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Out of School Science Programs for Talented Students: A Comparison

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Abstract. Six categories of out of school science programs for talented students are described in relation to six criteria: method of selection, goals, structure, benefits, drawbacks, and predictions about participants' future in science. The context for development of this analysis is described as well as suggested directions for the future.

1. Background

The Center for Psychology in Schools and Education (CPSE) at the American Psychological Association promotes the high quality application of psychological science to education programs and policies. The mission of CPSE is to generate public awareness, advocacy, clinical applications, and cutting-edge research to enhance the educational opportunities for students at all levels of schooling. The Center is made up of four offices that enhance the mission of CPSE:

- *Post Doctoral Education*: PhD students in psychology are very well trained in research methodology and in theories of teaching and learning. Their work, however, tends to take place in laboratories or in one-on-one clinical settings. This program matches outstanding new psychology PhDs with experienced education researchers for a two-year apprenticeship conducting research in schools.
- *Optimizing Student Success with Reasoning, Resilience and Responsibility:* These attributes enhance student engagement in school and in academic achievement. A team of researchers and expert public school teachers organized by CPSE

developed a teacher-training program that infuses Reasoning, Resilience, and Responsibility into 3rd grade mandated curriculum in local public schools.

- *Coalition of Psychologists:* Within the discipline of psychology, one can find over 50 sub-disciplines, with often conflicting goals. CPSE hosts a coalition of psychologists from 11 sub-disciplines to focus on common concerns related to teaching and learning in schools.

2. Center for Gifted Education Policy

The fourth office in CPSE is the Center for Gifted Education Policy. The following activities define its mission:

- *Continuing Education for Psychologists*: These sessions offer awareness training to psychologists who wish to expand their services to gifted children, adolescent and adult clients.
- *Prototype Talent Development Programs*: The Gifted Center has created two evidence-based out-of-school programs for talented adolescents. The Young Scholars Social Science Summit is a one-day program focused on social science research methods. A second program, the Pinnacle Project, will be described in more detail later in this chapter.
- *Advice to Parents, Teachers, and Psychologists*: This advice is delivered through two channels. One is the CGEP listserv, which includes over 350 participants from around the world. The listserv offers a place to post announcements, queries, and requests for research subjects or good scholarly references (to join contact Jason Gorgia at jgorgia@apa.org). The other channel is through the CGEP website (www.apa.org/ed/cgep.html). In addition to describing the Center's activities, the website lists references to various organizations in our field and the tables of contents for major journals in gifted education.

3. Experiences and Background with Out of School Science Programs

Often I am asked for advice from parents, teachers, and psychologists about placement of gifted adolescents in out of school talent development programs. I have developed a set of criteria by which I offer my advice, taking into account the needs of the student and the benefits of the program. The judgments are also based on the following activities I have been intimately connected with.

- *Westinghouse Science Talent Search Study* [1]: A 13-year longitudinal study of students who won the most prestigious science award in the US. The winners were selected on the basis of a research paper and a set of interviews with eminent scientists.
- *Evaluation of Olympiad Studies* [2]: We reviewed studies conducted by scholars around the world regarding the background variables of participants in the Olympiads as well as some measures of the reported effects of Olympiad participation.
- *Pinnacle Project* [3]: Conducted for three years (2001-2004) as an intergenerational, interdisciplinary mentorship program, the Pinnacle project

addressed high level talent in the sciences, and also in the arts and professions such as journalism.

- *Comparison Study* [4]: In collaboration with the College of William and Mary, CGEP explored differences between participants in an out of school research science program and an Olympiad-type program with regard to school and home support and preparation.

4. Six Models of Out of School Science Talent Development

From a review of programs offered at the 2004 NATO-UNESCO Advanced Research Workshop on Science Education: Talent Recruitment and Public Understanding, as well as the programs widely promoted to students in the United States, I have identified six categories of out of school science experiences.

- *Kitchen science – conducted informally at home alone or with friends. Usually involves chemistry or rocketry.*
- *Olympiads and other test-based competitions*
- *Science research programs*
- *Intergenerational, interdisciplinary programs*
- *Intensive summer courses*
- *Science clubs*

5. Six Dimensions of Analysis

When considering each program for an individual student, I consider the following criteria:

- *What is the selection process for the program?*
- *What are the goals of the program?*
- *What is the structure of the program?*
- *What the main benefits of the program?*
- *What are the main drawbacks of the program?*
- *What predictions might we make about the effects of the program on participants?*

6. Brief Analyses by Program:

Kitchen Science:

- *Selection:* Self-selection by an individual on his or her own (with or without family or friends)
- *Goals:* The purpose of Kitchen Science is to fulfill curiosity and to have fun exploring various materials and interactions.
- *Structure:* None
- *Benefits:* The explorations are conducted in the context of every day life and can feed a lifetime of curiosity about scientific matters. Occasionally, a kitchen experiment may lead to an invention that brings profit to a young scientist.
- *Drawbacks:* Unless the activities can draw the attention of a mentor, the depth of scientific exploration can be limited. Further, without a mentor, it is difficult to

find out about career paths, out of school programs and higher education opportunities.

- *Predictions:* Some of the most accomplished scientists began their lives in science in this way. Other kitchen scientists enjoy playing around but lose interest when the more tedious aspects of conducting science, including required academic coursework, take a larger role.

Olympiads and Other Competitions:

- *Selection:* Is conducted on the basis of a series of increasingly more difficult tests
- *Goals:* Capitalizes on the joys and challenges of competition experienced by athletes
- *Structure:* Top scorers on first test are invited to sit for next test. One or two additional tests winnow down participants to approximately 20 who attend a ten day or two week intensive preparation for international competition. Five or six team members are selected for international competition based on performance at the camp.
- *Benefits:* Competition serves as a motivator to learn a tremendous amount of information. Students meet others who enjoy both fast paced competition and the sciences.
- *Drawback:* The practice of preparing for speedy solution of given problems does not provide realistic preparation for scientific careers.
- *Predictions:* Because of the drawback listed above, it is best to also experience a Science Research program in order to get a more realistic sense of science as a career.

Science Research Programs:

- *Selection:* Selection tends to be based on a variety of sources including essays, standardized test scores, and teacher recommendations.
- *Goals:* To serve as an apprenticeship in the techniques, knowledge, and values of science research.
- *Structure:* Intensive involvement in an active professional scientific endeavor. Often relevant coursework is provided as well.
- *Benefits:* Participants learn that scientific efforts are complex and do not always lead to success. They also get a realistic picture of careers in science research as well as socialization into the value system that supports retention in the field.
- *Drawbacks:* Programs select willing mentors who open their labs to adolescent scientists and provide them with attention and support. But too often, the transition into higher education leads to disappointment when lab heads are not interested in collaborating with anyone below graduate school level.
- *Predictions:* If students maintain their interest through the first two years of undergraduate education, they are likely to make a successful transition into science research careers.

Intergenerational/Interdisciplinary Pinnacle Project Model:

- *Selection*: Eminent mentors in seven or eight disciplines in the arts and sciences provide criteria for what they think a talented adolescent should have accomplished at this point.
- *Goals*: Providing an environment and relationships to stimulate intellectual and creative growth leading to path breaking work.
- *Structure*: A summit including meetings with mentors in one's field as well as in other disciplines. Over course of summit and following year, teams conduct intensive work on a project as well as expose one another to path breaking work in other disciplines.
- *Benefits*: An expanded view of giftedness across various disciplines in the arts and sciences as well as a more sophisticated world view borne from exposure to frontiers of various fields and disciplines.
- *Drawbacks*: Funding challenges to support such an elite program. Adults get so excited by the interdisciplinary activities, that adolescent participants can struggle to be heard.
- *Predictions*: Offers a path to eminence with some detours in other fields.

Intensive Summer Courses (contributed by Harald Wagner, Bildung und Begabung e.V., Bonn, Germany):

- *Selection*: Selection is based on a combination of standardized tests and/or school recommendations.
- *Goal:* Provides challenging coursework and social opportunities with like-minded peers and inspiring teachers; fostering autonomous learning, knowledge production and teamwork; improvement of oral presentation techniques and scientific writing.
- *Structure:* Courses of one to several weeks duration provided in diverse academic areas at each site. Extensive leisure time is available for sports, music, excursions, discussions, socializing etc.
- *Benefits:* Long lasting contacts and friendships in an alumni network; realistic assessment of and increased confidence in one's own abilities; improved motivation, cooperativeness and communication skills.
- *Drawbacks:* Relatively expensive to participate, unique "hot house" experience that has no chance for continuation in "real life," sometimes making return to school a painful contrast.
- *Predictions*: Increased academic and social self-confidence provides a valuable bridge from school to university.

Scientific Clubs (Contributed by Tamas Korcsmaros, Hungarian Research Student Association):

- *Selection*: Individuals create a group based on mutual interests in science.
- *Goal:* The clubs allow for sharing scientific knowledge and help in solving problems encountered in members' projects.
- *Structure*: Like any friendships established around mutual interest, the structure can vary from none to a lot, depending on the projects and the personalities of the participants.

- *Benefits*: Provides members with partners for discussing new and creative ideas, dealing with successes as well as disappointing project results, and advice on publication and other desired outcomes.
- *Drawbacks*: The intensity of the relationships can enhance the likelihood of budding romance. When these romances end, the group camaraderie can be affected.
- *Predictions*: Can lead to lifetime friendships that help to maintain vocational or avocational interests in science.

8. Future Directions

- The status quo: Maintaining the profusion of models stimulates creative approaches, many options for different students, and exciting findings for use in research on talent development and recruitment.
- It might be useful to develop a compendium of existing programs in each category (and add categories as they emerge) for use by teachers, students and parents.
- We could also take a harder look at the strengths and weaknesses of each program design and make adjustments. Some of the programs have been in place and successful for such a long time that change is not viewed as a valuable pursuit.
- The field of talent development would be much enhanced if we could commission a longitudinal comparison study of the career choices and success of participants of each type of program.
- Generate some proposals for policy makers for out-of-school and in-school talent development and recruitment based on best practice conducted in exemplary programs. Policy makers might consider integrating some of the successful practices from each type of program into the school curriculum and schedule.
- Convene program leaders, funders, and policy makers to explore ways of expanding and sustaining successful models in and out of school.

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Introduction

The Korean Gov
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