The Concept Mastery in the Perspective of Gender of Junior
High School Students on Eclipse Theme in Multiple
Intelligences-based of Integrated Earth and Space Science
Learning

W Liliawati*, J A Utama and L S Mursydhah
Department of Physics Education, Universitas Pendidikan Indonesia

*winny@upi.edu

Abstract. The purpose of this study is to identify gender-based concept mastery differences of junior high school students after the implementation of multiple intelligences-based integrated earth and space science learning. Pretest-posttest group design was employed to two different classes at one of junior high school on eclipse theme in Tasikmalaya West Java: one class for boys (14 students) and one class of girls (18 students). The two-class received same treatment. The instrument of concepts mastery used in this study was open-ended eight essay questions. Reliability test result of this instrument was 0.9 (category: high) while for validity test results were high and very high category. We used instruments of multiple intelligences identification and learning activity observation sheet for our analysis. The results showed that normalized N-gain of concept mastery for boys and girls were improved, respectively 0.39 and 0.65. Concept mastery for both classes differs significantly. The dominant multiple intelligences for boys were in kinesthetic while girls dominated in the rest of multiple intelligences. Therefore we concluded that the concept mastery was influenced by gender and student’s multiple intelligences. Based on this finding we suggested to considering the factor of gender and students’ multiple intelligences given in the learning activity.

1. Introduction
According to national curriculum, earth science topics are given in 7th grade class while space science topics are in 9th grade [1]. One of the obstacle factor in the ESS learning is the broad range of topics covered and limited teaching materials that is easy to be understood by students [2]. Liliawati et al. [3] found that, for example, topic on the motion of celestial bodies was elusive because students had difficulty in imagining their motion on the sky. Based on interview with one of junior high school science teacher in Tasikmalaya only a small percentage of students have good score in ESS subject. This was confirmed by test of “Motion of Celestial Bodies” for 9th grade students in Bandung conducted by Budianto [2] which showed unsatisfactory results for all school groups. The poor understanding of the students on ESS topics because students only experienced learning by lecture and memorizing method [2].

Gardner [4] explains that an individual has verbal-linguistic intelligence, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal and naturalist intelligence. All learning
should be able to arise these intelligences because every student has a distinctive emphasis on using them to access the information [2]. That is why teachers should be good finding and exploring their students’ multiple intelligences through a variety of learning activities which is educational, inspiring and fun [5]. In addition, the diversity of students’ intelligences has effect to their understanding in grasping a concept given in the learning process.

One research revealed that one’s intelligence was also influenced by gender [6]. Male’s and female’s brain is programmed with a few differences; the female’s brain is biologically programmed to respond to the human and the face in the form of interaction, while male’s to respond to objects and shapes translated into actions. Female students are more proficient in relationships with others, be able to understand the condition of people around them and be able to work together more cooperatively than the male students [7]. The aim of this study is to identify the difference of concept mastery between male and female students after the implementation of integrated Earth and Space Sciences (ESS) learning that accommodate multiple intelligences.

2. Research Method

Integrated ESS learning in The Motion of Celestial Bodies theme that accommodates multiple intelligences consists of three sub-themes, namely the rotation and revolution, laws of motion and the eclipse. The first sub-theme (the motion of rotation and revolution, the Earth’s rotation and revolution period, the evidences of rotating Earth, the influences of Earth’s rotation and distance to the Sun) was given in one in-class meeting. In the second sub-theme meeting was delivered topics on Kepler’s law, Newton's law of gravity, the conservation of mechanical energy, the conservation of angular momentum and Nebula model of the Solar System. During the third sub-theme, students studied about umbra and penumbra, polychromatic light, light dispersion and Islamic sharia according to eclipse phenomenon. We also prepared the syllabus, lesson plans, learning scenarios and learning media.

Prior to the implementation, students are given multiple intelligence identification questionnaire consisting of 40 statements using a Likert scale (1-4). For each intelligence there are five statements. Student’s dominant intelligence is determined by the maximum score of each intelligence type. One student can have more than one dominant intelligence if he/she obtains the same highest score (the maximum score for each intelligence is 20) on some intelligences. The results are used as a reference in determining students’ dominant intelligence and make heterogeneous groups of students. Once groups of students consist of various intelligences are made, the integrated ESS learning is implemented. We held the learning process on December 14-18, 2015 for 9th grade students of SMP-IT Nurul Amanah, Tasikmalaya. In this school female students and male students are in a class apart, so we had two experimental classes (18 female students class and 14 male students class) in practice.

We assess the learning process using observation sheet consists of three forms of assessment, namely self-assessment, peer-assessment and observation sheet by observers. Self-assessment and peer-assessment is conducted at the end of each learning process, while the observation is during the learning process. In each sub-theme there is validated pre-test and post-test (essay form) to test students' concept mastery. To obtain the improvement in students' concept mastery, the data are analyzed by using the normalized gain [8].

3. Result and Discussion

3.1 Multiple Intelligences Identification

The kinesthetic (31%) and interpersonal intelligence (28%) had been identified as the dominant students’ multiple intelligences. Kinesthetic and interpersonal intelligences are the most dominant multiple intelligences owned by a junior high school students [1] [2] [7] [9] [10], so our initial questionnaire survey is in agreement with the other authors. This means that junior high school students will be easier to solve the problems or perform activities in interpersonally and kinesthetically. But we find that the dominant multiple intelligence between male and female student is different as shown in Figure 1 (see also [12] [13]).
Female students are obviously dominant in naturalistic and interpersonal intelligences. This means that female students tend to spend time and do activities together, so this preferences have an effect on their cooperation attitude, easy interaction and easy to empathize with others. Contrary to this, male students have a dominant kinesthetic intelligence that means they love to do physical activity such as playing football or running around during free time [11].

Biologically, human's brain is programmed to feel happy in a relationship with another person that is manifested in the form of actions (kinesthetic), such as playing together, doing activities together, etc. [6]. Being junior high school student means most of them are in puberty. Hormonal excess produced during puberty needs to be expressed through physical activities, like doing extra-curricular at school. This is evidenced by the dominant number of male students who join sport and many female students who participate in “paskibra”. These are favourite extra-curricular for students in Bandung [14].

### 3.2 Multiple Intelligence Activity

Table 1 presents the percentage of the multiple intelligences activity emergence of students based on gender during integrated ESS learning process that accommodate multiple intelligences. At every meeting of female students’ class it has already emerged the multiple intelligence activity by the average percentage above 80%. The emergence of multiple intelligence activity is highest for kinesthetic (98%), visual spatial (96%) and naturalistic intelligence (100%), while it is the lowest for logical mathematical (70%). For male students, the percentage of multiple intelligence activity emergences is highest for naturalistic (98%), while the lowest is logical mathematical (79%).

The emergence of multiple intelligence activity with the lowest percentage for logical mathematical is in accordance with our results at the beginning; logical-mathematical intelligence is the most non-dominant skill among students. On learning activities, students looked confused and less enthusiastic when doing activities that contain elements of logical mathematical intelligence, so they took more time to work on activities and need more guidance. This is also in line with study conducted by Xie and Lin [10] that the student is weak in the verbal linguistic and logical-mathematical intelligence.

### Table 1. Percentage of Multiple Intelligence Activity Emergence based on Gender

| Multiple Intelligences     | Percentage of Multiple Intelligence Activity Emergence on Learning Process |
|----------------------------|--------------------------------------------------------------------------------|
| Intraperusal               |                                                                                |
| Interpersonal              |                                                                                |
| Kinesthetic                |                                                                                |
| Visual Spatial             |                                                                                |
| Musical                    |                                                                                |
| Linguistics                |                                                                                |
| Logical Mathematical       |                                                                                |
| Naturalist                 |                                                                                |
3.3 Students’ Concept Mastery Improvement

The improvement of students’ concept mastery is obtained by normalizing the average gain (N-gain) of pre-test and post-test scores for each sub-theme. Overall the average value of the N-Gain for male students is in medium category (0.65) while for female students is in low category (0.39). Based on these results, concept mastery between male and female students is different. The students’ improvement of concept mastery for Rotation and Revolution sub-theme is not significant compared to the other sub-theme, indicating this sub-theme is elusive for both male and female students. However, the achievement of male students on this sub-theme is better than female students.

Table 2. Averaged N-Gain based on Gender

| Sub-theme            | Gender | Pre-test Score | Post-test Score | N-Gain | Category |
|----------------------|--------|----------------|-----------------|--------|----------|
| Rotation and Revolution | Male   | 30.00          | 54.90           | 0.4    | Medium   |
| The Law of Motion    | Female | 24.92          | 45.24           | 0.3    | Low      |
| Eclipse              | Male   | 28.82          | 59.11           | 0.4    | Medium   |
|                      | Female | 23.56          | 73.37           | 0.7    | Medium   |

For the Law of Motion sub-theme, the average value of the N-Gain for both male and female students is in the same category: medium. In this sub-theme, the students’ improvement of concept mastery is increased significantly. Many students said they had not heard of Kepler's laws, so they were enthusiastic in the learning process. In addition, the learning process designed by teacher for this sub-theme was attracting students.

For Eclipse sub-theme, the average value of the N-Gain for both male and female students is in medium category. The students’ improvement of concept mastery is quite visible, especially for female students. The eclipse is a rare phenomenon they can observe but they are familiar with the terminology. Many myths in the community about the eclipse, so students are interested finding out the truth. Additionally, the teacher designed the learning activities successfully to attract students by sketching an eclipse, singing etc. Form of the instrument (essay format) can be a matter causing the improvement in students’ concept mastery is not significant. This is because the problem requires students to think more broadly and in fact most students have difficulty answering the questions.
4. Summary
Based on the result we conclude that gender has a relationship with multiple intelligences and the ability to master the concept. Gender gives substantial contribution determining one's dominant multiple intelligences and the dominant multiple intelligences affect one's ability to understand the concept.

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