acts toward an object for some interval of time, for instance from \( t_1 \) to \( t_2 \). From equation (1) can be obtained

\[
I = \int_{t_1}^{t_2} F \, dt
\]  

(3)

Equation 3 above describes a physics quantity called linear impulse \( I \), and is equivalent to the change of linear momentum, shown in equation 4 bellow.

\[
I = \int_{t_1}^{t_2} F \, dt = \int_{t_1}^{t_2} p \, dt = p_2 - p_1 = \Delta p
\]  

(4)

Consequently, momentum and change of momentum in contacts turn out to be very beneficial concepts in comprehending mechanics and in applied problem solving. For instance, Brunt [18] show in what way momentum and the principle of conservation of momentum in an isolated system can be implement to descend and concept Newton’s three laws of motion.

It is difficult to create idyllic learning circumstances. Educators regularly implement conventional teaching model that makes physics as a chant, dull and less challenging lesson. As the result, students have difficulties in understanding physics concept taught by educator [19]. Cooperative learning can be one of alternative in teaching physics. There is numerous cooperative learning model type, Team Assisted Individualization (TAI) is considered to be the appropriate model for teaching physics and accommodate the difference of students learning styles. The intention of TAI is to diminish the consequences that appear throughout the learning process as of student difference [20]. TAI mix cooperative learning with individual instruction. In TAI, students initially learn concept or material individually and brought their knowledge to the group in order to unravel problems together. This cooperative model accentuates all cooperative learning key components, such as: positive interdependence among students, individual responsibility, face to face meeting, intensive communication, and group evaluation. Those components make classroom management becomes more effective.

From those theories and reasons which stated above, this research aims to determine student achievement on impulse momentum subject using cooperative learning which instruction based on learning styles compared to student achievement with cooperative learning which instruction mismatched with their learning styles.

2. Methods

2.1. Research Design

This research was designed according to quasi experimental with non-equivalent control group design.

|          | Pre-test | Treatment | Post-test |
|----------|----------|-----------|-----------|
| Experiment | O        | X         | O         |
| Control   | O        | C         | O         |

**Figure 1.** Non-equivalent control group design.

Both experiment and control group got the identical treatment, which is cooperative learning. The experimental group were formed into cooperative groups which instructions is based on learning styles
for each student and the control group formed into cooperative groups which instruction was mismatched with students learning styles.

2.2. Instrument
The VARK Learning style questionnaire is utilized to classify students learning style. This questionnaire consists of 16 questions with four responds for each question. Each option is associated with a different learning style preference. The example of the question shown in Figure 2 below.

![VARK Questionnaire example](image1)

This questionnaire viewed as 16 test lets of four dichotomous items each. The estimated reliability coefficients and validity were adequate [1]. Another finding gives sustenance to the questionnaire’s suitability and reliability as a tool for measuring learning styles in Visual, Auditory, Read/Write and Kinaesthetic ways [8].

Impulse Momentum achievement test, developed by researcher consist of 19 multiple choice questions regarding impulse and momentum materials. The reliability coefficient of this instrument test was determined to be 0.32. The Figure 3 bellow show validity index of each question.

![Validity index of impulse momentum achievement test instrument](image2)

2.3. Procedure
Research was conducted towards 50 senior high school students, which divided into experimental group and control group. The control group formed into cooperative groups which instruction was mismatched with students learning styles. The experimental group were formed into cooperative groups which instructions is based on learning styles for each student, in the experimental group students arranged to work with the other students who has different learning style with this structure.
students to share the material they study and see the problem from each other’s perspectives. With this technique, both the enthusiasm to learn together can be enlarged, and the students with diverse learning styles can be barred from learning smaller amount than the others [15]. In the experimental group appoint to do the task which suitable with their learning style.

3. Result and Discussion

VARK questionnaire was utilized to classify students learning style. The result is shown by the Figure 4 below.

![Learning styles profile](image)

**Figure 4. Learning styles profile.**

The result from Figure 4 learning styles diversity in sample. To measure the effect of two different interventions on students’ achievement test scores, t-test was conducted to compare students score between experiment and the control group.

| Table 1. T-test result on experiment and control group. |
|---------------- |---------------- |---------------- |---------------- |---------------- |---------------- |
| N               | X               | s²              | T               | t table         | Sig.            |
| Control Group   | 25              | 0.303           | 0.034           | 2,135           | Significant     |
| Experiment Group| 25              | 0.395           | 0.022           | 2,064           | Significant     |

According to results of the analysis on Table 1 above, it is shown that there is significant different between control group and experiment group (t < t table). It means that the experimental group which formed into cooperative groups that instructions is based on learning styles for each student has significant different compared to the control group which formed into cooperative groups which instruction was mismatched with students learning styles in terms of student achievement. Research done by Onder [15] shown that there is significant difference between students whose learning style is matched with learning instruction and students whose learning style is mismatched with learning instruction.

The Tukey test was conducted to determine in which group the difference occurred. The analysis result shows in the Table 2 below.
Table 2. Tukey test result on experiment and control group.

|                  | N  | $\bar{x}$ | $s^2_e$ | Q   | $Q_{table}$ |
|------------------|----|-----------|---------|-----|-------------|
| Control Group    | 25 | 0.303     | 0.0071  | 5.459 | 2.920       |
| Experiment Group | 25 | 0.395     |         |      |             |

The Tukey test result indicate that the students in in experiment group is more success than students in control group ($Q > Q_{table}$). Research done by Onder [15] also indicate that students’ learning result is significantly enhanced if their learning styles are properly coordinated to the learning environment.

### 4. Conclusion

According to analysis result it shows that there is significant difference between students which formed into cooperative groups that instructions is based on learning styles for compared to the control group which formed into cooperative groups which instruction was mismatched with students learning styles in terms of student achievement. It is also found that students which formed into cooperative groups that instructions are based on learning styles for compared to the control group which formed into cooperative groups which instruction was mismatched with students learning styles in terms of student achievement.

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