Testing the Effectiveness of Laboratory Activities on Students' Understanding of Biological Concepts

Uma Mahalingam

Honors Thesis Project

22 March 2018

Introduction:

Created in 1980, Howard Gardner's Theory of Multiple Intelligences has firmly rooted itself in the belief that "human cognitive competence is better described in terms of a set of abilities, talents, or mental skills, [called] *intelligences*."[1] While individuals may illustrate each of these abilities, talents, or mental skills to an extent, no two people exhibit the same exact combination of intelligences.[2] Gardner has based each intelligence off of commonalities between all individuals, like sensitivity to sound and ability to speak a language. Linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, interpersonal, intrapersonal, and naturalist intelligences describe the different intelligences with which people learn. A few years after proposing these intelligences, Gardner added two more, the existential and pedagogical intelligences. The existential intelligence is known as the intelligence of asking big questions, while the pedagogical intelligence focuses on the ways in which humans are able to relay information, such as

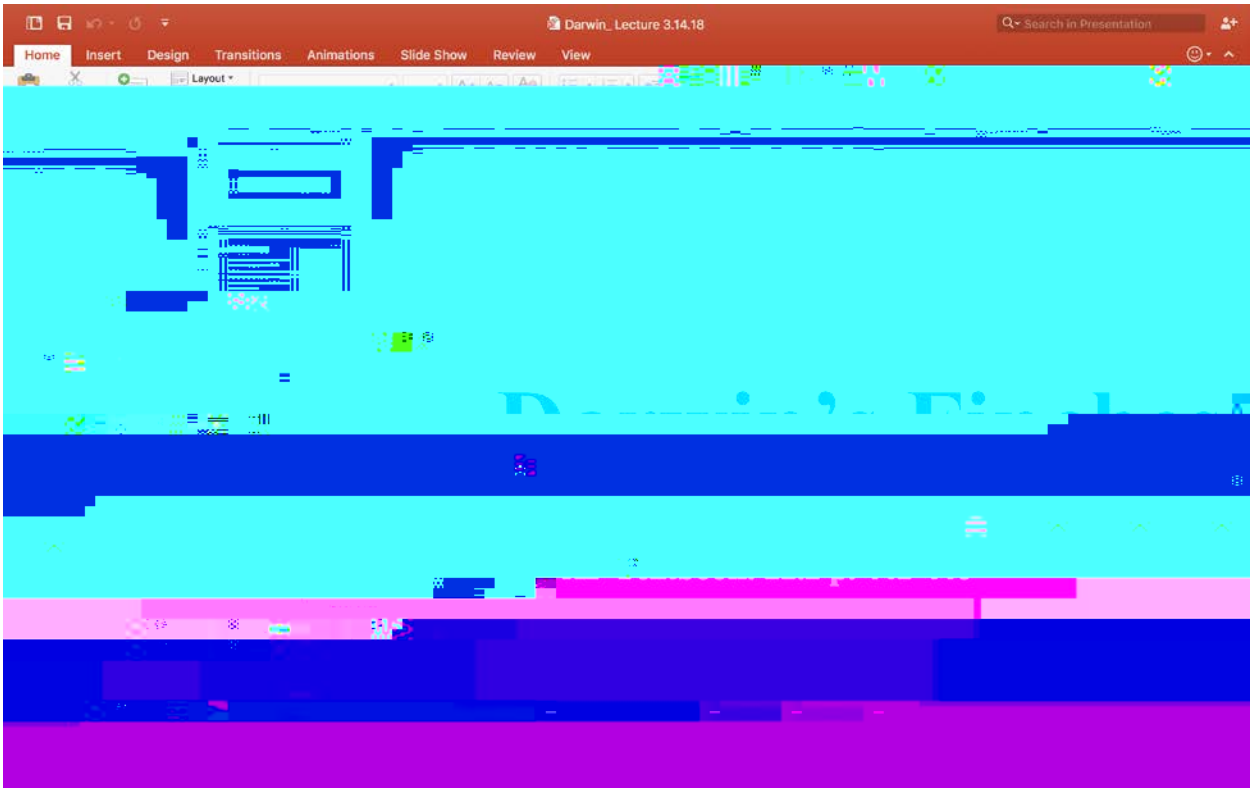

Figure 1: Screenshot of PowerPoint slides used to teach students in the lecture session

The PowerPoint, shown in Figure 1, created for those listening to the lecture about Charles Darwin and the finches he studied in the Galapagos Islands was based off the information from Chapter 22 of their AP textbook.[5] During the lecture sessions, I presented the PowerPoint slides while asking questions along the way to check for understanding. By doing so, I addressed learners who might have exhibited the linguistic intelligence by orally and visually communicating information. After going through the slides, I gave students a lesson assessment to complete independently, addressing the intrapersonal intelligence. The naturalist intelligence was required throughout as students needed to be able to connect Darwin's work with the Galapagos finches to the big idea of Natural Selection.

Figure 2: "Investigating Bird Beak Adaptations Lab Activity" Set-Up

The lab activity utilized for those participating in the lab sessions was from a kit called, "Investigating Bird Beak Adaptations Lab Activity", shown in Figure 2. The kit provided the procedure along with all of the supplies needed for the activity. Each lab table represented an "island" in the Galapagos, and students had to go from one island to the next to determine which beak would be best at obtaining the food source. By working as a group and traveling together, learners exhibited the interpersonal intelligence. The food source for "Island #1" was aquatic vegetation, represented by pieces of cork floating in water. The food source for "Island #2" was worms, represented by pipe-cleaners buried in moist soil. The food source for "Island #3" was seeds, represented with sunflower seeds that would need to be crushed. The food source for

“Island #4” was nectar, represented by water (nectar) in a graduated cylinder (plant). At each “island”, students had to use each “beak”, represented by the dip net, the pliers, the pipette, and the tweezers, to obtain the food source. Students had fifteen seconds at each island to try each “beak” using only one hand, totaling one minute at each “island”. Afterwards, students had to determine which “beak” was best at obtaining the food source on that particular “island” by counting the pieces of food, addressing the logical-mathematical intelligence. When facilitating the activity, I allowed students to read the background information independently, addressing the intrapersonal intelligence. I then asked some basic questions to check for understanding. Afterwards, I moved with students from one “island” to the next, timing them as they used “beak” after “beak”. After completing the lab activity, students completed the assessment independently, addressing the intrapersonal intelligence. The whole lab activity itself addressed the naturalist intelligence as students had to determine which “beak” would work best for the food source on each “island”. In addition, since the activity had a tactile component, it appealed to bodily-kinesthetic learners.

Students in Group 3: Lecture & Lab listened to the same lecture first. They then participated in the same lab activity and then completed the assessment. Students in Group 3: Lecture & Lab had an advantage as the implementation of different instructional strategies, such as lecturing and doing a lab activity, addressed the majority of the intelligences. As a result, they should have obtained the highest scores on the assessment because linguistic, interpersonal, intrapersonal, naturalist, logical-mathematical, and bodily-kinesthetic learners all had opportunities to learn using their dominant intelligence.

these three students. Table 4 shows the p values calculated through three t-tests. The p-values suggest that none of the values, since they are not less than 0.05, are statistically significant.

Discussion:

According to Howard Gardner's Theory of Multiple Intelligences, Group 3: Lecture & Lab, including Students G, H, and I, should have obtained the highest scores as both lecture and lab sessions would have appealed to learners exhibiting various intelligences. However, there were many factors that could have influenced the data collection of this experiment. Due to the recent snow days and delayed openings as a result of winter weather, I fell behind with my original plan of conducting the experiment earlier. Consequently, I wrote a letter to my cooperating teacher's AP Biology students to give them an overview of the experiment and ask for participation. After reading the letter, out of seventeen students, twelve expressed interest. However, out of the twelve, only nine shared availability with others. As a result, I had to divide those nine students into groups of three based on their availability, rather than their academic ability.

To begin with, I was faced with a pool of AP students, all of whom are on the same, accelerated academic path. Grouping them randomly based on their availability, rather than basing it off of their academic performance in my cooperating teacher's AP course or off of their dominant intelligence(s), was a factor that probably led to some groups performing better than others. To improve this experiment, I would give students an assessment for them to determine what type of intelligence is their most dominant, like those that I have taken in my teacher education courses at Ramapo. From there, I would group students, either in homogeneous or heterogeneous groups, based on their intelligences. This way, there would be more of a

correlation between the instructional strategy used, the learners' dominant intelligences, and their assessment scores.

Grouping students based on their availability led to an unequal distribution of juniors and seniors in each group, as well. Two students in Group 1: Lecture, Students A and C, were seniors while Student B was a junior. Students D, E, and F in Group 2: Lab were all seniors, while Students G, H, and I in Group 3: Lecture & Lab were all juniors. Perhaps the juniors who participated were not as prepared academically as the seniors, who have had an additional year of schooling, explaining why Group 3: Lecture & Lab had the lowest scores. To improve this experiment, I would try to work with just juniors or seniors so that I could collect data from participants at a more similar academic level. To improve this experiment, I would try to work

and retained, rather than how much they have remembered from previous lessons, classes, activities, etc.

Upon further research, Gardner's Theory of Multiple Intelligences suggests straying away from standard assessments to measure student learning as many students' intelligences are not well captured on a typical, written quiz

Although there were many factors that influenced the data collected from this

References & Resources:

1. Gardner, Howard. *Multiple Intelligences: New Horizons in Theory and Practice*. Basic Books, 2006, books.google.com/books?id=8K54fg6YU4EC&printsec=frontcover#v=onepage&q&f=false.
2. TEDxTalks. “Beyond Wit and Grit: Rethinking the Keys to Success | Howard Gardner | TEDxBeaconStreet.” *YouTube*, YouTube, 10 Dec. 2015, www.youtube.com/watch?v=IfzrN2yMBaQ.
3. Gardner, Howard. “Multiple Intelligences After Twenty Years.” 21 Apr. 2003, pp. 1–14., www.kvccdocs.com/FYE125/lessonresources/Gardner-MI-Article.pdf.
4. “Howard Gardner Discusses Multiple Intelligences | Blackboard BbWorld 2016 HD.” *YouTube*, YouTube, 19 July 2016, www.youtube.com/watch?v=8N2pnYne0ZA.
5. Campbell, Neil A., and Jane B. Reece. *Biology*. 7th ed., Pearson, Benjamin Cummings, 2005.
6. “Investigating Bird Beak Adaptations Lab Activity.” *WARD'S Investigating Bird Beak Adaptations Lab Activity | Ward's Science*, www.wardsci.com/store/product/8878029/investigating-bird-beak-adaptations-lab-activity.