Using the Theory of Multiple Intelligences to Understand Guided Inquiry

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Abstract

We show how guided inquiry in a science classroom theoretically covers Howard Gardner's Theory of Multiple Intelligences. We propose that the success of guided inquiry may rest on this breadth of accessibility to these eight intelligences.

Introduction

During the summer of 2012, we observed four workshops at the University of Notre Dame concerning guided inquiry and modeling instruction for middle and high school teachers. Our observations are the basis for our definitions and the connections made in this paper, and thus may not be found in direct literature.

The Theory of Multiple Intelligences

Howard Gardner introduced his Theory of Multiple Intelligences in 1983, and it has been widely utilized as a descriptive tool in educational circles. Currently, Gardner has identified eight different kinds of intelligences; these are mathematical (the ability to recognize patterns and understand relationships between objects, especially numbers), linguistic (the ability to understand and creatively utilize written and oral language), bodily kinesthetic (the ability to use the body to create a representation and to handle objects), musical (the ability to create or repeat musical compositions), naturalistic (the ability to categorize objects or ideas), spatial (the ability to visualize representations of objects and procedures), interpersonal (the ability to discern others' emotions), and intrapersonal (the ability to discern one's own emotions) (for more detail, see Gardner's *Frames of Mind*, 1983 and *Multiple Intelligences in Theory and in Practice*, 1993).

Defining Guided Inquiry

Guided inquiry is the process by which students learn through interaction with data, technology, and each other instead of direct instruction. "Stand and deliver" or lecture instruction is rarely effective. The quickest way to transport information is through lecture; however, it is also the quickest way to lose the attention of the students in a classroom. In contrast, one premise of guided inquiry is to ensure the engagement of all students. Through guided inquiry, students are led to their own conclusions using personal experiences   that is, students are being taught how to think and how to solve problems.

In the high school science modeling curriculum, guided inquiry classrooms also make extensive use of personal whiteboards. The whiteboards can be a medium for group problem solving and also for reporting data to the rest of the class. Laboratory experiments in a guided inquiry or modeling classroom involve students collecting data without a set procedure. Students are required to create their own procedure and report results without having known the desired result. Science notebooks are another resource for guided inquiry because they allow students to make personal records of what has been learned. Through the inquiry process students are asked questions on multiple levels, including their concrete knowledge, their ability to analyze, and their creativity in synthesis. Finally, when presenting information and discussing the implications of the current model, Socratic seminars promote the inclusion of all student ideas. Taken together, all of these teaching methods promote student learning in the best possible manner, because each student learns differently and is able to see the material presented in a variety of ways.

Connecting Guided Inquiry to Multiple Intelligences

Mathematical Intelligence

Mathematically intelligent students will be able to effectively analyze data: once data have been collected, students have to analyze it and determine the trend. This is especially valuable because students are not given the expected outcome, and therefore have to reason their own way toward a conclusion. Often, the data can be most eloquently expressed in a table, chart, or graph, the creation of which also requires students to draw upon their knowledge of mathematical relationships and definitions.

By working in a group to prepare a whiteboard, students with strong mathematical intelligence can guide those whose mathematical intelligence is not as strong in the process of forming a hypothesis about data trends. This gives students a chance to ask each other questions and check understanding before having to present to a larger group or the entire class. Mathematically intelligent students will also be able to perform a group self check of numerical answers to aid in confidence during the presentation.

Once data is shared throughout the classroom, the teacher is responsible to lead the students to a data set that most closely resembles the canonical scientific principle being investigated, or to a general consensus combining the results of the entire class. Mathematically intelligent students will aid in this process by comparing different data representations and looking for unit consistency. Afterwards, depending on the relationship to be established, students can be asked to derive their own mathematical model of the situation, including any formulas that may be useful in expressing the relationship. Here again, students will have to use mathematical intelligence. Strong mathematical students then have the opportunity to lead those struggling with the mathematical principles of a derivation.

Linguistic Intelligence

With whiteboards, linguistically intelligent students are able to present their work through storytelling. Their creation of this story, which is an interpretation of data, will allow these students to better recall what they have learned. These stories will also help other classmates understand the material.

Lab notebooks are also a way for linguistic students to present their materials through storytelling. The notebook is a personal place for these students to begin to incorporate the new vocabulary. As these students utilize this vocabulary, they are able to help less linguistically intelligent students learn to use the words correctly. They also learn to effectively describe experimental designs and write acceptable lab reports. Since scientific reading and writing is a specific type of language, students with linguistic intelligence will grasp and model this language fairly quickly when challenged to do so. Again, these types of students are able to help those who do not possess the capabilities of this new science language.

Through Socratic seminars, linguistically intelligent students can become great leaders and role models in leading discussions. Their participation can encourage shy students, who are unlikely to respond to teacher lead discussions, to participate in discussions. The linguistically prepared explanations are more accessible than teacher explanations for students who are grappling with the concept, again increasing student comprehension.

Bodily Kinesthetic Intelligence

Kinesthetically intelligent students enjoy hands on projects rather than writing reports. Simply the act of gathering into different groups for labs and presentations will make these students more comfortable in a guided inquiry classroom. Labs increase information retention in kinesthetically intelligent students because they can recall bodily movements in the experiments and the process of creating the experimental set up. Mock demonstrations can be performed by these students during whiteboard presentations or during seminars. This type of presentation is beneficial for conceptual understanding via dramatization with hand gestures and other types of bodily movement. When kinesthetically intelligent students volunteer to dramatize a concept, other students in the classroom are more likely to participate as well.

Though kinesthetically intelligent students may not be strong writers, the science notebooks become their personal record of their actions, reinforcing the concept to be grasped. Once the concept is understood and these students have written it in their own words, they are able to help other students who still struggle with the concept. Not only that, but these students can use the lab notebook to record their ideas about new or unique dramatizations for the concepts.

Musical Intelligence

Musically intelligent students will learn a concept more thoroughly if given a song or rhyme relating to the topic at hand. During bodily presentations, as described above, these students may offer songs or "raps" to help synchronize the movements and remember the order of a process. Even if the teacher has a rhyme or rap from the past, musically intelligent students should be encouraged to create such tools for themselves and the current class. These students can lead the class in these activities and thereby increase participation of students who otherwise might not participate. The combination of actions and music can solidify the concept and encourage artistic creativity for all students.

Naturalistic Intelligence

Naturalistically intelligent students will excel at object classification in lab. When given the opportunity, these students are able to help their fellow classmates distinguish the differences between objects, and perhaps consider classifications that were otherwise unnoticed.

Naturalistically intelligent students have a stronger capability of noticing the differences and similarities between presented whiteboards. Though students' work may look similar, differences of significant figures, units, and data trends will be noticed. These students can then lead discussions for the class about the importance of a common scientific language for describing data. Naturalistically intelligent students can help the class as a whole come to an understanding that even replicated data can vary within the precision of the measurements.

Through Socratic seminars, naturalistically intelligent students are able to help the group articulate trends. In turn, each student should then be able to explain the concept in his or her science notebook in a way that is personally meaningful. These students can also record unique classifications that have not been addressed in class, and help others make charts, graphs, and other types of organizational tools.

Spatial Intelligence

Although perhaps not initially obvious, some students use their spatial intelligence to picture (in their mind or in a drawing) how an experiment or procedure will work and what the outcome will be. This is especially true if the experiment is one that is readily visible or is a thought experiment.

More obvious is the use of technical drawings in the science notebooks. Spatially intelligent students find it helpful and useful to make drawings where they can put down what they see, helping them to interpret details that they may otherwise have missed. Spatially intelligent students are also able to critique drawings by students who are not as spatially intelligent, helping to promote drawing and interpretation skills.

Similarly, spatially intelligent students find diagrams and drawings on whiteboards easy to understand and interpret. A spatially intelligent student is also able to answer questions about how or why a representation was made the way it was, and should be asked to justify personal representations made in science notebooks. Modeling good justifications will strengthen the class' acuity in producing scientific drawings.

Interpersonal Intelligence

Due to the large amount of group and class interaction in a guided inquiry classroom, interpersonally intelligent students are indispensable. Although it may appear that interpersonal skills would not be useful in understanding science, interpersonal skills in one student will check for understanding in other students. Properly utilized, interpersonal skills will also help to bring out those students who do not often speak or who prefer to work alone instead of in a collaborative group.

In their science notebooks, interpersonal students are encouraged to record observations about the ways in which their groups worked well together or did not work well together. This can give more insight not only into which members are working and which are not, but also into who understands the material and who does not.

During whiteboard presentations, interpersonal students are helpful in mediating and directing discussion. As much as possible, since students are supposed to guide the question sessions, these students should be allowed to find commonalities between groups and prevent disagreements. Interpersonal students can also help cross check understanding across groups and not just within their own.

Intrapersonal Intelligence

Intrapersonally intelligent students need time to reflect on what they have learned in order for the concepts to solidify. Whiteboard presentations and seminars allow time for this to take place. These students are likely to connect what they are learning in the classroom with concepts in their everyday lives, and so can help other students learn the concepts by sharing these connections. Because of the nature of intrapersonally intelligent students, the science notebook is indispensable it is the record of the students own thoughts on the concepts presented and learned.

Conclusion

Guided inquiry practices are closely tied to all eight multiple intelligences in Gardner's theory. Therefore, we propose that the success of guided inquiry rests on this breadth of accessibility for the different types of students found in classrooms. Since this is a theoretical framework, future research includes studying this link in controlled classroom settings. Further curriculum adaptations should continue to consider elements accessible to all student intelligences, especially those who needs have not been met in traditional classrooms and through traditional teaching methods.

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