The application of multiple intelligence approach to the learning of human circulatory system

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Abstract. The purpose of this study is to offer an alternative teaching approach or strategies which able to accommodate students’ different ability, intelligence and learning style. Also can gives a new idea for the teacher as a facilitator for exploring how to teach the student in creative ways and more student-center activities, for a lesson such as circulatory system. This study was carried out at one private school in Bandung involved eight students to see their responses toward the lesson that delivered by using Multiple Intelligence approach which is include Linguistic, Logical-Mathematical, Visual-Spatial, Musical, Bodily-Kinesthetic, Interpersonal, Intrapersonal, and Naturalistic. Students were test by using MI test based on Howard Gardner’s MI model to see their dominant intelligence. The result showed the percentage of top three ranks of intelligence are Bodily-Kinesthetic (73%), Visual-Spatial (68%), and Logical-Mathematical (61%). The learning process is given by using some different multimedia and activities to engaged their learning style and intelligence such as mini experiment, short clip, and questions. Student response is given by using self-assessment and the result is all students said the lesson gives them a knowledge and skills that useful for their life, they are clear with the explanation given, they didn’t find difficulties to understand the lesson and can complete the assignment given. At the end of the study, it is reveal that the students who are learned by Multiple Intelligence instructional approach have more enhance to the lesson given. It’s also found out that the students participated in the learning process which Multiple Intelligence approach was applied enjoyed the activities and have great fun.

1. Introduction
Howard Gardner with his book Frames of Mind in 1983 proposed the theory of Multiple Intelligence to critics educational system which always focuses on Logical-Mathematical and linguistic capabilities [1]. He proposed every human has their intelligence and ability as their strength and also their weakness. Multiple Intelligence theory is different than intelligence quotient (IQ) in some ways [2]. Multiple intelligence never working alone means every person has not only one intelligence but some dominant intelligence will work together, intelligence will influencing person’s performance and products and not by a test score and also influence by the culture around them [2]. The theory of Multiple Intelligence (MI theory) claiming that as each person has a different personality and emotional level, they also have different profiles of intelligence [3]. We can find all intelligence in one person but only some potential in particular intelligence. On the other hand, all intelligence are
dynamic and can be developed and also changed. Especially, culture, beliefs, social environment and personal properties are the factors developing the intelligence [4].

According to the Multiple Intelligence theory from Gardner, there are eight different types of intelligence named as logical-mathematical, linguistic, musical, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal, and naturalist. Logical-mathematical intelligence is the ability to perceive relationship and connections and to use symbolic thought, abstract and sequential reasoning skills [5]. Linguistic intelligence is the ability to think in words and to use language to express effectively both orally and in writing [6]. Musical intelligence is the ability to be sensitive to pitch, melody, rhythm, and tone [4]. This intelligence enables person to recognize, create, reproduce, and reflect on music. Visual-spatial intelligence is the ability to think with pictures, images, shapes, and lines, perceiving and comprehending three-dimensional objects [7]. Bodily-kinesthetic intelligence is the ability to expressing her/his self with movements, gestures and facial expressions, using the effective coordination of brain and body, creating a product using the whole body or a part of the whole body [7]. Interpersonal intelligence is the ability to understand and interact effectively with others. Intrapersonal intelligence is the ability to understand oneself and one’s thoughts and feelings and take responsibility for his/her own life [6]. Naturalist intelligence is the ability of recognize and researching all living things in nature and thinking of their creation [7].

One of the main issues in the teaching of Biology is that students sometimes didn’t catch the facts and missing the big ideas of concept in Biology learning. This make students become lose interest in learning Biology and also disconnected with their experiences. Teachers in the classroom play an important role to create a conducive and effective learning environment [8]. It is require to planning varied teaching styles which are can encourage students in the learning process through their preferred learning styles. The change and modification of teaching approaches is predominantly to enhance students’ performances in Biology learning. Hence one of the approaches are to change the emphasis of teacher-directed teaching which is also known as the teacher-centred approach of lecturing to more students-centred approaches that involve a higher degree of students’ active participation in the learning process [8]. According to this fact, it is quite important to apply multiple intelligence theory in Biology teaching [8].

Teachers can apply the multiple intelligence approaches in their classroom to present their lesson using a wide variety of instructional techniques involving the use of words, numbers and logic, music, group activities, physical activities, pictures and self-reflection to cater for diverse learning styles of the students [9]. Multiple intelligence theory can give a “framework” that help teachers make decisions about the way to deliver the lesson and learning experiences for students. The multiple intelligence approaches to teaching allows teachers to merge their creativity in their instructional planning where student-centred activities could be conduct in eight different forms based on the eight types of multiple intelligence [8].

The final goal of multiple intelligence theory is to increase student understanding of Biology lesson, especially for the difficult concept. Classroom activities often more than one of the multiple intelligence [10]. Below are the following classroom activities examples:

a. Writing a report – linguistic intelligence
b. Composing a song – musical intelligence
c. Group work – interpersonal intelligence
d. Hands-on experiment – bodily-kinesthetic and logical-mathematical intelligence
e. Drawing and ordering pictures – visual-spatial intelligence
f. Self-reflection – intrapersonal intelligence
g. Observing the living things – naturalist intelligence
The purpose of this study is to determine the multiple intelligence profiles from the students and also apply the multiple intelligence approach in Biology learning process to deliver human circulatory system lesson by using some activities based on eight types of multiple intelligence theory.

2. Methodology
This study was carried out as a descriptive research which is to describe the events systematic and factual about the facts and the relationship among the research phenomenon [11]. Describing the facts from the problem as it is without manipulation.

The population of this study was eight types of multiple intelligence from all middle school students in one private school in Bandung area. The samples of this study were all grade 8 students using purposive random sampling technique who enrolled in the academic year 2016-2017. There were eight students in one class, 2 (25%) female and 6 (75%) male students.

The instrument used in this study is Multiple Intelligence Test for young people based on Howard Gardner’s MI model to find the potential intelligence from the students as a reference to plan the way for deliver the lesson and also activities as students’ experiences. The MI test showed as the percentages of intelligence owned by students.

2.1 Procedures of The Study
To determine the multiple intelligence profile, Multiple Intelligence test for young people based on the Howard Gardner’s MI model was given at the beginning of the lesson. The test is using scale test 1-4, and the result is compile as a percentage. The result becomes a reference to plan the lesson and also the activities in the class. The lesson and activities are about the human circulatory system with sub topic are about the parts of the heart. It was crucial to develop appropriate techniques and provide necessary materials that reflect the principles of Multiple Intelligence Theory.

In the next week, the learning process has been given by using some multimedia to cover their intelligence, for example, short clip for visual-spatial and musical intelligence, a slide presentation for linguistic intelligence, discussion for interpersonal and logical-mathematical intelligence. They discussed the parts of the heart and their function including the pathway of blood.

The activities were planned based on the eight types of multiple intelligence and they did all the activities in four rotation. The activities process of the study was as below:

| Table 1. Activities process rotation applied in the study |
|----------------------------------------------------------|
| **Interpersonal Intelligence** Teach the students about parts of the heart and their function including the pathway of blood. |
| **Naturalist and Visual-spatial Intelligence** The procedure started with an observation of mammal heart. They observed the heart, drawing, coloring, and labeling the parts. The students get an experience to see and hold the real heart. This makes them more interest especially the student who has dominant naturalist. |
| **Bodily-kinesthetic and Logical-mathematical Intelligence** The students had a small investigation to measure and compare their resting and heart rate after doing the activity. They make their prediction or hypothesis. They were walking and running to have different pulse rate and make a comparison using a graph and symbol. |

All the activities carried out in a group work
Linguistic and Visual-spatial Intelligence
The procedure started with a reading session about the pathway of the blood. They gave some random pictures and based on the text they asked to sort the pictures in the right order. The linguistic student loves this activity so much.

Table 1. (continued)
Musical and Linguistic Intelligence
Student created a lyric about the parts of the heart and their function and combined it with the song they choose. They sing their song.

Intrapersonal Intelligence
They were given a self-reflection to get their response to the teaching and learning process in the classroom.

3. Results and Discussion
The study results describe the students’ Multiple Intelligence profiles from the test given. The data description of the Multiple Intelligence profile of the students is in the form of the rank and mean based on the Multiple Intelligence Test. Table 2 presents these results as follows.

| Intelligence      | Mean | S.D. | Rank |
|-------------------|------|------|------|
| Kinesthetic       | 14.625 | 2.56 | 1    |
| Visual            | 13.625 | 2.5  | 2    |
| Interpersonal     | 13.125 | 2.47 | 3    |
| Logical           | 12.125 | 2.29 | 4    |
| Musical           | 11.625 | 2.07 | 5    |
| Naturalis         | 11.25  | 2.31 | 6    |
| Linguistic        | 11     | 3.58 | 7    |
| Intrapersonal     | 10.125 | 2.03 | 8    |

Table 2 showed that students’ multiple intelligence profile. Of the eight multiple intelligences, students most perceived the bodily-kinesthetic (M = 14.625) and visual-spatial (M = 13.625) intelligences followed by interpersonal (M = 13.625) intelligence. Linguistic (M = 11) and intrapersonal (M = 10.125) intelligences were perceived least by the grade 8 students as shown in Table 2. In figure 1, present the percentage for each intelligence owned by students in grade 8.
From figure 1, it showed the percentage of multiple intelligence profile from the students grade 8. The most predominant are bodily-kinesthetic (73%) intelligence followed by visual-spatial (68%) and interpersonal (66%) intelligence. The least intelligence showed by linguistic (55%) and intrapersonal (51%) intelligence.

The students are good in body movement involved activity, and they loved to move. Also they stronger in visual and interpersonal, it means they are good in group work and the activity that involves the spatial sense. Teacher than planned some activities that cater their predominant intelligence to develop their skills and qualification for understanding the concept of the human circulatory system.

3.1 The learning process results of the students

They did five activities alternately in five rotation in a group work. In the first station, they observed the mammals heart, draw it, coloring and labeling on the worksheet was given. This activity is to cover their visual-spatial intelligence. Based on the analysis of rubric to their worksheet, almost all of them did this very well. They able to drew the mammals heart based on their observation. Figure 2 below show one of their drawing result.

![Figure 2. The mammals heart observation result](image-url)
The figure 2 above shown students’ drawing the mammals heart based on their observation. He able to describes what he saw very well and also labeling the parts of the heart. It means, by accommodating their visual intelligence they can develop their skill and understand the concept more easier.

In the second station, they used their kinesthetic intelligence to measure and to compare their resting pulse rate and after they did walking and running. They did this in group work. They also used their logical-mathematical intelligence to make a prediction and determine they make the correct prediction or not. They measure their resting pulse rate and collect the data. Next, they were walking and running and measure their pulse rate and collect the data. They create a graph to represent their data and also answers the questions given. Figure 3 below show one of the students result from their worksheet.

![Data table]

| Student’s name | Resting heart rate | Walking heart rate | Running heart rate |
|----------------|--------------------|--------------------|--------------------|
| Han Han        | 67                 | 80                 | 97                 |
| Sam            | 70                 | 73                 | 85                 |
| **Average**    | **68.5**           | **76.5**           | **91**             |

**Figure 3.** Data table and graph of the comparing pulse rate activity

Figure 3 shown students’ result from the activity they were done. They were able to make a graph based on the data they have to represent their data collection. They were also able to conclude that their pulse rate will increase according to their activities. They understand their pulse rate influenced by some factors and that related with how their heart work to pump the blood.

In the third station, they started with the reading text about the path way of blood in the heart. They were given some random pictures and need to sort them in the correct order. Linguistic and visual-
spatial intelligence are cover in this activity. Same with the other station, they work in group work so they can discuss with the team. Figure 4 shown one of the students’ work.

![Image of heart anatomy with labels for atriums, ventricles, valves, and other cardiac structures]

**Figure 4.** Sort the pictures activity to describe the pathway of blood

Figure 4 shown they did well in sorted the unscrambled pictures. They were able to understand the context of the reading text given about how heart works to pump the blood. They also able to describe it using their own words by creating some sentences from the pictures. Their linguistic intelligence was developed in this activity.

In the fourth station, they created the lyric related to the parts of the heart and how the heart works. They combine it with one song and harmonize the lyrics with the rhythm of the song. The musical intelligence is require in this activity, besides the linguistic intelligence. Figure 5 below show one of the result.

![Image of handwritten lyrics for heart parts]

**Figure 5.** Create the lyric of the heart’ parts
Figure 5 shown they did well to make a lyric and also put it in one appropriate song. They able to develop their musical skills and also understand how the heart works. They perform the song in front of the class and singing together with their class mate. Some of the students find difficulties to make a lyric because their musical intelligence is weak, but they can push them self to try making a lyric so without they realized, they improve and develop their skill by finished the task given.

Self-reflection has been given at the end of the learning process. The students reflect their self toward the teaching and learning process. They were given questionnaire with 1-5 scale and eight statements. Students feel this learning process is more interesting and challenging; they loved to join and involved in learning process. They understand the lesson and more conceive of the concept of the heart. They feel happy to interact directly with observed the mammals heart and this gives them a new experience. The students find some difficulties but it does not make them desperate and distract instead makes them more encouraged to solving the problem.

Every student has strength and weak sides no matter what his/her intelligence area is [7]. On condition that teacher can use more intelligence in the learning process, the students also learn how to develop their skill become their strengths. Multiple intelligence approaches make the learning process in the classroom more effective and success.

4. Conclusion
The findings provide the following conclusion: 1) There are three top rank percentage of multiple intelligence profiles from grade 8 students i.e., bodily kinesthetic (73%), visual-spatial (68%) and interpersonal (66%) intelligence. 2) The learning process is planned using multiple intelligence approaches by creating some different activities based on eight types of multiple intelligence theory. That gives the students chance to involved directly in the learning process to understand the concept; they become more connected to their learning. The result shown they able did all the activities very well, and that makes the learning process more effective. 3) Multiple Intelligence approaches helps teacher engage students through their natural curiosity and increase students participation through their excitement. “If students become engaged in the learning of science and develop positive attitudes toward science, there is a greater probability that they will develop high levels of scientific literacy” [12].

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