State Science Standards In a Progressive School

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The depth and breadth of the learning at this progressive school often matches — and often exceeds — prescribed state standards.

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During my second semester as a graduate student of education, Kristan (one of my professors) introduced me to progressive education and free schools. The progressive education philosophy, as practiced in free schools, allows students to exercise their own voices in their education. Students decide which classes they want to attend, if they choose any at all. Within these classes, they also maintain control of material covered, which creates an environment in which individual students have complete responsibility for their own education.

At first I could not understand how students would learn. This form of learning was completely foreign to me, and I began thinking it could never work. I assumed that students would never go to class, would never learn to add and subtract, let alone move on to calculus. I also assumed that days would be spent playing on the playground with little to no traditional learning happening. However, intrigue quickly replaced these assumptions, and I began to question everything about these and similar alternative schools. What happens if a student never chooses to attend classes? How do colleges view free and alternative school pupils? How does society view these schools and the students and teachers there? Question after question swirled in my head, and I began to consider a brand new (for me, at least) area of education. Under Kristan's guidance, I read a great deal of literature about educational alternatives, such as progressivism, critical pedagogy, freedom-based education, and critiques of conventional education. While somewhat convinced of the validity of these forms of education, I was still curious and wanted to see these alternatives in "real-life."

My Questions

Since I was pursuing a license to teach secondary school biology, I was especially curious about how science was taught in non-traditional schools: Would the students graduate with much science content and skills? My experiences as a public school student as well as my preparation to become a public school science teacher had immersed me in the seeming importance of following the state-mandated science curriculum (in Virginia, called the Science Standards of Learning, or SOLs). I wanted to understand not only how science was taught at a progressive school, but also whether such a school could argue it was accomplishing what the state required of public school teachers in teaching specific content. To answer these questions, I felt I needed to see for myself what a science education was like at an actual progressive school.

The School

Luckily for me, the Blue Mountain School was located close to my university. The school was founded in 1982 in the small, southwestern Virginia town of Floyd. The school educates around 50 students and employs ten teachers, a director, and an office manager. According to the Blue Mountain School website, the school is a "contemplative, progressive" school. Teachers at this alternative school educate students from preschool through middle school with four major age groups: early childhood, early elementary, older elementary, and middle school. Each group is not divided by a set age or even grade; rather, students graduate to the next level based upon their maturity and educational factors. Classes take place from 9 a.m. to 3 p. m. Monday through Thursday from September to May. Older students (older elementary and middle school) participate in core classes including math, science, English, and history. Students also attend courses in such areas as service learning, music, art, and contemplative learning.

Blue Mountain School uses a slightly more regimented learning approach than free schools, but is still extremely flexible compared to most public schools (Miller 2004). Because it is a private school, Blue Mountain is exempt from the state-mandated curriculum; rather, teachers are free to create a unique curriculum for their students. For example, the science teacher, Miranda, planned to begin her lessons for the year with a unit on cosmology, the creation of the universe. Depending on student interest, Miranda can spend as much time as needed on this topic. Furthermore, should students express an interest in a topic unrelated to the current topic, the teacher is allowed to deviate from his or her initial curriculum.

According to the school's website, teachers in elementary and middle school "work to balance their students' need for structure with their increasing need for freedom and choice as they grow." As a result, classes ordinarily start with a discussion that serves as an informal assessment of what the students already know to engage them in the material, increase their confidence and curiosity, and allow teachers and students to realize what students might be struggling with from past lessons and what should be focused on in the current lesson. Questions play a central role in the teaching that takes place at Blue Mountain. In fact, the school website has this to say about questioning.

> As students explore new topics and skills, teachers encourage questions like: What did we expect to learn? What did we observe? Did we answer our questions or learn all that we wanted to about this topic? Do we need to spend more time trying to answer our questions or exploring what we've learned? Questions like these help students reflect on what they are learning, making new connections and finding meaning in each lesson and activity.

Study Approach

I spent five weeks observing the only classroom at Blue Mountain School explicitly focused on science. Occasionally I had the opportunity to study other groups of students or teachers in the school during recesses, lunches, special events, and presentations, but this was not my main research focus. Miranda instructs two classes with fewer than ten students in each. Each class lasted about two hours with a ten to fifteen-minute snack in the middle of the period. Often classes would extend beyond the set time or begin late for the school neither uses bells or adheres strictly to the schedule. The youngest science class Miranda teaches is the upper elementary class ranging from second to fifth grade. The older class ranges from fifth

to eighth grade. Because Miranda teaches science on Tuesdays and Wednesdays, I observed her classroom only on those days during my five weeks of observation. In addition to classroom instruction, I observed Miranda's planning time and lunch on Tuesdays. If any out-of-the-ordinary science instruction took place on the days I was scheduled to be at Blue Mountain, such as the Valentine's Day Special Tea, I remained in the classroom and observed these as well. Conversations with Miranda, the director, and other teachers were also recorded in my field notes.

Because Miranda is the school's only science teacher and the only teacher with whom I had a great deal of contact, she was the only person interviewed using pre-written questions. Others involved at Blue Mountain were asked many questions about the school and its practices during conversations throughout the study and these answers were recorded thoroughly in my notes. During my interview with Miranda, we discussed her science teaching methods, classroom setup, teaching theories utilized in her classroom, curricula and resources she may incorporate, Virginia science SOLs and their impact on her teaching, scientific concepts she believes are important, assessment of student learning, her experiences in public education and the effect that had on her teaching at Blue Mountain, traditional teaching methodology, and student voice/choice.

To further enrich the data gathered from the observations and the semi-structured interviews, I examined other documents about science education and Blue Mountain School. In order to gain a better understanding of the science curriculum and its relationship to the Virginia science SOLs, I collected any handouts Miranda distributed to her pupils during the study. These consisted of worksheets, note sheets, and stories. To study the school itself, its philosophies, and how it operates, I obtained the school handbook and also read their website and newsletters available online. Lastly, I accessed the Virginia science SOLs from the Virginia Department of Education website for comparative analysis.

My Findings

After spending time with Miranda at the school, I discovered that the development of specific science skills and the understanding of scientific information (content) were very important to her. Her teaching thus seemed to be similar to my own experiences of the goals of science teachers in public schools; however, within this teaching of scientific skills and content, Blue Mountain seemed to also teach students in a way that would develop certain attitudes, such as independence, an understanding of oneself and others as social and emotional beings, and the value of inclusiveness and interconnectedness. Blue Mountain also practiced different pedagogical approaches in its teaching of science, with specific focus on activity-based learning and assessing students in non-conventional ways. I found these differences of attitude development and pedagogy most interesting, for I felt Blue Mountain was essentially going above and beyond state requirements for teaching science. This is intriguing since many people might believe that private schools of this type are not "up to par" with the rigor and content focus of conventional public schools.

Science Content and Skills

Blue Mountain School emphasizes content in science. To some extent, I would argue that the science content at Blue Mountain School goes into much greater depth than in public schools. For example, under the study of cosmology, the SOLs only require that students know the phases of the moon. However, Miranda taught her students theories on how the moon was formed and myths surrounding its formation and phases. Doing so provided students with an historical background and historical connections to the science behind the moon's phases. It may well be, though, that Blue Mountain School does not cover the breadth of information mandated in the SOLs every year simply because of how much time teachers spend on specific topics. However, my own experience tells me that "covering" a lot of information does not necessarily lead to the permanent retention of the information, nor does it lead to significant levels of engagement with the content.

Science content information was certainly important at the Blue Mountain School and science skills were clearly paramount. These skills aligned well with the Virginia SOLs, which would seem to indicate that the school went above and beyond the requirements in its teaching of science skills.

The 2010 Virginia science SOLs emphasize the scientific skills students must be able to master, such as making observations, creating hypotheses, utilizing the scientific method for experiments, creating experiments, correctly using the metric system for measurements, questioning, formulating inferences, collecting and analyzing data, recording observations, classifying objects and organisms, building and using models to further understanding or for explaining connections. Students at Blue Mountain School certainly demonstrated most of these abilities during this study.

Occasionally students had an opportunity to select activities from science shelves within the classroom. Often these activities contained an experimental element, which students of all ages were required to write up in their sketchbooks.

Miranda routinely requested students to formulate hypotheses and inferences. In addition to hypotheses associated with the experiments recorded within their sketchbooks, students received other opportunities to cultivate this skill. When the class was discussing a science problem, Miranda asked students either to individually or as a whole class make predictions based on previous knowledge. Similarly, during activities incorporated into lessons (though not full fledged experiments) Miranda asked her students to create hypotheses as to what may occur or to infer what scientific principles might be at work.

Observations and data of formal experiments were recorded in sketchbooks and often involved worksheets for lesson activities. For the younger grades, observations and data were often depicted exclusively through pictures; however, older students, especially middle school students, were encouraged to include as many written, narrative details as possible, in addition to any relevant drawings. Whenever measurements were taken as part of the observations, students used the metric system. Miranda would often remind students that scientists all over the world use this system and since they were in science class, they should as well.

While the school, in my opinion, does a great job teaching these skills, it cannot fulfill some of the skills standards as completely as perhaps some public schools. Because it is a private rather than public school, Blue Mountain operates with a limited budget. Equipment readily available to most students in public schools may be missing entirely or may be in limited supply. For example, I only observed one microscope at Blue Mountain, and laboratory equipment and computers appeared to be in short supply. Blue Mountain does not maintain a computer lab like the schools I have been involved with and only has one computer in each classroom, which limits virtual learning. Since the Virginia science SOLs dictate that students be proficient using microscopes and lab equipment, Blue Mountain does not have the financial resources to achieve these standards.

Attitudes Developed through Science Teaching

In addition to the scientific content and skills addressed in the Virginia science SOLs, students at Blue Mountain were encouraged to acquire certain attitudes. While the SOLs do not specifically address desired scientific or educational attitudes, the introductory statement included at the beginning of all the elementary grade 2010 SOLs alludes to attitudes the state of Virginia wishes to cultivate within science students. Occasionally, the attitudes encouraged at Blue Mountain had a direct correlation to the state standards, but the attitudes I determined to be routinely promoted were independence, an understanding of oneself and others as social and emotional beings, and the value of inclusiveness and interconnectedness.

Independence through Freedom

Students at Blue Mountain do not exercise total freedom. While Miranda decides which broad scientific topics are covered within her classroom, the students ultimately determine the specifics of the material and the amount of time spent covering them. For example, when I first began observing, Miranda revealed they had been covering cosmology for almost four months since the beginning of the school year. One might assume these students were having difficulties learning the material. Instead, the students as a whole were extremely interested in the topic and wanted to learn more and more about cosmology. Rather than move on to another topic, Miranda allowed her students to more deeply explore the subject. As a result, the students truly know an enormous amount about the creation of the universe and

the major bodies making up the universe (galaxies, stars, planets, black holes, etc.). It was not uncommon to hear students converse in grand detail about the nuances in cosmology, things they had learned four months before. Deep learning appeared to be taking place.

In an interview Miranda talked about her students requesting to learn about new topics. Her response to these requests is usually positive as long as they are feasible and relevant to the topic at hand.

Students are encouraged to express their individuality and independence as much as possible in every assignment. Moving beyond rigidity, Miranda assigns projects with options built in. During my observation period, Miranda assigned a functional geography project. A sheet specifying the information students were required to include in their project was distributed. However, the format was not specified, which allowed students to present the material any way they chose. Miranda noted that the projects were like mirrors of the students who created them. Each student chose a different way to convey the information that reflected their individuality and their freedom within the established parameters.

Ideally, Miranda would like her classes to be freer and more and independent. She envisions a future in which the students at Blue Mountain are almost exclusively self-directed in the science classroom. Miranda describes her vision this way:

> They [the students] would be completely self-directed where each individual child would have their own index card and [I would] say do five of these by the end of class. They could research something; they could be doing some of the activities on the shelves; they could be working with a partner on something; they could be working in workbooks. It could be anything…. So it would really be me … going around to each individual child at different times to see how they are doing or [asking] if they needed any help from me.

But she is not quite there yet. Instead, her students do a lot of groupwork and activities together because Miranda does not feel they are ready for such extreme independence.

Regardless of how far from Miranda's ideal the students are currently, she still allows them as much independence as possible. When students ask her a question, she often directs them to sources where they can answer the question for themselves. For example, students often wanted to know more about a subject related to what they were learning or to something going on in the world around them. Most of the time, Miranda explored the question a bit with them and then encouraged them to research it on the computer or in other classroom materials.

For example, Miranda introduced the concept of the phases of the moon in a variety of ways. She asked her students to construct a flipbook containing pictures and labels of the phases. While some students were still involved in a demonstration with Miranda, others discovered a chart book containing the phases of the moon. Utilizing this tool, this group of students began trying to label their flipbook with the correct phases on their own, without Miranda's assistance or prompting. Their independent thinking was not prompted by Miranda but was encouraged once she noticed their self-direction.

Though the Virginia SOLs do not cite specifically freedom and independence as goals for public school students, the introductory piece of the science SOLs does require students to "develop scientific dispositions and habits of mind including curiosity" and to "make informed decisions regarding contemporary issues, taking into account … personal responsibility" (Virginia Department of Education 2010). The instructional practices at Blue Mountain School that foster freedom and independence also serve to instill curiosity and personal responsibility within its pupils. By giving students more freedom to pursue topics of their own interest, Miranda required students to tap into their own curiosity and, by encouraging independence, Miranda has also instilled the disposition of personal responsibility. Each student must take charge of his or her individual education and be responsible for it.

Understanding Oneself and Others as Social and Emotional Beings

I often witnessed students being taught more holistically than the children I had observed in public schools. Social and emotional issues were brought to

the forefront of learning at Blue Mountain. Often students would comment negatively on their work or themselves. Whenever Miranda heard negative comments from students, she would immediately have them say two or three positive things about themselves or their products. In this way, students begin to recognize they must treat themselves as positively as they would others at the school.

Miranda and I often discussed problems she continued to encounter with her elementary students, such as name calling and being unkind to one another. The result was the implementation of a system to encourage these children to become more aware of their actions. Students received a gem for every pleasant thing a teacher heard them say or do. However, for every negative comment or action, the students would lose a gem. Once three gems were lost, the student received a stone. When I questioned Miranda about the gem and stone system, she was not quite sure if the system would be effective. She said that the teachers and the director had decided to try this approach for a week and then decide whether it should be continued. Miranda opposed using the gems and stones for rewards or punishments. She said that she believes that being a good person should be a reward in and of itself and that students should not be bribed to follow rules and expectations. Miranda also believes that engaging in nasty behavior introduces its own set of natural consequences in the form of losing friends and having a more difficult time navigating through life. When I later arrived in Miranda's classroom, her students were engaged in creating "finger labyrinths" decorated with the gems and stones from the behavior experiment. Miranda explained to the children the gems and stones would no longer be employed for discipline and said that the point had been to make them more aware of how their words and actions have an impact on themselves and those around them. Rather than simply abandon the stones and gems without explanation or closure, Miranda decided to create a lesson surrounding them to debrief the students about this experience and reiterate their purpose, thus furthering the students' social development.

Recognizing that the gems and stones project did not fully serve its intended purpose, the school brought in guest speakers to discuss bullying and the impact of their actions with the students and to engage in team-building exercises. As a result of one such visit, Miranda began engaging students in compassion meditation at the end of each class period. The meditation focused on perceiving everyone as human, just like oneself and to connect the inner goodness within oneself to the inner goodness within all humanity. Once again, this was viewed as an important application of classroom time, because it served the purpose of creating a whole-minded student, not solely one focused on facts, figures, and test scores.

Emotions are recognized and brought to the surface in the science classroom at Blue Mountain. One afternoon one student was having a particularly difficult time obeying Miranda and maintaining her composure in the classroom. Eventually, the youngster's anger bubbled to the surface and she stormed out of the room after a private discussion with Miranda. Rather than pretend that the emotional level had not risen, an adult volunteer returned and thanked the class for remaining patient with the student who had stormed out. After this acknowledgement, class resumed without whispers about the emotionally charged event.

In addition to service learning courses, yoga, and meditation, recess and various other forms of free time are important for holistic learning. Every day each student participates in at least 30 minutes of recess, is allowed two 15-minute snacks, and a 30-minute lunch period. These breaks promote informal learning about life in general, engaging with others in further discussion of classroom material or creativity.

It became clear to me that Blue Mountain is focused on cultivating students who are both socially and emotionally aware. By employing positive practices and encouraging personal responsibility for actions and inclusiveness, Blue Mountain fosters these behaviors. While these lessons appear to have very little connection with teaching science, they do occupy a significant portion of time set aside for learning the subject. Blue Mountain has set a precedent for educating the entire pupil even in the science classroom. According to Haynes, Ben-Avie, and Ensign (2003) this method permits students to approach learning science with an entirely different outlook

and with respect. Incorporating social and emotional elements into the science curriculum provides students with a basis for creating important connections from science to their lives outside of the classroom. Haynes, Ben-Avie, and Ensign (2003, 125) have argued that

> emphasis … on the history of science and personal and social perspectives opens the way to a fuller appreciation of science as a human activity — one that implies responsibility to the human community.

Blue Mountain's emphasis on the whole student does not align with any specific SOL, but is addressed in the introduction to the science SOLs. The standards state that science students should "apply scientific concepts, skills, and processes to everyday experiences" and that students should have a respect for living things (Virginia Department of Education 2010). While respect for living things quite possibly refers to respect for living scientific specimens and not specifically other human beings, it seems logical that if students have respect for themselves and their fellow students this respect will be extended to other living organisms more readily than if this social and emotional learning had not occurred.

Valuing Inclusiveness and Interconnectedness

Inclusiveness is engrained in the students at Blue Mountain School, and the students sought to include me in the day-to-day activities of the classroom and larger school. They frequently approached me with questions, comments, and invitations. Having an observer simply be a mere presence in the classroom is not sufficient for these children. They genuinely desire contact with everyone involved in any capacity at Blue Mountain. This extended beyond occasionally requesting assistance from me if Miranda was occupied with another student. Students in the upper elementary class repeatedly asked about my teaching notes and what I was writing. Sometimes, if I failed to jot down something they felt was important, they would call it to my attention. When I entered the classroom on Valentine's Day, one of the students left without a word, and returned with a valentine addressed to "Science Lady."

Blue Mountain's emphasis on inclusiveness is readily apparent. First, it is stated explicitly in their Family Handbook (2011) that

> [w]e celebrate diversity in our membership and in the world. We explore wisdom traditions and cultural celebrations, engage in service learning, and work to contribute positively to both our local community and the larger global community.

In the February 2012 newsletter a new teacher wrote about Blue Mountain and his feelings toward their inclusiveness:

> Since my family's move to Floyd late last summer, the local community has been very welcoming, and this is especially true with Blue Mountain School. The staff, teachers and parents at Blue Mountain are always kind and warm to us, whether it's sharing a humorous story about something our son did in class or the school's sincerity in accepting my wife and I into the community. (Blue Mountain School, "Indigo Messenger" 2012).

In addition to valuing and teaching about human interconnectedness, connections between all the subject areas were apparent throughout my visit. When studying moon phases, Miranda repeatedly connected the science behind the changing phases to math and often brought in history as well. Indeed, one lesson was so linked to math one of the students commented, "We're actually doing math today." Miranda taught the phases of the moon in terms of fractions and money. And to assist in further understanding, Miranda took down the clock on her wall and drew the various phases of the moon on the face. Story after story about the moon and its phases incorporated aspects of history. Her goal is to help her students see how it relates to everything.

> Science is a way of knowing, and I want them to know that. It's a way of knowing all their different subjects, how everything is connected, all the different kinds of science, even down to social science.

Interconnectedness is certainly addressed in the introduction to the science SOLs. The standards re-

quire students to explore the natural world through collaboration and with an understanding of historical contributions to science. Furthermore, the document calls for students to "develop an understanding of the interrelationship of science and technology, engineering, and mathematics" (Virginia Department of Education 2010).

Activity-Based Learning and Learning through Stories

Most of the instruction taking place in Miranda's classroom involved activity. When learning about moon phases, students constructed their own clay moons placed on top of a pencil or stick. These props were then utilized in further instruction about the movement of the moon around both the sun and the earth. A lamp placed in the center of the table represented the sun and the student's head represented earth. Students were then able to orbit their clay moon around their head and the sun to visualize the phases of the moon. For homework, students were assigned to teach someone the phases of the moon and to take their sketchbooks home every night for about a month to sketch and label the moon phase for the evening. To wrap up the lessons on the phases of the moon, Miranda asked her students to find various bits of nature to represent the different moon phases. Students picked up leaves, grass, and rocks from around the grounds of Blue Mountain and used them to construct all the phases of the moon. Some of the children supplemented items from nature by incorporating man-made materials scavenged from around the play area. A partnership of students used a hula-hoop, their bodies, and the sun to cast shadows on the ground to represent the phases of the moon from new moon to full moon.

Miranda also employs stories as a primary form of teaching. Trained in Montessori education, Miranda teaches the Five Great Lessons from Montessori schools. The Five Great Lessons consist of "Coming of the Universe and Earth," Coming of Life," "Coming of Human Beings," "Communications in Signs," and "The Story of Numbers" (Lillard 2005). These lessons are broken down into stories. Told dramatically and often with demonstrations accompanying them, these stories create a framework for students to recall information.

Assessments

At the Blue Mountain School one of the first things one notices is there are no tests or grades. So how does a teacher know if his or her students are truly learning the material in an ungraded atmosphere?

I explored this fundamental question in my interview with Miranda. She reported giving the middle school students one "review" a year. Essentially, the review is a test without that name. Miranda spoke about the anxiety of middle school students over tests and grading. One of the students began talking about how much she disliked tests or "reviews" and the amount of worry and concern this caused her. However, Miranda administers a few formal test assessments with the middle school children, because she recognizes they need to be prepared to endure tests later in their educational careers. Miranda described her approach to tests as follows:

> I know what I'm covering is more than they need to know for public schools. So I think it's fine. The best [way] that I've found for me to assess is to just talk about the material with them and see what kind of information they are getting. That way they are not stressed out over a test….

While Miranda may not test her students frequently, she assesses their progress and knowledge every day. Content, whether related to the SOLs or not, is not often formally tested at Blue Mountain; instead, Miranda relies on other forms of informal assessment to ensure the students are learning the information presented or gained through activities, experiments, research, or stories.

Conclusion

My observations at Blue Mountain were vastly different than my experiences with public education. Students at Blue Mountain certainly learned a great deal of science, but this was accomplished differently than what I have observed in public schools. The information, skills, and attitudes studied and encouraged at Blue Mountain often aligned with the Virginia SOLs. The gathering of content-related information is at a much slower pace. This allows for deeper exploration and understanding of scientific topics rather than a shallow scratching of the surface. Furthermore, Blue Mountain seeks to move students

beyond simply learning information to pass a test. In short, the school seeks to feed the students' social and emotional well being by emphasizing it throughout the school and the curriculum.

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