Instructing Exceptional Students in Science

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Introduction

Observations in two schools for exceptional students revealed a deficiency in science and mathematics curriculum. In both schools students were being taught hygiene (i.e. brushing teeth, combing hair, etc.) in place of real science. In commenting on this situation an assistant director and instructor at one of the schools mentioned that she and the other instructors did not know how to incorporate real science and mathematics into the curriculum for students with exceptional needs. She went on to mention that due to the mandates of the No Child Left Behind Act, they were definitely trying to include science and mathematics among the subjects they offered, but that no one had any ideas as to how to do that. The director at the other school stated that he would definitely like to include real science in the curriculum at his schools, but that his instructors weren't trained to do so. What is more, the classrooms at this school did not contain any scientific equipment; and thus were not conducive to science learning. He was, however, open to having scientists come to the school to instruct students in science. The first school mentioned is a part of the Chicago Public Schools (CPS) system. The second schools is not a part of CPS and services students with exceptional needs over the age of twenty-one.

A review of the literature indicated that students with exceptional needs can and should be exposed to and instructed in science and mathematics on the same level as students in general (regular) classrooms. A number of articles offered suggestions as to how to go about doing this. Three articles in particular were especially informative. These articles emphasized teacher preparation, differentiated instruction, and

accommodations—in regard to equipment—as means of introducing science and/or mathematics into the classroom.

Summary

The first article, *Teaching with CLASS: Creating Laboratory Access for Science Students with Disabilities*, by authors Mary Ellen Bargerhuff and Michele Wheatly, details measures that were taken at Wright State University (WSU) to accommodate students with disabilities in laboratory science classes. To begin with, they installed special weighted, bases in their laboratories so that students in wheelchairs could have access to microscopes. They bought plastic beakers instead of glass ones to accommodate students with limited hand movement. Finally, they purchased models to service students with visual impairments. The models allowed these students to explore with their hands what they were not able to see (Bargerhuff and Wheatley 2004). Thus, WSU illustrated that a key component in introducing science into the classroom is supplying the classrooms with adaptive scientific equipment.

Another key component to introducing science in classrooms for students with exceptional needs mentioned in this article was preparation of teachers. WSU hosted a two-week summer workshop in which in-service teachers were given instruction on working with exceptional students and given the opportunity to implement the strategies they learned with exceptional students. The article goes on to mention that the students were able to instruct the teachers on "how to best meet their individual learning needs (Bargerhuff and Wheatley 2004)." This article emphasized the need for teachers to receive direct instruction on how to serve exceptional students and experience working with exceptional students as part of their preparation.

The second article, *Developing Scientific Talent in Students With Special Needs: An Alternative Model for Identification, Curriculum, and Assessment*, was primarily concerned with a program for students who were twice exceptional. Nonetheless, this article exemplified ways in which exceptional students could be effectively instructed in science. This article stressed the importance of exceptional students being exposed to diverse topics so that they can become excited about them. Rather than engaging in lectures in the areas of "biological science, physical science, engineering design, and the visual and performing arts" students were given projects to complete (Cooper, Baum, and Neu 2004). The authors Cooper, Baum, and Neu mentioned "the use of authentic equipment, inquiry methods, tools, and materials that scientists and engineers employ" as motivating students and encouraging them to engage in science (Cooper, Baum, and Neu 2004). Again, we see the need for equipment in the classrooms, but also the use of the inquiry method of learning science—which has been proven to be beneficial for all students studying science. Scientists and engineers, experts in the fields, mentored the students. Exceptional students need to be instructed by teachers highly qualified to teach the content area in which they are giving instruction.

Another feature of the program was that the complex tasks given to students were broken down into smaller tasks. Students were also held accountable for staying on task while completing their projects. This was, however, ensured by the instructors giving them clear expectations, objectives, and guidelines toward completing their projects.

Finally, assessment used in this program was atypical. During their projects student success was determined by their constructing and applying knowledge while

progressing toward their finished project rather than traditional assessment tools. The final project was also used in assessing student success.

The third article, "Tiered Lesson: One Way to Differentiate Mathematics Instruction," explains how to differentiate mathematics instruction. However, the information given can be applied to science curriculum as well. According to the authors, Pierce and Adams, students should be arranged in groups so that they can collaborate in learning. In accord with the strategy of tiered learning, a science lesson plan would address a particular concept (i.e. velocity), but would allow for several paths for arriving at understanding based on the students readiness, interest, or learning profile. The teacher assesses the students' readiness and interest through observation and previous instruction. The students learning profile can be assessed through observation in addition to assessment inventories. Armed with the knowledge of these three things, teachers can design a lesson plan to meet the individual needs of all of their students. This paper highlights tiered lesson plans for mathematics instruction. However, this format can be easily adapted for science curriculum.

Remedial Plan

How best to service exceptional students in the area of science is a difficult question to answer. Nonetheless, it is imperative that schools/administrators, teachers, and parents consider it. Exceptional students need access to the same science curriculum that students in general (regular) classes have. It will take the cooperation of the school, teachers, and parents to ensure this happens.

To begin with, all schools (including those that only service students with exceptional needs) must see to it that adaptive science equipment is included in their

classrooms. Furthermore, schools must invest in assistive technology to better serve the needs of exceptional students in science.

Beyond that, the school—namely administrators—must provide their teachers with proper preparation. According to authors Bargerhuff and Wheatley, "Formal preparation of science teachers has not kept pace with changing legislation that mandates access of students with disabilities to general education curriculum (Bargerhuff and Wheatley 2004)." This includes instruction on how to serve students with exceptional needs in the areas of science and experience implementing this instruction. In addition to that requirement, science teachers should be proficient in the area of science they teach. It is a disservice to exceptional students to have an instructor trained in special education teach all of their subjects. All students are deserving of highly qualified teachers—that is, in the case of science, teachers that are trained to instruct in that particular area of science. This may require "providing intensive inservice to science educators and special educators (Bargerhuff and Wheatley 2004)." In addition to ensuring that exceptional students in their schools receive the same qualified teachers, schools must also mandate that they receive the same science curriculum that other students receive. Exposing exceptional students to highly advanced science curriculum may aid in identifying their talents and lead to their success in science. Although the curriculum and instructional methods may be modified to accommodate their needs, the content should be the same as what other students receive. More specifically, students should be exposed to and instructed in all areas of science: earth science, geology, biology, chemistry, and physical science/physics. Such fundamental courses should not be replaced with hygiene or life skills.

Teachers have a crucial role to play in ensuring that exceptional students receive appropriate science instruction. First, teachers must be willing to undergo the training and preparation necessary to instruct exceptional students in science. The above-mentioned preparedness may be provided through workshops, courses, and mentoring from special educators and/or scientists. Teachers must also be open-minded. They must see the relevance of and develop a desire to instruct exceptional students in science. This commitment to efficiently instructing exceptional students is often gained from actual experience in working with exceptional students. One of the teachers participating in the WSU summer workshop commented, "I was a little nervous in the beginning, but soon relaxed after I realized I could treat him like a normal kid (Bargerhuff and Wheatley)!" Another teacher stated, "a twinkle in a student's eye when he connects with a concept is reason enough for us to . . . keep the focus on our students (Bargerhuff and Wheatley)." After working with exceptional students teachers will find that their students will reward them in full, but first they [the teachers] must be open to trying.

Teachers must also be willing to adapt to the needs of students when it comes to lesson plans and assessment. When exceptional students are included in general education classes, differentiated learning is needed. When exceptional students are in resource rooms or classes that are strictly for exceptional students there is still a range of abilities and levels of readiness within the classroom. Thus, science teachers should always differentiate learning. In particular, with science students, interests in the topics or content may vary widely. Hence, science teachers should use tiered lessons. This allows for them to adapt the curriculum to the individual needs of the students based on readiness, interests, and learning style as well. Teachers must also find creative methods

for identifying interests in the material. They must observe activities that will allow for the students potential talents to surface. Such activities should be designed so as to identify the student's readiness level as well. That is why teachers must be trained in and have a robust understanding of the content they are teaching. Otherwise, it will be difficult, if not impossible, for them to identify such potential and accurately determine the students' readiness levels. Then, once they've discovered this potential, they must consider these findings when preparing instruction or curriculum. Thus, teachers must show flexibility and willingness to adapt in order to provide effective instruction. "Proactive planning by conscientious teachers often negates the needs for complex modifications" to universal instruction designs (Bargerhuff and Wheatley 2004)."

Also, inquiry methods of learning should be used in instruction whenever possible. Hands-on activities will keep students engaged, motivate students to learn, and provide students with a more robust understanding of the material or concepts being covered. Discovery learning will help students to retain information much longer and easier because they will associate what they are learning with the activities they are engaged in. According to authors Cooper, Baum, and Neu, "The new national- and state-level curriculum standards emphasize this inquiry-based approach to teaching and learning science (Cooper, Baum, and Neu 2004)." In addition to utilizing the inquiry method of instruction, teachers should give the students instruction in stages. The skills and concepts they learn in one lesson should be built on or used to prepare them for subsequent lessons. Complex tasks should be broken into smaller tasks. Such strategies will make science instruction more effective for exceptional students, and non-exceptional students as well.

Additionally, teachers must be willing to modify assessment procedures/tools. Assessment tools should measure a student's success despite their disability. Teachers must focus on the student's strengths rather than their weaknesses. The instructional methods/learning activities they use should capitalize on the student's strengths or talents. This, in turn, should be directly related to the assessment tools used. The assessment tools should also be used to identify potential talent in science among exceptional students. This kind of identification should prove more beneficial and accurate than utilizing test scores alone (Cooper, Baum, and Neu 2004).

Finally, parents too have a responsibility toward their children when it comes to learning science. The parent can aid in the identification of twice exceptional students by observing their ability at home. Thus, they can make this known to teachers and/administrators. That way the students' strengths and weaknesses can be simultaneously accommodated. They can also increase their child's exposure to science through informal science education. This includes taking their child to museums, showing their children documentaries or films related to science, and helping their child to identify science outside of the classroom.

When it comes to exceptional children learning science, parents must be their child's strongest advocates. They must holds teachers and schools responsible for teaching their children the same science—science containing the same concepts or content—as other students. Thus, parents must be keenly aware of what their child is learning and doing inside of the classroom. This requires frequent communication with teachers and classroom visits if possible.

Conclusion

It is imperative that exceptional students be instructed in science. It is disheartening to see that this is not already the case. However, to see this come to fruition will require cooperation of school administrators, teachers, and parents—all of who must realize and be working toward the greater good of the student. Personally, as a future educator, I intend to do all that I can to ensure that exceptional students are exposed to and instructed in science.

To begin with, I am adapting physics curriculum to better suit the needs of students with learning disabilities and mild-retardation. This includes breaking activities into smaller steps and revising assessment tools commonly given in accord with the curriculum. I intend to conduct workshops at one of the schools mentioned at the onset of this paper.

I am also trying to recruit some of the physics students at Chicago State University (CSU) to assist in these workshops. My hope is that this can become one of the CSU Society of Physics Students outreach projects and a part of their tradition.

I do not have much experience working with students with disabilities. However, conducting these workshops will afford me the opportunity to gain that much needed experience. I look very much forward to implementing the strategies and skills that I have learned from articles presented and from the exceptional learners course that I am currently taking. I look forward to taking another course to better prepare me for instructing exceptional students in science. If possible, I would like to participate in a summer workshop that will give me more intensive training in teaching students with disabilities science.

Although not mentioned in this paper, there are a number of skills that I must learn before becoming an effective science teacher for exceptional students. One of these things is classroom management and discipline. I sincerely hope that the instruction that I receive and the experiences I will gain in the near future will provide me with the tools that I need to be better equipped in these areas as well.

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