

Students were selected from almost 9,000 registered students after a series of exam-based competitions. During the National Finals, which brings 20 of the best and brightest biology students across the nation to spend 2 weeks studying with distinguished biology professors and immersing themselves in a university laboratory, 4 are selected to represent the nation at the IBO. Professors at the National Finals strive to design laboratory experiments, which enhance the USABO scholars' knowledge of theory and challenge assumptions.

Testing at the IBO is equally distributed between a theoretical and laboratory examination. Historically, Team USA has excelled at the theoretical exam, but found the practical exam more challenging. However, the average laboratory score for Team USA in 2007 increased significantly from 2006. This improvement can be directly traced to recognition by USABO faculty for the need to develop lab skills by increasing attention to hands on experimentation in U.S. training. In fact, U.S. student, Meng Xiao He, garnered the highest laboratory score in the world!

Many factors contribute to the poor laboratory skills among U.S. students. Most notably, the rising costs of equipment and specimens combined with increased liability costs have made it prohibitively expensive for many schools to provide advanced laboratory experiences. This is combined with inadequate teacher training and insufficient school time given to students for hands-on laboratory experiences. Remarkably, for many of the USABO students, the National Finals marks the first time that they have been given the opportunity to work in depth with sophisticated equipment generally unavailable in a typical high school.

Team USA demonstrates that students who exhibit a genuine interest for learning will persevere and "show their stuff" among the world's finest young scholars. Given the proper instruction and education, U.S. scholars can continue to prevail in innovation, to remain globally competitive and to lead this nation into the future.

What Young Teachers of the Gifted Need to Know and Do
Sanford Aranoff, Ph.D. Professor of Physics and Mathematics
Rider University Lawrenceville, New Jersey

I. Introduction

Dear reader, please allow me to share some thoughts with you to help you with this very important task. You must realize that you have a very important responsibility. Education is the only way to change people. This has been verified in the millennia of human existence. Education means communication, which is talking and listening. You are dedicating your life to changing people for the better. This realization will give you the courage, stamina, enthusiasm, and satisfaction from your teaching.

The focus of this paper is on gifted children. These people will be at the forefront of society in the future. Our society has very serious problems that will need the very best efforts to solve. Failures will cause serious hardships. The type of world our students will inherit may be so different from today's world that we cannot imagine. We will need the best creative and analytical abilities in our future leaders to manage this world. Our job as teachers is to help our future leaders to be properly effective in the new, strange, and challenging world.

Exciting, isn't it? Your responsibility as a teacher of gifted children is awesome! Let us work together, trying to think clearly on the best way to carry out this responsibility. Before I start with my suggestions concerning how to teach, please allow me to discuss some problems facing our society, which I have personally seen, problems that appear to be the result of poor teaching in high school.

II. Problems

When I finished my doctorate, and began teaching at Rutgers, I took a summer position at Bell Laboratories working on an anti-missile project. The idea was to build a defense against enemy missiles. I was offered a full time position at double my

university salary, but turned it down. I disliked intensely the work atmosphere. People were not focused on trying to understand the problems involved and how to solve them; instead, they would talk only about their social lives. Management also did not understand how to focus on a problem. They would frequently stop work on a project in the middle of the project, and move to something else. I realized that nothing could get accomplished this way.

To this day, we do not have an anti-missile defense. We may have to go to war against Iran to take out the nuclear missiles, as we cannot live with this danger.

The reason is that we do not know how to work on government defense programs. We do not see the work as challenging problems to be solved. We do not see the work as extensions of our math and science training. The danger we are currently in, that we do not have defense against missiles, can be traced to our poor education practices.

In 1993, I was a software developer for Grumman on the JSTARS project. This is a radar surveillance system, and used in the first Iraqi war. When I started working, I noticed that the program contained errors in high school trigonometry. I asked my manager how this code could have passed inspection. He replied that the government inspectors were paid for inspecting, and wanted to continue issuing favorable reports in order to guarantee a job coming back.

Why are we not using JSTARS to monitor the borders in Iraq, to prevent infiltration from Syria or Iran? Why are we not using JSTARS to help monitor traffic in our cities? The answer is because of errors similar to the high school trigonometry error

discussed above! If we cannot get our high schools to do the job correctly, we will not be able to build defenses necessary for the security and future of our country!

Recently there was a news item about soldiers suing the government for illnesses caused by depleted uranium. The complaint is that they were not informed of the dangers. Wait a minute! High school students know (or should know) of the dangers of lead. Uranium is chemically similar to lead, and so one does not want to get any uranium inside the body. Furthermore, uranium radiates alpha particles with a half-life about the same as the age of the earth.

If our soldiers are so uninformed that they do not know these things, I am concerned that there are other things in this age of technology that they do not know, which they should know, that will hurt them on the battlefield and impair our ability to fight! Whose fault is this? Our fault, as educators!

A friend was telling me how they can save energy and so reduce global warming. He visited a place where they pumped water to a reservoir on top of a hill. By day, the water fell down and created electricity. Most of the electricity was sent to the grid for public use, with part of it saved to pump the water back up at night.

I vainly tried to explain that this cannot be, due to conservation of energy, and that the only purpose of the reservoir was to even out power generation between high and low demands. Whose fault is it that an intelligent responsible citizen does not know elementary things like conservation of energy? How can such people vote and make rational decisions for our future? It is our fault, as educators!

A recent item about *Consumer Reports* testing automobile collisions mentioned an error caused by a faulty calculation of momentum in collisions. High school students learn how to make these calculations. They were testing colliding one car into another, without properly understanding the basic physics! Sadly, there are very many stories like these!

III. The Future

What will the future of our high school students be like? Can we imagine it? Consider the Internet, for example. The Internet has radically changed society. What is strange is that if we read science fiction from the days before the Internet, we will not find any hint of the Internet. Science fiction writers are people who stretch their imagination to reach wild extremes, yet were unable to even dream of the Internet! This means that the future may be so different from today that we are unable to guess what will be. It means that we have to train our gifted students to learn how to think correctly in order to best deal with the world.

We have failed in the past. We have not educated our students in knowing how to do technical work in an industry setting so that they can build defenses like anti-missiles or JSTARS, and consequently, our country is in grave danger. The future may be even scarier. Our responsibilities as educators are serious!

Here is a thought of a possible future:

In 30 years, computers will be smarter than people. Will we say they are alive, as they will be built out of DNA, and grow by neural training? We may be able to create such "living" entities that will live forever, for when parts wear out, they are replaced, but the memory is intact. These "beings" will be networked together via the Internet. The science fiction android is not an independent entity, but part of the monolith. Will they be like angels from Heaven, very intelligent, can do no evil, fully interconnected with other angels? There is no way we can kill this monolith, as each part is connected to each other, and we cannot kill the entire system. We will have created a new life form that we will not be able to destroy. We must at least be aware of what we are doing, and the possible dangers, before it is too late. Maybe life exists elsewhere in the universe, in the form of such monoliths.

There is a lot more one can say on this topic, e.g., brain implants, all interconnected via the Internet. Will computers be able to control large numbers of people via the implants? What about warfare, where an enemy would easily fry all electronics in a city? How will our students deal with these situations when they become adults? We do not know the answers. We can only help them learn how to think, so that they can get information and rationally analyze options. What we want to do is to help our students to learn how to think.

Science helps humanity. Science teaches us how to be a master over nature. We can change things, and make them better. Yes, things can and do go wrong, with the result that scientific progress is harmful. The goal is to study and understand how to avoid the dangers, and to make things better. We must teach our belief of science and progress, and try to avoid defeatism, which has turned many away from science. The scary thoughts about the future, along with bad experiences from the past, make it imperative that we try to push for an understanding of the world using science and mathematics, to help prevent bad things and to increase opportunities for good things.

IV. How to Teach

Here are some brief ideas on how to teach, especially gifted children: **We must understand the material we are teaching.** We have to have an open and questioning mind. In particular, we have to understand the foundations, the basis, of mathematics and science.

Here briefly is what I feel the foundations are: *Mathematics is logic, based upon arbitrary assumptions, with the sole requirement of consistency.* Students frequently do not understand what the word arbitrary means. It means that we can say anything we want, as long as we are making sense and do not contradict ourselves. Isn't it fun to say anything you want? Math is fun!

Some teachers simply instruct the students on how to do the math problems, without giving them the basic understanding. If they do the work, the teachers are happy. Sorry to disagree! Students must understand that math is logic!

Science is noting the agreement of the chosen mathematics with experiment and observation. The books that I have seen are not careful with this distinction, and this hurts students. We build our logical systems, and then examine the world to see how much our logic agrees with the world. Science is then selected mathematical systems along with reports of observations and experiments.

We have to understand this ourselves. When we teach, we have to start with these explanations.

We have to start from the beginning. For example, if we discuss quadratic equations, we must first ask the class what equations are. (Answer: Something that contains an equal sign.) We then explain the word quadratic. In every discussion, we have to make sure that the beginnings are fully clarified. I have noticed when attending seminars for mathematicians or scientists, the beginnings of seminars are usually full of questions. People focus on the beginnings of what is being discussed. We teachers must also make sure that the beginnings are clear.

You have to think about the subject before class, and ask yourself if the material makes logical sense. If it does not make sense, you can be sure that a gifted student will ask you. At least try to anticipate the questions! Okay, you are prepared. You understand the material. How do you conduct yourself in class explaining things?

While talking, watch their faces carefully. If you see any signs of puzzlement or disinterest, then stop and ask them what they are not sure about. You have to give attention to your students, and treat them with respect. You have to find out just what they understand and what they do not understand.

- Everything you say must be followed by an example.
- Try to present the same idea in different ways.
- Your goal must be their improved understanding of the concepts.

Look at their written work, both homework and on the board. Insist that the work be neat; there be no ambiguity in symbols such as between small L and 1. If they make too many mistakes, cross out the work with a single diagonal line. Insist that all math work be done with only one step at a time. This may require much more paper. Finally, I personally never write on the other side of a sheet, as this way I can look at two sheets at the same time.

Finally, be happy and optimistic, and try to keep the students happy. We learn the best when we are relaxed and happy. This is similar to the need to be relaxed while eating. Both the stomach and the brain function best when we are relaxed. This means we can be playful with the ideas.

What are the teacher's goals? It is not to explain to the students all the material that they are expected to cover, for this is impossible. It is not possible to cover properly in class all the material that they will be tested on. Instead, the goals are to teach them how to:

- study
- think about mathematics
- enjoy the subject and to be creative in their approaches
- learn to read word problems
- work together
- know how to properly check their work
- work neatly
- take tests.

Once they have the proper background and know what to do, they will be able to cover on their own the material that the teacher had to rush over or skip altogether. The classroom environment can be designed to meet these goals. When examining their work, the teacher should note if the work is neat or not. Ask them how they checked, and how do they know the answer is right. Discuss the homework with the entire class. "John did a good job by quickly checking the work by doing..." When they say something creative, praise them, tell them they must continue.

An example lesson in mathematics is that the teacher explains the concept of *x-intercept*. This is the point where a line intercepts the *x*-axis. The next thing explained is *y-intercept*. Rather than explaining these two ideas in sequence, the teacher can explain the first, clearly drawing a diagram. Then she can ask the students, does every line have an *x-intercept*? The answer is clearly no, for horizontal lines have either 0 or an infinite number of *x* intercepts (if the line is the *x*-axis).

Next, the teacher can ask what the students can generalize. Let a student suggest the idea of the *y-intercept*. This way the student not only learns the concept, but also learns how to think and approach mathematics. This self-thinking is critical if the student is to be able to review all the required material, including material not covered in class. This approach, furthermore, helps clarify and impress the ideas, and will help them do problems.

Behavior of the Gifted Student. An excellent student, well behaved, gets along with everyone else, eager and enthusiastic. All that you have to do as a teacher is to properly explain the material. Sure! You wish! How about this scenario: The student comes into the math class, sits on a swivel chair in the back, and starts spinning around. Other students talk loudly, and are not interested in you, the teacher.

The students want to play. Play with them for a minute or so, turning the play around to an educational topic. For example, with the student spinning on the chair, I told him to stretch his arms out, and I would spin him. Then he should bring his arms in. He would notice that the spinning increased. This is due to conservation of angular momentum. After that, the students sat down and eagerly participated in the lesson.

V. Help

The intelligent person reaches out for help from any source possible. High school teachers can benefit by getting university professors to help them. There is an unfortunate schism between high schools and universities. If the teacher approaches the professor with an open questioning mind, asking the professor for help in understanding an idea, the professor will respond favorably. The questions can be done in person or via email. It may help to go to university seminars occasionally, and socialize during the pre-seminar teas. Professors are interested in logic

and ideas, and if you can discuss matters of logic and ideas, you may find a very receptive and helpful response.

Once a teacher is aware that a student is gifted, it would be best to confer with others how to best conduct the class. This is a challenge for the teacher, and the teacher should try to get help and advice from others.

VI. A Personal Experience

Here is a personal experience I had with a gifted student. I will call him John, which is not his real name.

I have known John for the past several years, and am very impressed. Last week I was teaching a practical math class. To my surprise, I saw John there. I sat next to him and started talking. I asked him what he was doing there. He said that he failed a math course, and so was required to take this course. I asked him why he failed. He said he was bored. I discussed boredom with him. I told him that if he knew what was going on, he should quietly do something else. It does no good to pay attention if he already knows what is being discussed. He should occasionally listen up for there may be a new idea being discussed. I told him that I understand how he feels, as I was a gifted child in school also. I feel happy that I was able to talk to John, and help set him on the right track. Losing a brilliant mind like John would be a serious loss for society.

Teachers need to be alert to students who are very superior, and to treat them differently. It is sad that John's teachers last year did not see his potential and permitted him to fail. Parents of gifted children need to inform teachers so that the teacher can do what can be done.

Again, just as the intellectually challenged students need special treatment, the intellectually superior student needs special treatment. Well, I told John that he should do today's assignment, which will be easy and quick for him, and then go to something else.

VII. Literature on Teaching Gifted Children

There is a lot of material available on this subject. The writing is voluminous. The teacher needs to absorb and remember a few key ideas. It is not possible to teach, think of the scientific ideas, watch the students, and simultaneously keep in mind the vast things written on the subject. You have to look at these writings, take notes that will summarize the ideas, and then focus on the summaries.

This is similar to the way students learn. A chapter in a geometry book will have many pages, explaining the ideas and giving examples. However, there are only two or three key ideas, set in colored frames, which the students must know. I tell students that after they went over the material, checking that they understood the ideas, they must go over the chapter, looking only at these few key ideas, and focusing their attention on these ideas. Teachers must do the same when reading the literature on education.

For example:

http://www.prufrock.com/client/client_pages/new_teachers_cfm

This article originally appeared in *Gifted Child Today*, 28(1), 22–23. Winter 2005.

A Message to New Teachers of Gifted Children (Prufrock Press) – Excerpts

By James R. Delisle, Ph.D.

“Some of your school's highest achievers are not gifted, and some of the most gifted children you will meet are not high achievers. . . .”

“All children in your school need an advocate—someone who believes in the irrefutable sanctity of their simply being individuals. For many students, your advocacy is easy: rewards for good work and behavior and an occasional ‘How's it goin'?’ in the hall. But, some of your gifted students will need something deeper and more personal. They will need you to believe in them when they, and others, don't. . . .”

“ . . . Caress this child emotionally; let him or her know that grades are a small and often insignificant measure of success. If your gifted students are caring, giving, introspective, and committed to relevant learning, they are more successful than are the straight-A students who possess none of these attributes. Yes, your advocacy efforts will also involve speaking to parents, educators, and community members about the needs of gifted children, but the front line of advocacy is that boy or girl in front of you who wants to be acknowledged and accepted as a human being, not just a ‘smart kid.’ ”

“ . . . When times get tough, politics get dense, budgets get cut, and criticism piles high, you have one place to turn that will always renew your spirit: the gifted children you teach. They look to you for wisdom and guidance; you need to look to them for support. If you get the privilege to know gifted kids who continue to connect with you long after they leave your classroom, then you will truly know what it means to be a teacher.”

Try to summarize this in one or two sentences. *Believe in your students, and accept them as people.* How is this a one sentence summary?

Here is another:

http://www.austega.com/gifted/articles/Rogers_researchsynthesis.htm

Research on Instructional Delivery: Projects, Independent Study, Hands On (from Dr. Karen Rogers Updates, 1999)

Gifted students demonstrate the following at a statistically significant level when compared to normal students: (1) Preference for self-structured tasks and self-imposed deadlines; (2) Preference for working on projects alone or with one like

ability peer; (3) Preference for self-instructional tasks (programmed instruction), games or simulations; (4) Greatest preference for independent study projects that are reading/content acquisition-based; and (5) Greater interest in learning "something new and different," rather than doing hands on things.

Research on Instructional Delivery: Pacing, Process Modifications (from Dr. Karen Rogers Updates, 1999)

(1) The learning rate of children above 130 IQ is approximately 8 times faster than for children below 70 IQ; (2) Gifted students are significantly more likely to retain science and mathematics content accurately when taught 2-3 times faster than "normal" class pace; (3) Gifted students are significantly more likely to forget or mislearn science and mathematics content when they must drill and review it more than 2-3 times; and (4) Gifted students are decontextualists in their processing, rather than constructivists; therefore, it is difficult to reconstruct "how" they came to an answer.

Effective Teachers of the Gifted (from Dr. Karen Rogers Updates, 1999)

Based on questionnaire data and needing more thorough re-

search, effective teachers of the gifted have the following characteristics: (1) High degree of intelligence, intellectual honesty; (2) Expertise in a specific intellectual or talent area (mathematics, writing, etc.); (3) Self-directed in own learning, with a love for new, advanced knowledge; (4) Equanimity, level-headedness, emotional stability; (5) A genuine interest in, liking of gifted learners; (6) Recognition of the importance of intellectual development; (7) Strong belief in individual differences and individualization; and (8) Highly developed teaching skill and knowledge.

Student responses suggest effective teachers of the gifted need to: (1) Be patient; (2) Have a sense of humor; (3) Move quickly through material; (4) Treat each student as an individual; (5) Avoid being a "sage on the stage" all the time; and (6) Consistently give "accurate" feedback.

Homework for you, the teacher. Summarize these in one or two sentences. If you cannot, it means you do not get the point. Now you know how students feel when assigned homework! You thought you were just going to sit back, relax and read. No! You have to work!

NCLB Implications of Identifying and Teaching Gifted Students

Stephanie Giese

Teacher of the Gifted Hillsborough County Public Schools Tampa, Florida

No Child Left Behind (NCLB) is a controversial piece of legislation that has left many educators with questions that seem difficult to answer since the law was passed in 2001. Particularly in the field of gifted education, questions often seem to be piling up, and for educators one question stands out among the rest. How does this law affect our teaching? Especially for teachers of gifted students, it may present a challenge, but there are many things that we can do within our own classrooms to benefit those children.

In order to understand how NCLB applies to gifted education, one must first examine the legislation as it applies to the general classroom setting. This can be a difficult task in itself because the application varies from state to state. Throughout the country all states must place highly qualified individuals in the classroom, and all states must make adequate yearly progress towards having all of their students working on the proficient level. However, each state determines for itself what its definition is for "proficient" students.

This puts most schools in a position where they need to focus their resources on low-performing students in order to make adequate yearly progress (AYP). In an interview published on the web site for the National Association for Gifted Children, Jane Clarenbach, who is the NAGC Director of Public Education and Affiliate Relations, stated: "... The punitive nature of the

law forces local school leaders all too often to make resource choices to address the needs of one group of students—those performing below 'proficient' on a statewide test—at the expense of students already performing at the proficient level. NCLB does not provide incentives or rewards for districts doing a great job of working with above-proficient learners. . . ."

For gifted education, no state has a federally funded program in place within the public school system as compared to special education. But it is important to recognize that despite a lack of extensive federal funding, many states do offer gifted and talented classes or enrichment opportunities for gifted students which are funded locally or through state grants or limited federal (Javits) grants. For those states that do serve academically gifted students, the program qualifications vary. Because there is not a national program in place for gifted education, there are many discrepancies from state to state.

In Florida, a state with mandated gifted education programs, students are recommended for screening by either their teachers or their parents. They are screened using a standardized intelligence test. If they score high enough on the screening test, they are recommended for further testing by a qualified psychologist. It is a rigorous, but unique process in that Florida recognizes the achievement gap and provides a criterion for lower test scores from students with lower economic status (as