Pursuing Diversity at State-Supported Residential STEM Schools

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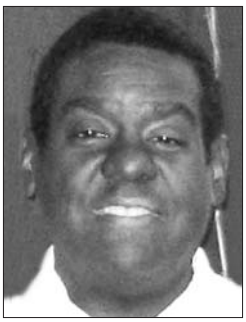

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Roughly 80% of the math and science schools under the NCSSSMST umbrella are non-residential programs, with about 18% residential and 2% both residential and nonresidential (Atkinson, Hugo, Lundgren, Shapiro, & Thomas, 2007). Now numbering 16 (with the Tennessee Governor's Academy closing May 2011), the state financed residential schools provide advanced instruction to talented teens interested in STEM careers. The schools are clustered in the Midwest, South, and Southwest, and for brevity, references to these institutions will employ state names only.

As Table 1 shows, the residential schools are categorized as either advanced high schools, following the original North Carolina model, or as early college entrance academies following Texas.

Table 1: State-Supported Residential STEM Schools

Advanced High Schools	Early College Entrance Academies
North Carolina School of Science and Mathematics (1980)	Texas Academy of Mathematics and Science (1987)
Louisiana School for Math, Science, and the Arts (1982)	Advanced Academy of Georgia (1995)
Illinois Mathematics and Science Academy (1986)	Georgia Academy of Mathematics, Engineering, and Science (1997)
Mississippi School for Mathematics and Science (1987)	Missouri Academy of Science, Mathematics and Computing (2000)
South Carolina Governor's School for Science and Mathematics (1985)	Kansas Academy of Mathematics and Science (2006)
Indiana Academy for Science, Mathematics and Humanities (1988)	Carol Martin Gatton Academy of Mathematics and Science in Kentucky (2007)
Alabama School of Mathematics and Science (1989)	
Oklahoma School of Science and Mathematics (1990)	
Arkansas School for Mathematics, Science, and the Arts (1993)	
Maine School for Mathematics and Science (1993)	
Tennessee Governor's Academy of Science and Mathematics (2007)*	
*May 2011 Closure	

Four of the schools serve students in grades 10 through 12, the remainder in grades 11 and 12. Enrollments range from 66 at Kentucky to 650 at Illinois. State appropriations cover tuition and books, and nine schools grant room and board waivers with financial aid available at the other seven.

Several authors have detailed features of the schools (Cross and Miller, 2007; Jones, 2009; Muratori, 2007; Olszewski-Kubilius, 2010). The core curricula are very similar as all provide instruction in college-level mathematics chemistry, physics, biology, English, and social studies, with only credit hour differences. Twelve of the 16 schools have a foreign language graduation requirement; 10 require art, music, or drama; nine require health and physical education, and 10 have business or technology requirements. Beyond the demanding core, students may choose electives that expose them to rigorous study in other fields.

Entrance criteria also are similar and in most cases, admission is limited to state residents. Complete files will contain transcripts, essays, awards, honors and activities, teacher evaluations, and standardized test scores. Seven of the residential STEM schools accept the SAT or ACT, while others accept either the PSAT or the PLAN, a pre-ACT product. Only four schools publish minimum score requirements on Web pages, but all expect high aptitude and motivation. In addition, 11 schools conduct pre-admission interviews including two that interview applicants' parents as well.

As state-supported entities, the schools seek to enroll classes as diverse as their states. Table 2 presents enrollment statistics for 2008, the most recent year in which data for all the schools were available. The table shows the extent to which first year enrollment (i.e., admits) at each school compares to the corresponding state ethnic proportions.

Table 2: 2008 Enrollment by Racial and Ethnic Group[1]										
	Caucasian		African-American		Hispanic		Asian		Native American	
	Admits	State	Admits	State	Admits	State	Admits	State	Admits	State
North Carolina	65%	74.1%	12%	21.9%	3%	5.6%	18%	1.7%	1.0%	1.3%
Louisiana	78%	64.2%	10%	32.9%	2%	2.6%	7.0%	1.4%	--	0.6%
Illinois	44.7%	79.5%	9.7%	15.2%	4.6%	13.6%	32.7%	4.0%	--	0.3%
Texas	37.9%	52.4%	8.3%	11.6%	6.8%	31.9%	46.0%	3.1%	1.0%	0.7%
Mississippi	57.0%	61.2%	23.0%	36.9%	1.0%	1.5%	18.0%	0.8%	--	0.4%
South Carolina	78.0%	67.7%	8.0%	30.0%	--	2.8%	12.0%	1.1%	--	0.4%
Indiana	67.8%	88.9%	5.3%	8.6%	2.6%	3.9%	7.2%	1.2%	--	0.3%
Alabama	61.7%	71.3%	25.9%	26.4%	1.8%	2.0%	6.9%	0.8%	0.7%	0.5%
Oklahoma	67.9%	78.4%	2.6%	7.9%	2.6%	5.7%	15.4%	1.6%	11.5%	0.8%
Arkansas	82.4%	81.0%	5.0%	16.2%	3.1%	3.7%	8.2%	0.9%	1.3%	0.7%
Maine	90.0%	97.1%	5.0%	0.6%	--	0.8%	5.0%	0.8%	--	0.6%
Georgia (GAMES)	73.6%	67.5%	7.5%	28.7%	5.7%	6.2%	13.2%	2.4%	--	0.3%
Georgia (AAG)	61.0%	67.5%	21.0%	28.7%	0.2%	6.2%	7.0%	2.4%	--	0.3%
Missouri	90.0%	85.3%	4.4%	11.6%	--	2.3%	3.3%	1.3%	2.2%	0.5%
Kentucky[2]	84.8%	90.3%	6.0%	7.6%	--	1.7%	9.0%	0.9%	--	0.2%
[1]Totals may not equal 100% due to rounding. Hispanic may include any race.										
[2]Kentucky values represent 2009 figures.										

Great effort is expended pursuing diversity, although Table 2 spotlights enrollment gaps. Admission personnel frequently are charged with narrowing the gaps. An organization formed at Indiana in 1996, the Association of Consortium Admissions Representatives (ACAR), sponsors summer conferences and teleconferences for data sharing and brainstorming, and much of the information in this summary was gathered on such occasions.

This précis is descriptive rather than evaluative. Diversity at most of the state STEM schools is understood broadly to encompass inclusion by ethnicity as well as by region, socioeconomic status, and gender. Specific initiatives are tailored to underrepresented targets, while general strategies such as field visits apply to constituencies at large. The reasoning is that casting a wide recruiting net will capture a percentage of students representing the state's entire economic and ethnic spectrum. Table 3 lists common recruitment activities.

Disseminating Information

Brochures in tow, itinerant recruiters crisscross the state in a ritual one might have thought outmoded in this era of networks and mass communications. Inefficiencies in fact are considerable. Admission staff turnover is high as tours can be tedious and frustrating with cancelled or delayed flights, detours and wrong turns, highway construction, and other vagaries of travel. Statewide outreach is emphasized because geographic diversity is desired. North Carolina is even legislatively mandated to admit equal numbers of students from each of the state's 13 congressional districts. Oklahoma similarly enrolls students from each of the state's 77 counties.

Tours can be quite involved, as illustrated by over 100 stops per season by Arkansas personnel. Louisiana's extensive community meetings will have assistance from students or alumni living locally. To accommodate working parents, state STEM school sessions often are held in the evenings. Attendance is unpredictable and frequently disappointing, with up to 40% marked by low turnouts or no-shows. Hence, care needs to be taken to avoid scheduling against, for example, the World Series, although one cannot know weeks in advance that a severe thunderstorm will deter attendance. Presentations also have been

Table 3: Common STEM Recruiting Activities	
Activity	**Evaluation and Benefit**
Web sites	Wide public access; marketing
Preview days	Open house inspections; direct questions addressed
Spend-a-day	Shadow opportunities popular with applicants
Direct mailings	List-providers segment market to client specifications, enabling focused contacts; information provided via DVDs, view books, and correspondence
College fairs	College, community college, and health professions fairs designed mostly for juniors and seniors seeking postsecondary options; less suited to sophomores.
Phonathons	Have dramatically elevated interest at certain STEM programs
Financial aid counseling	Of prime interest to many families
Parent, alumni groups	Marketing value proportional to energy and degree of participation
Teleconferencing	Beneficial information shared among admission reps; cross-fertilization of ideas
Print advertising	Ineffective without adequate budget
Counselor and teacher conventions	Has merit; limited by access and availability of conferences
Radio, TV interviews	Cost-prohibitive; on-air opportunities infrequent
Focus groups	Insightful observations contributed
Field visits	Often inefficient, but variety of potential destinations including chess tournaments, science fairs, education service centers, middle and high schools, professional conferences, etc.
Teacher appreciation banquets	Acknowledgement and validation of teacher contributions; public relations benefit
Toll-free number	Hot line improves access to admissions personnel
Candidate nominations	Students, teachers, counselors, professional group representatives, and alumni occasionally submit names of promising candidates. Not a consistent source.
Summer math programs	Help identify talented prospects; improve academic skills

marred by such unforeseen developments as locked venues, unlit parking lots, and late arriving audiences. Implausibly, latecomers have asked STEM speakers if they would repeat their entire presentations.

For daytime events, school schedules need to be kept in mind. Recruiters have faced vacant assembly halls because students were preparing for finals. Others have been interrupted by class change alarms, public address announcements, and even televisions suddenly powering on with educational programming. Another misfortune is being assigned to an isolated side room, or to the lunchroom where students are preoccupied with dining and socializing, not hearing a visitor.

Many counselors and teachers do support STEM initiatives, some enthusiastically so, but by no means are math and science representatives welcomed on all campuses. At one point, STEM representatives were barred from a Dallas school where high achieving minorities were enrolled. Other principals who oppose the exodus of high performers to the specialty schools likewise have denied recruiters access to their classes. On rare occasions, educators have asked to be removed from mailing lists. Students may be caught in the delicate position of needing a recommendation from a philosophically hostile teacher.

Recruitment circuits have been mainstays because few other options are available for face-to-face meetings with talented freshmen and sophomores. With new technologies, however, this touring tradition may be phasing out. The economic downturn also has exerted effects, as South Carolina recently cancelled statewide travel. Commenting in *The Chronicle of Higher Education*, a former admissions dean dismissed tours as "certainly not a cost effective way to do business." (Hoover, 2008, p. A1).

Recruitment Opportunities

While thousands of juniors and seniors are drawn to college fairs, no comparable events exist for younger students. Instead, STEM counselors must aggressively find opportunities, such as appearing at chess tournaments, meetings of state gifted and talented organizations, at minority professional societies, and at math and science teacher conferences. A phonathon utilizing STEM student callers led to increased applications at several schools. Oklahoma recruits students at middle school mathematics contests. Recently, 90% of Oklahoma's applicants had participated in the math contests, attended open houses for eighth to tenth graders, or had shadowed STEM students.

In 1990, the Texas Academy began recognizing the critical role teachers play in educating youth

by hosting an annual teacher appreciation banquet. For 13 years, Texas Academy students invited hometown teachers who had been instrumental in their development to the elegant recognition ceremony. Recognized teachers and counselors have represented all ethnic groups and state regions. Accepting awards, teachers would occasionally admit having been disappointed their prized students enrolled at the academy. However, after witnessing the outpouring of appreciation, and observing the accomplishments of the student body, they sometimes reassessed their opposition. A state deficit-induced budgetary cutback in 2003 ended the cherished Texas banquet as a novel marketing initiative. Missouri's teacher recognition banquet, however, continues.

Recruitment ideas sometimes collide with budgets. STEM advertising has appeared in minority newspapers and other periodicals, but budgets disallow announcements in large circulation papers. In any event, a consultant advised that ads are effective only when appearing on the same page and section weeks at a time, which clearly is cost-prohibitive. As for special editions, STEM advertisements in back-to-school periodicals just get lost among a welter of public, private and parochial school, military, fashion, and technical institute listings. Finally, paid radio and television spots are out of the economic question. Admission directors have been interviewed on local television and radio, but such occasions are rare and difficult to arrange.

Within the past five years, efforts to attract applicants through Web sites have markedly increased. Several schools have revamped their sites by streamlining and overhauling navigation, and giving prominent attention to student activities and achievements.

Direct Mail

Direct mailings reach students identified through list brokers. Each year, the Duke University Talent Identification Program (Duke TIP) compiles names and addresses of students who have earned exceptional standardized test scores. Annual purchase of the Duke TIP list facilitates contact with unusually talented students.

The College Bound Selection Service and the National Research Center for College and University Admissions partition their databases to meet client specifications. The list providers can thus isolate students by ethnic group, region, or academic achievement so that recruitment letters can be customized to the targets. However, because recipients will discard most unrequested letters, mail must be sent in volume, including up to five spaced mailings to the same address. Repeat mailings are in response to STEM alumni who admitted that, as sophomores, they usually ignored first, second, and even third mailings before finally considering the contents.

Preview Days

An effective way schools showcase their institutions is through preview days that attract up to 250 families each occasion. Some schools also permit prospective applicants to shadow students for a day. Illinois not only hosts a preview day for general audiences but also one exclusive to under-represented minorities. The school also has instituted a December banquet honoring minority achievers. Direct mail is addressed to minority churches and recently, Illinois opened field offices in Chicago and East St. Louis with staffs dedicated to attracting minorities.

Summer Math Programs

Some of the longer established STEM schools operate weekend or summer programs that introduce potential students to expectations and thereby serve as prospect pools. Examples:

- Illinois' Virtual High School and Early Involvement Program help economically disadvantaged students improve science, mathematics and English skills.
- South Carolina hosts a summer residential program for rising eighth through tenth graders. GEAR UP, or Gaining Early Awareness and Readiness for Undergraduate Programs helps low-income youth enhance academic skills and acquire financial assistance information.
- Texas' Summer Math Institute is an intensive three-week program for rising seventh through eleventh graders. An African American STEM

counselor has directed SMI since 2001, and years earlier, SOAR, or Summer Opportunities for the Academically Ready, enrolled talented minorities who scored in the 95th percentile on a standardized test. SOAR lapsed due to faculty and staff changes, but the Summer Math Institute flourishes after almost a decade.

- Through its extensive External Programs, North Carolina helps improve K-12 teaching, especially in rural and remote regions of the state.
- Maine operates a summer program for fifth- through ninth-grade students interested in math and science classes.
- Georgia hosts a Young Scholars Institute.
- Finally, Indiana sponsors Saturday Youth Programs for elementary and middle school accelerated learners who study astronomy, zoology, and other sciences.

Admissions Funnel

The admissions process has been conceived as an imaginary funnel. As thousands of potential applicants symbolically enter the top, their numbers are progressively and significantly reduced by a series of filters, such as described below.

Math and science interest. The 4,500 students who apply for roughly 2,000 residential school STEM seats each year constitute a sizable number, but not the groundswell some might imagine. One indication of general math and science interest in this country is that only 16% of college-bound seniors in 2009 planned majors in biological science, physical science, mathematics or engineering (College Board, 2009).

Gender. Because gifted females pursue scientific careers less frequently than gifted males (Benbow and Arjmand), females are included in diversity discussions. Missouri and Georgia post standardized score requirements on their Web sites. The 2009 PSAT score distribution tables suggest 21% and 17%, respectively, of female examinees in Missouri and Georgia would have met the score standard (College Board, 2009a & b). Sophomore tables were not available for other underrepresented groups.

Math. In Texas, tables indicate only 3.5% to 7.5% of sophomore examinees — a maximum of 10,000 students across all ethnic groups — meet the school's SAT-Math expectations in any given year. Thus on a single criterion, the applicant pool is sharply circumscribed with over 90% of potential prospects eliminated.

Parental consent. Students must seek parental consent for STEM applications and for some parents, the decision to assent can be wrenching, as suggested by a recent email: "My mom did not want me to go, as I'm her only child. In fact, she even tried to promise me a car if I stayed in my school's IB program." Interestingly, observers at one STEM school note how few of the high achieving sons and daughters of their faculty ever apply there.

Relocation resistance. Students themselves are not infrequently ambivalent about applying, even after extensive efforts to qualify. A survey of non-applicants to the Texas Academy revealed considerable hesitancy to leave family, friends, and school activities (Jones, Fleming, Henderson, and Henderson, 2002). As one self-described gifted respondent from Houston lectured: "Life without extracurricular activities such as band is boring! To lure me you would need a marching and symphonic band. No one just wants to go to school 500 miles away to study mathematics." Most teens are not purely interested in academics. Even after admission, students can have second thoughts. Ten of 200 Texas offers each year are declined. Reasons cited often involve unwillingness to forgo marching band, athletics, ROTC, and other extracurricular activities.

All Texas applicants are polled to determine what factors most encouraged them to apply, and results indicate ethnic differences. Hispanics and Caucasians, for instance, were most persuaded by recruitment letters from the admissions office, while African Americans and Asians were most encouraged by enrolled Academy students.

Expenses. The residential STEM schools provide tuition and books, but, at seven schools, families

are responsible for room and board and travel expenses. Financial aid is available, but awards sometimes are insufficient.

Issues of distance and cost are material everywhere, but especially so for schools in the large states. Prospects residing many hours away must make cost-benefit decisions and for many, the scales tilt toward remaining home where they are well respected and successful, rather than taking financial and academic risks at an academy.

Parental education. Student GPAs, standardized test scores, and class rank all are directly related to parental income and education (Camara and Schmidt, 1999). Some 30% of Texas Academy parents were recently found to hold graduate degrees, with occupations concentrated in the professions. The pattern held even for underrepresented minority families. Thus, to the extent an applicant's family does not fit a white-collar profile, admission chances would seem to diminish proportionally.

Course-taking patterns. Academic preparation varies by ethnic group. Asians are more likely than others to take advanced mathematics and science courses (Camara & Schmidt, 1999; Planty, Provasnik, & Daniel, 2007). Compared with their state numbers, Asians are overrepresented at all of the STEM residential schools (see Table 2).

In 2005, the College Board found that pre-calculus was taken by:

- 62% of Asians, but 32% of African Americans;
- 54% of students whose parents completed college vs. 37% of parents who did not complete high school;
- 52% of students with family incomes of at least $50,000 vs. 40% with lower incomes (College Board, 2005).

Over time as admission requirements have become widely accessible, fewer noncompetitive prospects are applying to the longer established STEM schools. Given all of the above, the applicant-acceptance ratio generally is no higher than 2:1 to 3:1 across the residential STEM programs.

Table 4 indicates the African American and Hispanic applicant and acceptance pools for residential STEM classes in 2008. Given the comparatively small sizes of the pools, the table suggests how challenging the earnest task of achieving significant diversity is.

Table 4: 2008 Ethnic Diversity at Residential STEM Schools

	First Year Seats	Admits	Pool (%)	Admits	Pool (%)
North Carolina	341	33	168 (19.6)	10	41 (24.4)
Illinois	250	23	67 (34.3)	10	18 (55.6)
Mississippi	140	23	43 (53.4)	2	3 (66.7)
Texas	200	5	30 (16.7)	15	58 (25.9)
Louisiana	174	14	?	5	?
Indiana	100	12	12 (100)	4	4 (100)
Arkansas	150	8	10 (80)	5	6 (83.3)
Oklahoma	70	2	7 (28.6)	2	4 (50)
Maine	57	0	?	0	?

Future Trends

Admission practices clearly are moving toward greater use of technology. Social networking sites have been posted by a number of residential STEM schools for several years. One STEM school has had online applications for nine years while others feature blogs, discussion boards, and answers to frequently asked questions. Already, Arkansas conveys admissions decisions via text message as well as formal letter.

Lindbeck and Fodrey (2009) surveyed four-year universities to identify current practices and future plans for expanded use of technology in admissions. Table 5 summarizes results.

The most frequently named technologies were social networking, Web sites, email and cell phones. The surveyed schools rated high returns on investment with:

- Email for targeted mass mailings and deadline notifications;
- Web sites for electronic applications, virtual campus tours, electronic catalogs, and for financial aid and housing applications forms.

Survey respondents purchased student email addresses for mailings while cell phones were

Table 5: E-Recruiting Trends and Technologies	
Technology	**Applications**
Email	Deadline and acceptance notifications; counseling; parent communications
Social networks	Communication, FAQs, relationship building
Web site	Electronic applications; financial aid forms, course registration, etc. creates wide recruitment base
Cell phones	Phone numbers purchased for tele-counseling, relationship building
Podcasts	Guided assistance with admissions process
Blogs	Stimulate conversations
Discussion boards	Points of view
Streaming video	Personal touch; real time access
Flash drives	Uploaded school information for distribution
Text, instant messaging	Counseling
Virtual campus tours	Permit observation without time or travel expenses

useful in teleconferencing and general relationship building. The respondents identified future plans as including text messaging to convey deadline notifications and acceptances, with podcasts helpful in guiding students through the admissions process. STEM schools are predicted to proceed along these same lines.

Discussion

The admissions office may be an applicant's first point of contact, but hardly the last. Prospects and their families consider far more than just the office's public relations pieces. They consider a school's reputation and its attrition rate, both overall and by categories. They inquire about its support systems, hidden costs, residence hall policies, and the success of its graduates. All have access to alumni discussion boards where candid evaluations appear. Therefore, in model STEM programs recruitment is a collaborative effort among faculty, administrators, advisory boards, admissions and financial aid officers.

Model programs also are noted for having measurable objectives. Strategies not data-driven can be random and unfocused, leading to misplaced effort and dollars. It helps, for example, to periodically determine public perceptions of the institution. Students who decline either to apply or to accept an offer should be surveyed to gain insight into their misgivings. A comprehensive admissions analysis also would track enrolled students over time, calculating rates of persistence and attrition while assessing the relationship between performance and entrance criteria.

The Texas Academy routinely surveys enrolled students to determine levels of satisfaction. Modified from the Student Adaptation to College Questionnaire (Baker & Siryk, 1986), the survey is used to evaluate policies and procedures and highlight areas needing attention.

Regarding entrance criteria, the residential programs observe rigid, semi-rigid, or flexible SAT/ACT thresholds. Those enforcing a score minimum are well served to determine the proportion of eligible prospects capable of meeting the standard each year. Schools less dependent on a set score will have more leeway in evaluations. Even the College Board which sponsors the SAT emphasizes performance should be interpreted by a score range rather than by a discrete number, and that scores should serve only as part of several admission factors. Academic achievement has been strongly linked to standardized test scores, but not invariably so. Differences in drive and motivation, among other factors, explain why a student with less competitive scores graduates with honors while a much higher scoring student underachieves.

Whatever the school's admissions policy, advisory committees should be clear about the feasibility of enhancing diversity in light of standards they charge admissions personnel with enforcing. Given the link between professional families and test scores, students of lesser means are at a statistical disadvantage in gaining admission. A privileged background, however, is neither necessary nor sufficient to assure achievement, and top performers are found across the economic spectrum. The issue is how best to identify and recruit such diverse talents.

The admissions group, ACAR, will continue data exchanges, seeking breakthroughs and innovative strategies that might help accomplish this goal.

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