Learning to Discover, Discovering to Learn

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Every student deserves an opportunity to learn; we can all agree on that. In addition to the basics — reading, writing, and arithmetic — children should also have the opportunity to learn how to learn. There is an amazing world to discover and as students develop functional learning tools, they will engage the capacity of their brains to discover this world for themselves.

I believe the purpose of educating students in science is to give them both a core knowledge of the world around them and a practical understanding of the scientific method and how that process is analogous to everything they will do in life. Children must have the confidence to solve problems, be aware of their surroundings, and be given the best chance to realize their own dreams and goals in life. With attention to the variety of ways students learn, incorporating these "discovery learning" skills will better prepare students to develop into productive members of society and truly discover the world.

Learning to solve problems can best be approached by teaching students how to learn. Bruner explains this concept of "learning how to learn" by looking at the core structure of a subject and then how it's related to other subjects. If students can master a skill, that student will have the knowledge and confidence to master any skill. Further, he explains for this method to be successful a teacher must provide structure for learning fundamentals for life usage (not just the facts) — more specifically, ready students to learn, encourage the use of intuition, and find ways to stimulate the desire to learn. I agree with all these concepts and can visualize how they can be incorporated into the science classroom.

The key to incorporating these ideas is through the scientific method. The scientific method asks to consider a problem, hypothesize an answer, test the hypothesis, examine the results, and draw a conclusion. The foundation of understanding this process is the basis for moving forward with learning how to learn.

In some cases, students will need to memorize a list, learn to calculate results, or perform other seemingly mundane activities. This is important to help develop evidence, relevance, and a reference for further exploration or proving a theory. Ultimately, however, students will need to draw on their own creativity, perspective, and even intuition to form logical, structured hypotheses, perform relevant experiments, and develop an explanation for why things are they way they are in the world.

Science lab projects may not always need to have a right answer or be about performing a routine experiment. There should be an opportunity to figure out how to solve a problem, or collect data that might have a different answer. Information can be shared between students to compare procedures, determine what variables were used, and ultimately give students ownership of the answers.

A real-world example of an experiment to support this concept would be a plant growth study project during life science week. Students could be asked for ideas on how to make plants grow bigger or faster — perhaps a nursery wants to increase the quality and quantity of their stock. Students might choose an experiment to see if plants respond to sound, and if so which forms or decibels of sound might encourage more plant growth. Students would be given the core knowledge of how to perform the experiment, but then could choose the music variables, record data, and develop their own conclusions for a report to the nursery. Students would not only gain core knowledge on plants, but also practice problem-solving skills by finding class-developed answers to real-world questions.

If students are trained to have full use of their capacities, and in the case of science class, the capacity to solve problems, they will have the capability to incorporate these skills into other activities throughout their life. Dewey supports this when he says education is not just preparing for the future. Dewey describes the practice of students "voting" — not just learning to vote, but actually voting. This can be directly related to science class activities. Continuing with the previously mentioned plant growth experiment example, students would gain this "voting" experience by democratically choosing what types of sounds to test. Whether students are voting as a group or simply making individual choices, they are actually practicing making real-world decisions. This will prepare them to become an informed and skilled participant of society.

Dewey's statement that "no one really knows what the future will be," is as accurate as it is profound. The best we can do in light of this is to prepare ourselves for what could happen. What we do for our own individual futures should be well thought out, and preparations (financial investments, educational advancements, building relationships and networking) should be implemented. More importantly however, we as teachers need to prepare students for their lives by giving them full command of themselves. They need to acquire the tools — not just a diploma, but the knowledge and experience — that will give them the confidence, esteem, dignity, and self awareness to be adequately prepared for the future.

I agree with the notion that if you can develop your perspective to be aware of your surroundings, to know how to solve problems, and are prepared to be the best person you can be, society will benefit. Bruner and Piaget also infer to the relevance of educating students for the betterment of society.

Piaget goes further in his argument of bettering society by suggesting students be trained especially in science and mathematics because of the overwhelming choice of students to follow in liberal arts careers. Although I agree that society is in need of specialists who help shape the knowledge of our universe through discovery, in most cases it's not a lucrative career direction and society can function respectably with a diversified society. I would encourage students to follow their own passions when deciding what career path to follow.

This concept can be incorporated into the science classroom by reinforcing the importance of the learning process. If students are given examples of how the plant growth experiment process is analogous to other real-life situations — like market studies on what types of video games should be designed, what's the best tire to use on an all-terrain vehicle (ATV), or what are the best ingredients for an omelet — perhaps they would recognize the purpose of the lesson and understand its usefulness. Maybe students will not choose to be scientists and instead decide to be a computer programmer, off-road tour guide, or a 4-star restaurant chef. Regardless of the career paths they follow, they will still be making choices.

Students often react as if science is not important and they have no use for it in their perceived futures, I would reply to them that video games are designed by computer engineers and the science of computer languages, the ATV was designed by a mechanical engineer using the science of physics, and chefs need to know the science of chemistry to make that perfect concoction. If students have learned to make choices – to vote on the path they will follow – and know that it is at least an informed decision, I believe they will be more likely to succeed in life.

Students learn best when they are motivated to learn regardless of the process they use. I am encouraged that one of the most motivational methods of learning in the science room is through discovery. Although some students may prefer to memorize information and complete the lesson, I believe the process of getting to the answer of a question is equally valuable in education.

Bruner and Piaget both discuss the concept of learning through discovery. I find this the most intriguing theory and believe it is a very viable philosophy or approach to teaching. I agree with Piaget when he says the teacher should not be a lecturer, but an initiator. I still think there are times when lecturing is important, but it can be appropriately mixed with interactive lessons, student participation, and lesson guidance.

Lessons must be set up to direct students, stimulate initiative, and encourage them to use their intuition when forming hypotheses. Bruner often refers to forming hypotheses with intuition. He also suggests that once students learn to use their intuition and find success in solving problems for one topic, that they will have the capability to solve any task for their rest of their lives.

In a lesson on plant biodiversity, after asking students to use their intuition to hypothesize ways of determining local tree populations, perhaps they would arrive at an idea to collect leaves from trees in their yards at home for sharing in class. I would then assign them to draw an illustration of representative leaves. Although the lesson plan would be similar for everyone, each person would have a different image. The class as a whole would in effect create a tree diversity biome for the local area. The tree diversity could also be mapped along with the illustrations on the wall. Not only will students grasp the modeling of a biome, but they will never look at the tree in their yard the same. This becomes relevant when one considers science books are turned in at the end of a semester, but the tree in their yard produces leaves year after year.

I also argue that students learn best when they are having fun. Skinner describes efforting an association between learning and happiness. Physiologically, being happy releases hormones that feel good. Students may therefore become “conditioned” to associate learning with the positive feelings. Students will be motivated to learn if they are having fun and associate it with happiness. If students have fun creating a tree diversity biome in class, perhaps the illustrations on the wall will bring back those feelings when times are not as joyous.

Jensen describes how students’ brains work, and that affective learning comes from feeling, acting and thinking — the mind, emotions and thinking are all linked. I speculate that Stephen Hawking, the great physicist is not driven by physical activity, but by his mind and his emotions. I am not suggesting that being physically active won’t help learning — in fact it helps significantly. I am arguing that emotion can be just as powerful in developing motivation toward learning.

There are intrinsic motivational capabilities in each person’s brain that can be supported by creating a positive, engaging atmosphere. This positive atmosphere can be developed by eliminating threats to students like racism or bullying, setting goals for both individuals and the class as a group, increasing feedback, and activating and engaging positive emotions. In the previous example, the creation of a wall mural of neighborhood tree diversity is analogous to student diversity in the classroom and might encourage positive interactions between peers. Other projects of this same nature would sustain an instructional attitude of fun and discovery that unlike reading from a text book might change students’ attitudes toward enjoying science and the learning process.

I believe students should be taught how to learn. Although content is important and provides a structure to follow, especially for meeting state standards, giving students the ability to learn on their own will carry on with them beyond their years in school.

Students should be given the tools to discover the world around them and learn to solve problems. One tool, described by Bruner, is to teach students the skills to tap into their curiosity by drawing on their natural intuition. Sharing perspectives is yet another tool, according to Greene. She argues that students have the potential to see different views because each student has a different perspective, resulting in problem solving in more than one way.

In the science class, sharing different perspectives can benefit the process of forming hypotheses. To study the electrical conductivity of different materials, perhaps a student knows about electric fences because they live on a farm, while another may be familiar with starting a car with a battery. Others may not have any concept of amps and volts, but still know not to put a hair pin in an electrical socket. Students could discuss what materials they hypothesize will conduct electrical currents and then be able to make conclusions through team experimentations. Relating the conclusions to real-life applications would tie in the relevance of the lesson and validity of fellow classmates' contributions. Perhaps by hearing a story from a fellow classmate about touching an electric fence, others will have gained the intuition to not touch such a fence when they do happen upon one in the future.

Additionally, with the world and the knowledge surrounding it changing all the time, it is important to have multiple solutions to problems — whether as a teacher or a student. What works as the best process to reaching an answer now may not be the best process tomorrow. Consider the human population over 60 years of age. There is a much lower percentage of people in that demographic who do not have an email than do teenagers. If you ask a senior citizen how to research Stephen Hawking, they will point you to the nearest library. A senior in high school will be online with Dr. Hawking's biography in a matter of minutes. Consequently, the senior citizen may enjoy the social perspective of seeing neighbors at the library, while the high school senior may not know his neighbors.

As a teacher, I would enjoy hearing the different perspectives of students' experiences with electricity and other science interactions. The scientific world revolves so much on discovery, that one doesn't really "teach" science, but rather leads students in the process of discovery.

Piaget, with so many strong points about learning through discovery, is somewhat progressive (or extreme) to say all students should focus on learning math and science, and scientists and psychologists should decide the content. I believe a balance of information is important. Although science and math are all around us throughout our life, other curricula are equally important in providing opportunities for students to develop into unique human beings. Piaget does suggest relating science to other curricula, but perhaps may not be taking into consideration multiple intelligence theory, where some students may not learn as well without strong influences from other subjects.

Teaching social lessons also comes with the responsibility of teaching a class. Regardless of the career students choose as they reach adulthood, they will need to social skills to function in their respective societies. Dewey argued at the turn of the last century that education fails students when they neglect the school setting as a social community. It's hard to imagine what schools were like a hundred years ago to prompt someone to argue this. Today's schools are filled with social opportunities including clubs, sports, drama, and music activities in addition to the typical classroom communities. Particularly in the science classroom when students work together to share their perspectives throughout the scientific method for solving mysteries.

Piaget still explains it best when he says to "teach students to learn how to discover. To understand is to discover, or reconstruct by rediscovery and this must be complied with if students are to be creative and productive in the future, and not just repetitive."

From my perspective, the general nature of children is the desire for gratification (mostly junk food, toys, and fun with friends). They typically do not have the maturity to look past the desire to have what they want when they want it. Children, never-the-less, ultimately want to have fun. Children are also very prone to habit-forming activities, which may be bad when it comes to unhealthy eating patterns, sedentary after-school life, and lack of responsibility. Habit forming can also be good if early efforts are made toward healthy eating, physically active lifestyles, being responsible, and learning.

If a teacher can motivate students to make learning fun, and consistency can help develop good learning habits and responsibility, then children can earn trust to make good choices. They will be more aware of their consequences for failure to be responsible if they have met the challenges one faces when developing the good habits.

Bruner explains it further by suggesting that once a student masters a skill, or understands a particular scientific process, that that student is "well on his way toward being able to handle seemingly new but, in fact, highly related information." In other words, if the student grasps the structure of a subject, other related subjects will become meaningful. With understanding, especially of the consequences of failures, the student will naturally (hopefully) make good choices.

Piaget also supports the concept that students will eventually be able to make good decisions as they learn the process of problem solving and understanding the consequences of actions. Science experiments, as Piaget explains, resulting in solutions to problems are found in all branches of learning and can be associated between disciplines. Students who have the learned to recognize the significance of a subject and its relationship to other subjects will have a better ability to understand other relationships as well.

My philosophy includes wanting students to learn to make good choices. If students experience making good and bad choices and learn from consequences, future decisions will arguably be better and more effective. I believe there is a middle ground between meeting state teaching standards and providing students an opportunity to help come up with choices. Students will take ownership in the results of experiments if they have ownership in the questions and hypotheses. I also believe that students need to be directed through the decision-making process to help develop good habits and an understanding of safe procedures.

Asking students for their suggestions on what plant growth experiment they want to perform, how to determine a neighborhood tree diversity biome, or hypothesize why only some materials conduct electricity gives them a sense of ownership in the results — and then those results have relevance to their lives.

Discovery learning as described by Bruner and Piaget is very intriguing and these theories, I believe, are worthy of incorporating into my science classroom. Although some students may not learn well entirely by using the discovery method, providing options and a variety of teaching methods intertwined to accommodate multiple intelligences will be my intended strategy to reach all of my students.