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Articles

Direction Discovery

A SCIENCE ENRICHMENT PROGRAM FOR HIGH SCHOOL STUDENTS*

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Launch into education about pharmacology (LEAP) is an inquiry-based science enrichment program designed to enhance competence in biology and chemistry and foster interest in science careers especially among under-represented minorities. The study of how drugs work, how they enter cells, alter body chemistry, and exit the body engages students to conceptualize fundamental precepts in biology, chemistry, and math. Students complete an intensive three-week course in the fundamentals of pharmacology during the summer followed by a mentored research component during the school year. Following a 5E learning paradigm, the summer course captures student interest by introducing controversial topics in pharmacology and provides a framework that guides them to explore topics in greater detail. The 5E learning cycle is recapitulated as students extend their knowledge to design and to test an original research question in pharmacology. LEAP students demonstrated significant gains in biology and chemistry knowledge and interests in pursuing science. Several students earned honors for the presentation of their research in regional and state science fairs. Success of the LEAP model in its initial 2 years argues that coupling college-level coursework of interest to teens with an authentic research experience enhances high school student success in and enthusiasm for science.

Keywords: Inquiry-based learning, high school, pharmacology, constructivism learning, task-based learning, minority groups, science education.

The standard of living enjoyed by most western societies demands a workforce with increasingly advanced education in the basic sciences. Less than a decade into the 21st century, emerging challenges in energy conservation, global warming, drug-resistant pathogens, and personalized medicine illustrate the premium placed on continued graduation of skilled and innovative scientists. Yet, despite such demand for science-literate graduates, colleges and universities have experienced declining graduation rates for science and engineering majors over the last several decades [1]. There is considerable evidence that student attitudes and interest in the sciences are formulated before a student enters college. In fact, Tai *et al*. [2] have shown that students who develop science career aspirations as early as the eighth grade are more likely than their peers to succeed in earning a baccalaureate degree in science.

Initial attempts to enhance science education in the high school setting, including the availability of advanced placement courses in biology, chemistry, mathematics, and physics have met with mixed results. Though these more intensive "college-level" courses are consistently requested by students, they have not proven to be reliable predictors of success in college science [3]. In fact, benchmarks for college-readiness in biology suggest that U.S. students continue to perform significantly below the acceptable national standards [4], and as many as 10% of matriculating science and engineering majors feel the need for remediation in their chosen college disciplines [1].

Strategies to improve the high school science experience have focused on both the content and the manner in which it is presented. With regard to the latter, educators have adopted the 5E learning cycle [3, 5–8], in which science education is presented as a series of developmental steps that allow the learner to actively build conceptual understanding in science by integrating prior experience and first-hand knowledge [8]. This constructivist approach has been found to significantly improve student learning [9]. In terms of content, student performance in science classes improves when course material is viewed as relevant to their lives [10]. High school students are interested in topics such as their bodies, dis-

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Additional Supporting Information may be found in the online version of this article.

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TABLE I
Demographics of participant population (N = 47)

Gender	
Male	16
Female	31
Year in high school	
Sophomore	21
Junior	24
Senior	2
Self-reported ethnicity	
African American	19
Asian	6
Caucasian	16
Hispanic/Latin American	4
Other	2

ease, and drugs. Thus, several years ago, we developed a series of modules for high school teachers to teach basic principles of biology and chemistry in the context of pharmacology (i.e., drugs). The pharmacology education partnership (PEP) was field-tested with over 18,000 students nationwide, and the more PEP modules used by teachers, the better students performed in biology and chemistry [11, 12]. Our open-access PEP modules are now available for teachers (and students) at www.thepepproject.net.

Building on the strength of the PEP model, we developed and present here a high-school science enrichment program that utilizes 5E constructivist learning, integrates student exposure to career scientists in a research environment, and taps the potential for university resources to greatly augment classroom education. Launch into education about pharmacology (LEAP) at Duke University couples intensive coursework in pharmacology with a mentored, student-generated research experience, and exposure to a professional research environment.

METHODS

Participants

LEAP participants consisted of rising 10th and 11th grade students (as well as two 12th grade students) recruited from 31 public high schools across seven central North Carolina counties within a 40 min drive of Duke University. In 2006 and 2007, program announcements and nomination forms were mailed to biology and chemistry teachers at these schools. The teachers nominated students who had completed at least one course in biology and exhibited potential or interest in science irrespective of their scholastic performance. [About one-third of students entering the program had taken a chemistry course.] Each year, a total of 24 participants were selected from among 85 to 110 nominees on the basis of their teacher recommendation and a personal statement regarding their interest in learning science. The LEAP class demographics met or exceeded the population of under-represented minorities (URM) in North Carolina public schools [13] (Table I). Each year, the LEAP program staff included the Course Director, three graduate students or postdoctoral instructors and three undergraduate student assistants with an interest in teaching as a career. TAs were 16% URM and 83% female. Although no URM applied for instructor positions, 33% of instructors were female. Each of the staff functioned as mentors for the research component (see below).

The Program Components

LEAP includes two instructional components: an intensive summer course and a mentored research project completed during the subsequent academic year. Both components follow the 5E learning cycle to build conceptual knowledge of eight basic biology and chemistry concepts from a standard course of study including: 1) the physiochemical properties of a cell membrane, 2) mechanisms of transport of molecules across a cell membrane, 3) the nature of inter- and intramolecular bonding, 4) the nature of acids/bases, 5) concentration gradients and driving force, 6) structure-function of cellular organelles and nuclear material, 7) the role of an enzyme in a chemical reaction, and 8) designing and conducting scientific investigations. A schematic of our working model is shown in Fig. 1.

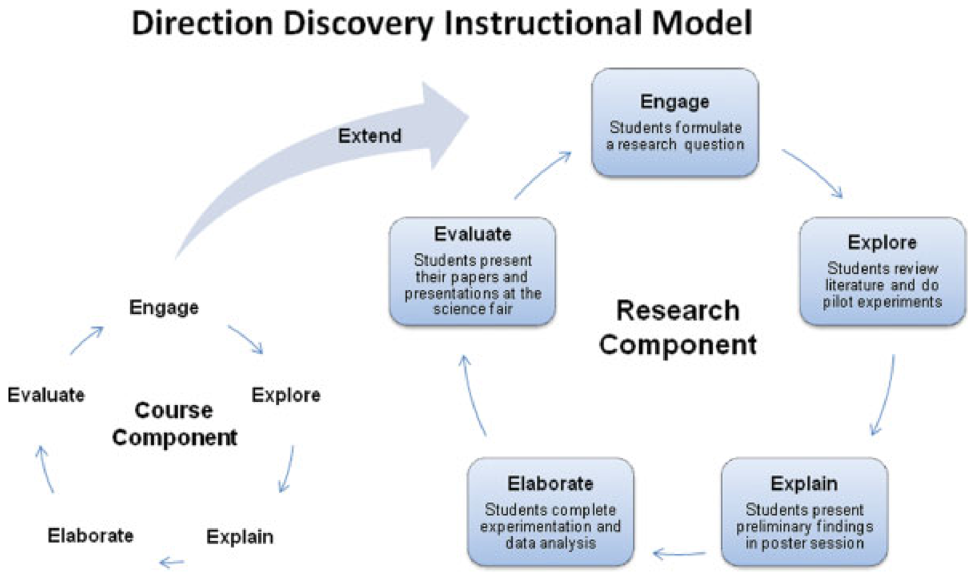

FIG. 1. **A working instructional model for the LEAP program includes a course and a research component**. The daily schedule during the summer course follows the standard 5E learning cycle. Students extend their learning beyond the classroom again as they complete a research project during the following academic year. The research component is designed to recapitulate the learning cycle with the student assuming more independence in the inquiry process. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

TABLE II
LEAP course content

Weekly theme	Daily topics	Sample class activities
Fundamentals in pharmacology	Introduction to drug targets	Drug name game; pharmaco-jeopardy
	Drugs in (*absorption*)	Research: acids, bases, and cocaine addicts[a]
	Drugs around (*distribution*)	Lab: aspirin crosses the membrane
	Drugs out (*metabolism and elimination*)	Research: athletes and anabolic steroids[a]
	Dose response and toxicity	Lab: caffeine and heart rate
Drugs and Disease	Cancer	Lab: tobacco as a bacterial mutagen
	Addiction	Lab tour: animal models of addiction
	HIV/AIDS	Debate: medical marijuana
	Obesity	Lab visit: fat rats
	Parkinson's disease	Movie and discussion: Awakenings
Bench to Bedside: Issues in Modern Medicine	Pharmacogenomics: personalized medicine	Lab: ADH—Drosophila
	Multidrug resistance: Malaria	Transmission game
	Ethnopharmacology	Discussion in the Duke Gardens
	Clinical trials/ethics in research	Movie and discussion: Ms. Evers' Boys (Tuskegee project)

[a] These class activities were developed and field-tested as part of the Pharmacology Education Partnership (www.thepepproject.net).

Pharmacology Course: Summer Component—Initially, students were introduced to pharmacology during a 3-week summer course (9 A.M.–4 P.M., Monday–Friday) at Duke University. Each week of the course featured a different theme in pharmacology (Table II). Topics in the syllabus, typically presented in undergraduate level classes, were presented using content and examples relevant to high school students. An introduction to fundamental concepts during week one included the mechanisms by which drugs work at their targets, and how they enter, travel through, and exit the human body. These same principles in pharmacology were reviewed in the context of familiar diseases during the second week, including two lab activities and class presentations. The final week of the course guided students to explore emerging issues in modern medicine, including personalized drug therapy, the business of treating third-world disease, and the ethics of clinical trials in medicine. The students also spent time in the lab learning some basic skills at the bench and performing pilot experiments for their research projects (see below).

The daily course structure followed the 5E's learning cycle model [5, 14]: a brief introductory presentation of the daily topic in the form of a question posed by the instructor (**engagement**), followed by an inquiry-guided investigation of the problem in a small group of four students and one staff (**exploration**). Students summarized their investigations with a presentation to their classmates (**explanation**) in which all forms of self-expression (oral, artistic, dramatic, and written) were encouraged. The afternoons included an opportunity for students to build on their new knowledge by designing and performing a laboratory experiment, formulating their own unique research project (to be carried out during the school-year), or interviewing a scientist with a working model of disease (**elaboration**). Each day concluded with a student self-assessment in the form of a concept map (**evaluation**) [15, 16]. The first week of classes, students were assigned a list of 10 concept words to incorporate into their maps; concept words were self-generated by the students in the second and third weeks. Emphasis was placed on using appropriate descriptive words and directionality of linkages to connect related concepts. Course instructors assessed linkages made between concept words using a scale of excellent, good, or inappropriate. Concept maps not only provided students a context for organizing new knowledge but also provided ongoing formative evaluation to the program staff.

Research Project: Academic-year Component—During the third week of the LEAP course, students developed their own research question that was pharmacology-focused and proceeded to write a hypothesis to test accordingly. The LEAP students were placed in the role of graduate students; they learned how to read the literature, choose an experimental method to test their hypothesis, write a research protocol, decide what supplies needed to be ordered, and consider "dose," concentration, and time in their experiments. With the help of the mentors, the experimental methods were chosen, from one of seven basic research platforms that we had developed for use by high school students. Examples of research platforms include, 1) use of qRT-PCR to measure expression of genes associated with inflammation, 2) DNA mutation-induced color change in bacteria, 3) cell (e.g., cancer cell line) migration assays *in vitro*, and 4) oxidative damage of zebrafish embryo neuromasts. Because of the limited time at the bench (see below), the predetermined research platforms were crucial—each had a measurable outcome. During the third week of the summer course, the mentors worked with students in small groups to carry out 1–2 pilot experiments to become familiar with their research platform and to practice skills such as volume/concentration calculations, pipetting, and behavioral scoring. The mentors attended a preprogram training session to become familiar with the research platforms.

During the academic year component of LEAP, students met with their mentors one Saturday each month from September through February for a total of 35–40 contact hours. During the Fall meetings, the mentors provided direction, focus, and resources as needed for the students' experiments. In addition, mentors provided guidance for students to analyze their results, address statistical issues, and make graphs of their data. The Saturday sessions in January and February were devoted to the preparation of research papers and LEAP student peer-review of oral presentations using powerpoint^{TM}. In the Spring, LEAP students presented their research at the regional and state chapters of the American Junior Academy of Science (AJAS) competition; they also submitted their research papers to the judges. At the competition, the judges provided each student with individualized feedback on their research, including the written and oral presentation of their findings. The feedback from the judges at the regional competition encouraged students to reflect on their research and to revise their work accordingly for advanced competition at the state level. A few students also presented their research again, at the regional and state science fairs. However, no organized feedback was provided.

Evaluation of Biology and Chemistry Knowledge

On the first day of the LEAP course, participants completed a pretest of science content knowledge. Eight concepts in the standard course of study for high school biology and chemistry were evaluated in a 10-item multiple-choice exam. Two sample questions follow below:

Q1. Protein synthesis proceeds in the following order:
  A. DNA is translated to mRNA, mRNA carries out transcription to a protein.
  B. DNA is transcribed to mRNA, mRNA carries out translation to a protein.
  C. RNA is transcribed to DNA, DNA carries out translation to a protein.
  D. RNA is translated to DNA, DNA carries out transcription to a protein.
  E. Don't know.

Q2. An acid that does not dissociate completely in water is called:
  A. a strong acid
  B. a weak acid
  C. ionized
  D. hydrophobic
  E. don't know

At the conclusion of the summer component, we administered a post-test that was identical to the pretest (questions were scrambled). In the second year (2007), we added a second post-test (post-test 2) at the end of the research component nine months later. Scores on the knowledge post-tests were compared with the pretest scores to assess the short- and long-term impact of the LEAP program on competence in basic principles of biology and chemistry. The complete survey can be found in the Supporting Information A.

Evaluation of Attitudes toward Science

Self-efficacy Survey—To assess self-efficacy in science, a 9-item pretest was administered to LEAP students on the first day of the summer course. Using a 5-point Likert scale with responses ranging from "strongly disagree" to "strongly agree," students were asked questions designed to assess their attitudes toward science, and their perceptions of their own ability to master concepts essential to a scientist [17]. As with the knowledge instrument, students repeated the self-efficacy instrument on the final day of the summer course (post-test), and then again at the end of research component of the program (post-test 2). The complete survey can be found in the Supporting Information B.

Retrospective Questionnaire—At the conclusion of the entire program, we also administered a retrospective questionnaire to assess student interest in science, intentions to pursue the study of science, and career inclinations. Retrospective questionnaires have limitations due to "demand characteristics" [18], but we included this assessment in case the pre/postself-efficacy surveys could not discriminate change (students were recruited with high interest and scored highly on the pretests). Responses from the retrospective survey reflected the students' own perception of their change in attitudes toward science resulting from their participation in the program. The retrospective survey questions are found in the Supporting Information C.

The total program costs (~$30,000/year) include stipends for the students and staff, lab supplies, lunches, and science fair fees. More programmatic details can be found in the Supporting Information F. A complete overview of the LEAP program will be available online at the LEAP Web site; http://www.rise.duke.edu/leap

RESULTS

Content Knowledge

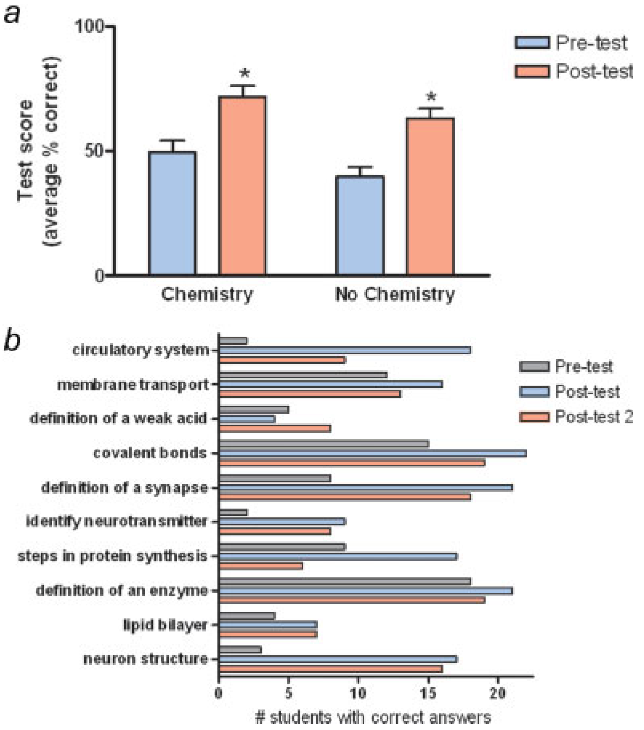

FIG. 2. **Students improve knowledge of basic biology and chemistry principles**. (*a*). Students answered 10 questions addressing eight fundamental principles in biology and chemistry on the first day (pretest) and last day (post-test) of the LEAP summer course. Bars represent average percentage of correct answers ± S.E.M (*$p < 0.001$ when compared with pretest, ANOVA, with repeated measures; $n = 47$ students). (*b*). Students in the 2007 class took a second post-test 9 months later, following the research component. Bars represent the number of students answering the question correctly ($n = 24$ students). [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

To determine the extent to which participation in the LEAP program enhanced student knowledge of basic concepts in biology and chemistry, we compared student scores from the 10-question pre- and post-tests. LEAP students demonstrated increased knowledge of biology and chemistry concepts following the summer course with an average gain of 25 percentage points ($p < 0.001$) (Fig. 2*a*). Interestingly, prior exposure to high school chemistry had little impact on student performance on the post-test, even though four of the 10 questions were chemistry-based. Inspection of the individual item scores reveals that, with the exception of an understanding of covalent bonds and enzyme function, less than 50% of students could answer the questions correctly on the pretest. However, in the post-test, the students scored significantly higher in areas of protein synthesis, neuron structure and function, and the circulatory system. In the case of the circulatory system, the improvement in the post-test in the 2007 course (Fig. 2*b*) was substantial, when compared with a very modest improvement in the 2006 course (not shown). In the 2007 course, we introduced a hands-on classroom activity to address this weakness. Students "role played" different drug molecules entering the body by different routes (e.g., oral, IV, patch, inhaled); they strung red and blue crepe paper "arteries" and "veins" across the room, attaching them to card-board organs that they made (e.g., heart, liver, brain, intestine, kidney, etc.) and taped to the walls. They

Table III
Average responses based on a Likert scale (1 = strongly disagree; 5 = strongly agree)

	Pretest		Post-test		Post-test 2	
	Avg. score	% With score of 5	Avg. score	% With score of 5	Avg. score	% With score of 5
Science motivation	4.2 (0.6)*	38 (11)	4.2 (0.6)*	43 (16)	4.2 (0.7)*	42 (15)
Science confidence	4.3 (0.5)*	41 (9)	4.4 (0.5)*	49 (7)	4.3 (0.6)*	43 (9)
Possible self in science	4.1 (0.7)*	40 (9)	4.1 (0.8)*	41 (8)	4.0 (0.9)*	39 (11)

*Standard deviation is reported in parentheses.

walked around the room, illustrating the path the drug molecules take through the circulation, depending on how they entered. We hypothesized that this activity may have led to the substantial improvement in the 2007 class scores on this item. The complete activity description can be found in Supporting Information section D.

In general, the knowledge gain was retained long-term. Students in the second class (2007) scored significantly higher on most questions in the post-test 2 exam compared with their pretest exam scores (Fig. 2*b*). For eight of the 10 items, the post-test 2 score did not differ significantly from the post-test score, obtained 9 months earlier. Overall, students were correct more often in their recall of the definition of a weak acid in post-test 2 when compared with post-test 1; it is possible that the better scores were associated with concurrent enrollment in a chemistry class. Most notable was the question about the steps in protein synthesis; students appeared to have lost their understanding of this concept over 9 months, scoring similar to their pretest.

Interest in Science

To determine the impact of the LEAP program on student interest in pursuing science, we administered a series of surveys on self-efficacy and attitudes in science. In the pre–post assessments of student self-efficacy, the average Likert scores hovered around four, for each of the pre and post assessments (Table III). Because of the high Likert scores on the pretest (students with a high interest in science was a basis for recruitment), there were no significant changes on either of the post-tests.

In contrast, the retrospective analysis did show that students felt more positive about a future in science. Approximately 75% of students responded that they were more interested in learning science, taking more science courses, and considering a science-related career (Fig. 3). However, some differences were evident when comparing responses between URM and their peers. Although URM students indicated that they were as interested as their peers in learning more science at the completion of the program, they did not reach the same level of interest in taking more science courses compared to their peers (50 vs. 95% answering more interest, respectively; $p < 0.01$) (Fig. 3). Additionally, there was a slight trend of less interest in choosing a science-related career (55 vs. 68% answering more interest, respectively), although this was not significant. Interestingly, when the results of the retrospective analysis for year one (2006) were compared with year two (2007), the students in the second class year reported a stronger increase in their interest to pursue science learning (67 vs. 90%, respectively), science courses (62 vs. 80%, respectively), and science careers (52 vs. 70%, respectively). Although the number of participants was too small to determine statistical significance, we suggest the improvement trend may have been due to the "fine tuning" that the LEAP program staff instituted in the second year to better the LEAP research experience. Some of the individual comments of students collected in the retrospective survey at the conclusion of the program are listed below:

What did you learn in this program about doing science or being a scientist?

- "I have learned being a scientist is hard work and dedication. Science is not too hard if you focus on what you want to achieve."
- "I learned that doing science is challenging and that you may not always yield the expected results. I also learned that in science, sometimes a failure can be a good thing because you may find solutions to other questions or problems that you had not expected."
- "I learned about what scientists do, how to improve research, how to write a scientific paper, and how to do a good science presentation. It has inspired me to consider a field in pharmacology."
- "I learned how to use scientific principles in everyday life. I learned how to use lab equipment & work with others in a lab situation."
- "Scientists work on small projects that contribute to a main idea."

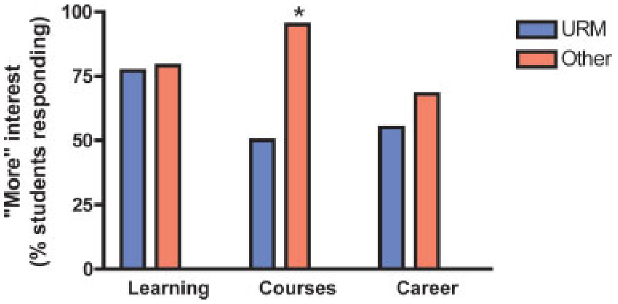

Fig. 3. **LEAP impacts students' attitudes toward science education and careers**. In a retrospective survey administered at the completion of the research component of the program students ($n = 41$) rated their interest in learning more (left), taking more courses (middle), and thinking more about a career in science (right). Bars represent the percent of students responding with more interest (* $p < 0.01$ when compared with URM, Fisher's exact test) URM = underrepresented minorities ($n = 22$, African American and Hispanic). Other ($n = 19$, Caucasian and Asian). [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

Research

As an introduction to basic research, each LEAP student designed a research plan to address one experimental question of their own interest. Students selected various research platforms (discussed in the Methods) that included molecular, cellular, and behavioral research models. In addition, some students selected social and behavioral studies involving adult human subjects. (A partial list of projects developed by LEAP students is found in the Supporting Information section E).

Once all the research was completed in December, the students wrote their research papers and prepared their Powerpoint Presentations (with both mentor and peer feedback) for the science fair competitions in February and March. After each competition, (either the AJAS or the NC Science Fairs), the mentors presented each student with an informal, itemized assessment of the research presentation. At the AJAS meeting, the judges also provided each student with feedback about their oral presentation and written paper, with suggestions for improvement in preparation for the state competition 3 weeks later. LEAP students, specifically, were praised by the judges for the use or discussion of statistics in their data analyses. Students made significant gains in their mastery of the scientific concepts as a direct result of feedback and practice sessions during the research component of the program. Students also made more effective use of their individual creativity in presenting their projects and explaining their findings as they gained experience from repeated competitions.

LEAP students received many accolades for their research projects, as evidenced by awards earned at the regional and state science competitions. Of the 41 LEAP students presenting at the competitions, there were 28 awards given to 21 individuals. Two LEAP students received scholarships for the presentation of their LEAP research projects at the North Carolina State Fair sponsored by Meredith College (2 at $40,000 each) and by Ohio Wesleyan ($5,000 and a microscope), respectively. In addition, one student received the U.S. Department of Health and Human Services Award (certificate) for research with the potential to improve the quality of human life. Similarly, in addition to their first place awards for LEAP research projects at the AJAS competition, three URMs were selected as “Best in Category” and received a travel award to attend the AAAS meeting. One student was elected to the student advisory board for the North Carolina branch of the AJAS organization. Finally, three students attended other local area science enrichment programs the following summer and subsequently advanced to receive awards in science fair competitions.

DISCUSSION

Previously, we have shown that pharmacology provides an engaging context to enhance the education of high school science students [11, 12]. In the program described here, we introduced high-school students to the study of how drugs interact with the human body and facilitated their research of relevant topics in pharmacology. We found that the latter component, the student-directed research in pharmacology, helped to foster an expanded interest in science and scientific pursuits. Other indicators of the success of the program were that the majority of students reported significant knowledge gains in biology and chemistry concepts and performed extremely well in science fair competitions.

Developing trends in educational practices have demonstrated success in two distinct models for bolstering self-efficacy in high-school students: an “interest-first model” and a “constructionist” model [19]. The interest-first model supports a learning environment in which the topic is perceived as “interesting” by the students and thus their motivation to learn the material increases. Using pharmacology as a context for teaching basic principles in biology and chemistry is consistent with this method of enhancing self-efficacy in science. Although students recruited into LEAP already had a high level of interest in and enthusiasm for science, they indicated that the LEAP program further increased their interest. The other method for enhancing self-efficacy favors a task-based approach, allowing students to build their interest and motivation for future learning from successes in “constructing” knowledge. The mentored research experience that followed the summer LEAP course is consistent with the task-based learning approach. In response, students completing the research component reported enhanced awareness of the career activities of academic research scientists, including the rigor and rewards of discovery science. Although some LEAP students will likely advance to careers outside traditional science disciplines, a few students are actively pursuing additional science enrichment opportunities on the path to a career in academic research. A discrepancy of 50% exists between the intentions of college freshmen to major in science and those students earning a bachelor’s degree in a science discipline [1]. To determine the impact of LEAP science enrichment in the choice of a college major and graduation in science, we intend to monitor the LEAP students’ decisions through graduation from college.

Knowledge gains were an independent measure of improvement in science. We found that the second LEAP class (2007) had larger knowledge gains compared to the first year class (2006). After the first year, we made several small changes to the program to try to improve upon this measure. We reduced the lecture time (from 1.5 h/day to 0.75 h/day), and incorporated more “hands-on” activities during the lecture (e.g., the addition of the circulation activity). Second, we encouraged students to work on research projects independently, rather than in small groups. During the first year, students collaborating on a research project in groups of four or more were particularly prone to become disengaged compared with their peers. Third, we refined some of the methods in the research platforms to ensure reliable results. These changes, coupled with the significant increase in student attitudes towards science may have contributed to the larger knowledge gains in the second year class.

One of the goals of the LEAP program was to introduce students to careers in scientific research. The numbers of students indicating an interest in the professions of research scientist and science teacher have declined steadily [1]. Although there was a substantial increase in the percent of LEAP students who would consider taking more science courses and pursue a career in science, the URM students were not as interested as their peers in taking more science courses. In addition, the URM were not quite as enthusiastic as their peers in considering a career in science. We are addressing these issues in future LEAP classes by highlighting careers in pharmacology-related disciplines and the coursework required to prepare for those careers.

To address the discrepancies in science education and subsequent success in science, our program intentionally limited the number of students with above average resources and academic credentials to 17–20% of each class. Consequently, LEAP was heavily attended by students with high enthusiasm or perceived potential, but average to below average performance and limited opportunities for pursuing research. Yet, despite past academic record, LEAP students excelled, demonstrating improved competence and earned the recognition of professional scientists at science fair competitions. Although this study was not designed to rigorously test the iterative 5E approach, the broad success of the LEAP program in each of its first 2 years argues that constructivist learning cycles, when used to present content that students find inherently interesting and relevant to their lives, can effectively augment the standard course of study at public high schools.

Based on our experience, we believe that the ability of universities to provide high school students with access to research infrastructure, experience, and relevance is essential to capturing the imagination and creative spark of high school students. In this regard, we think the LEAP paradigm could be adapted easily to other departments and programs with biochemistry and molecular biology-based research strengths. There are numerous themes that may interest high school students, including, stem cell technologies and ethics, viral infections and immunology (HIV/AIDS), and genomics of disease, etc. Such direct involvement by the university research community in enhancing public high school education could help to increase the number of students choosing to pursue science careers, especially within populations of URM.

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